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The sustainability of current account in the BRICS countries depends on economic policies' support to structural adaptation

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Abstract

This study undertakes a descriptively comprehensive and statistically robust assessment of the sustainability of current account (CA) and solvency of intertemporal budget constraint (IBC) in the BRICS countries. The long-run model estimated in one-regime setting with no structural break and in sample-split setting with multiple structural breaks provides dominant support to the sustainability of CA and solvency of IBC. The policy makers in the countries with surpluses in CA, such as China and Russia, need to manage upward pressure on domestic currency, encourage domestic investment, and seek opportunities for outward FDI. The central bank interventions in FOREX market, accompanied by both short-term portfolio and long-term direct investments overseas, would help relieve upward pressure on domestic currency and make productive use of foreign exchange reserves. The policy focus in the countries with deficits in CA, such as Brazil, India and South Africa, should be to accelerate productivity, boost exports, bolster saving, and implement fiscal consolidation to ensure the sustainability of CA and solvency of IBC.
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1. Introduction

The BRICS (Brazil, Russia, India, China and South Africa) bloc of nations are the fastest growing and the largest emerging market economies of the world. They jointly share just under half of the global population and collectively account for at least 23% of the global gross domestic product and 16% of the global trade. China and India dominate BRICS in terms of the magnitudes of their gross domestic product (GDP) and population. Russia, and again China, dominate in terms of their current account positions. Both China and Russia experienced robust surpluses in their current accounts, and they have been the net exporters of capital and thus the buyers of assets overseas. The staggering surpluses of 10.45–17.47% of GDP in Russia during 1999–2001 and of 8.42–9.95% of GDP in China during 2006–08 were followed by substantial shrinkages, however. Brazil, India and South Africa witnessed recurrent deficits in their current accounts, and they borrow capital from international financial markets/institutions to fund their investment and foster their expansion. The surplus in current account puts an upward pressure on the external value of domestic currency. Strong currency weakens the competitiveness of exports, induces the propensity to import, and imperils the sustainability of current account. By contrast, large and persistent deficits in current account tend to trigger sudden stops and large reversals of capital inflows, and lead to the insolvency of current account and the default on foreign debt. The current account deficits beyond a threshold level become unsustainable and warrant policy corrections.

The sustainability of current account in the BRICS countries is central to the stability of both regional and global economy, given the significant surge in their cross-border linkages through international trade, capital flows, market interdependence, and the regional/global supply chain and sub-chain networks. Husted (1992) determines the sustainability of current account (CA) and solvency of intertemporal budget constraint (IBC) in terms of the presence of cointegration between exports (inflow of resources) and imports (outflow of resources). The empirical research conducted in this vein has provided a mixed and inconclusive evidence; see Singh (2007, 2016) for the surveys. Despite an outpouring of research on current account, the question of whether current accounts are sustainable in BRICS remains virtually unexplored. This study fills the research gap and undertakes a descriptively comprehensive and statistically robust assessment of the sustainability of CA and solvency of IBC in the BRICS group of countries. The study contributes to the extant literature on the following counts.

First, the policy prescriptions for external sustainability depend on both economic conditions and financing needs of the individual countries, given the significant heterogeneity and wide dispersion across BRICS in terms of their external positions and socio-economic characteristics. The study conducts a country-by-country time-series analysis, as opposed to commonly undertaken group-based panel data analysis, and provides country-specific assessment of the sustainability of CA. Such an analysis is useful to resolve the heteroscedasticity of residuals (variance), which creeps in panel data models estimated on a highly heterogenous group of countries like BRICS, and to facilitate the formulation and evaluation of country-specific policies.

Second, the results often tend to be sensitive to the methodology employed to estimate the model. The academic debates and economic controversies — which surface in almost every sphere of empirical research — could be partially ascribed to the use of different methodologies and test statistics across studies (Singh, 2019). This study deviates from the common practice of drawing firm conclusions based on the estimates of single or select estimators. It estimates the model using several single-equation and system estimators in both one-regime and sample-split settings, and takes a robust account of the evidence.

Third, previous studies have either ignored structural breaks or have considered at the most two breaks. In fact, multiple structural breaks are inherent to the models estimated on longer time spans. This study extends the previous empirics and newly examines the sustainability of external accounts in the presence of multiple structural breaks that could occur over *long* as well as *short* time periods.

The remainder of the study is structured as follows. Section 2 undertakes a descriptive analysis of the macroeconomic and current account dynamics in BRICS. Section 3 presents the model. Section 4 discusses the empirical results. Section 5 provides policy perspectives. Section 6 concludes the study.

2. Macroeconomic and current account dynamics in BRICS

2.1. BRICS in a global setting

The BRICS bloc comprises a heterogeneous group of countries, which differ discernibly in terms of their natural resources, financial systems, trade openness, capital account regulations, external imbalances, exchange rate systems, institutional quality, structural characteristics, infrastructural development, economic policies, pace of economic growth, and level of economic development. Such diversity poses several cultural, logistical and geographical challenges for inclusive integration and economic cohesion among BRICS. Nevertheless, the BRICS bloc collectively accounts for at least 23% of the global GDP, 16% of the global trade, and 40% of the global population. It accounts for two-thirds of the emerging market activity and more than one-fifth of the global activity—as much as the United States and more than the Euro Area—compared with less than one-tenth in 2000 (The World Bank, 2016). The BRICS group contributed 18.44% to world exports and 16.17% to world imports in 2018 (United Nations Conference on Trade and Development, UNCTAD, 2019).

BRICS underwent tremendous transformation following the (1) institution of economic reforms including the devaluation of Real (January 1999) during the 1990s in Brazil, (2) dissolution of the Soviet Union (December 1991) and the devaluation of Ruble (August 1998) in Russia, (3) onset of economic reforms and the devaluation of Rupee (July 1991) in India, (4) onset of economic reforms and adoption of Open Door Policy (December 1978) in China, and (5) increase in openness to trade (commencing 1990) in South Africa. The liberalization of trade and investment helped BRICS achieve high economic growth through their integration with the world market (Chen and De Lombaerde, 2014). The economic growth in BRICS — 5.3% in 2017, 5.4% in 2018, 4.6% in 2019 and 4.9% in 2020 — significantly outpaced the growth in high-income and developing economies (The World Bank, 2020a). China and India witnessed the most rapid growth, outperforming other BRICS nations. High and sustained growth in China and India stemmed from several factors including low labour cost, large local market, increased orientation towards trade and foreign direct investment (FDI), and improved productivity and infrastructure. The economic growth in Brazil outpaced the growth in both Russia and South Africa.

The symbiotic relationships and cross-border linkages of BRICS have grown significantly over time through international trade, capital flows (equities, bonds, and FDI), market interdependence, and the regional/global supply chain and sub-chain networks. The booms and busts in BRICS, as such, can have substantial spillovers to the rest of the region/globe. These spillovers can traverse through a number of channels including spread of supply chain networks and integration of goods and factor markets. China is deeply integrated into supply chains in East Asia and the Pacific, and it constitutes a large export market for the commodity-exporting

countries in Sub-Saharan Africa and Latin America. China has been the main engine of global economic growth, especially since global financial crisis and its slowdown can have global repercussions, especially on natural resource and commodity dependent emerging markets and developing countries (Stiglitz, 2016). Brazil trades significantly with its neighbouring Latin American countries, partly as a result of its regional free trade agreements. Remittances from Russia account for more than 10% of the GDP in several countries in Caucasus and Central Asia. India is an important source of FDI and official development assistance for its neighbouring countries (Bhutan and Nepal). The New Development Bank (established in July 2015) provides a formal platform for multilateral financial assistance for infrastructural investments and sustainable projects in BRICS and other emerging economies. The global value chains powered the surge of international trade after 1990 and now they account for almost half (50%) of the global trade (The World Bank, 2020b). Many multinationals now focus on BRICS for their supply chain networks. These dynamics spur new market ecology; however, they add extra strain on regulatory systems, tax structures, and national accounting policies and practices.

2.2. Current account position in BRICS

The current account comprises net exports of goods and services, net primary income and net secondary income, and it reflects both international competitiveness and domestic economic conditions. China and Russia performed well in terms of their current account positions (Table 1). Both experienced robust surpluses in CA (except 1982–89 when China ran a CAD), and they have been the net exporters (lenders) of capital and thus the buyers of assets overseas.

Table 1
Economic growth and current account position in BRICS.

Period	Brazil	Russia	India	China	South Africa
(1) Economic growth (per cent)					
2017	1.3	1.6	7.2	6.8	1.4
2018	1.3	2.3	6.8	6.6	0.8
2019	1.1	1.2	5	6.1	0.4
2020	2.0	1.6	5.8	5.9	0.9
2021	2.5	1.8	6.1	5.8	1.3
2022	2.4	1.8	6.1	5.7	1.5
(2) Current account as percentage of GDP					
(2.1) Decennial averages					
1960–69					-0.17
1970–79	-4.15@		0.73@		-2.03
1980–89	-2.09		-1.58	-0.37##	0.78
1990–99	-1.65	3.03#	-1.26	1.68	-0.01
2000–09	-0.80	8.98	-0.52	4.96	-2.16
2010–19	-2.89	3.64	-2.22	1.88	-3.31
(2.2) Annual					
2020	-1.69	2.42	1.23	1.69	2.03
2021	-1.74	6.87	-1.09	1.79	3.70
2022	-1.3	11.9	-3.1	1.4	1.5

Sources: Author's calculations based on the data collected from the (1) World Development Indicators (Online), The World Bank; (2) The World Bank (2020a); and (3) International Monetary Fund (2022).
Notes: @ Brazil (1975–1979); # Russia (1994–1999); @ India (1975–79); and ## China (1982–1989).

The surpluses in CA are useful to offset or outbalance the net outflows of capital. The current account surplus (CAS) in Russia showed sharp increases during 2000–09 following the devaluation of Ruble in August 1998 — CAS reached the zenith of 17.47% of GDP in 2000. China had a staggering CAS of 9.95% of GDP in 2007.

The surplus in CA stems from a multitude of factors including large exports, low imports, high saving, weak domestic demand (low consumption and/or low investment), and policy manipulations in terms of the undervaluation of exchange rate. The weak investment demand often arises from adverse business climate and poor investment, or recessionary, conditions at home. The bumper current account surpluses (CASs) of 10.45–17.47% of GDP in Russia during 1999–2001 and of 8.42–9.95% of GDP in China during 2006–08 were followed by substantial shrinkages. The surplus in CA causes (1) the appreciation of exchange rate in a perfectly flexible exchange rate regime (with no intervention in the foreign exchange market by the central bank) and (2) the accumulation of foreign exchange reserves in a fixed exchange rate regime (with active intervention in the foreign exchange market by the central bank). The managed exchange rate, in fact, characterises the operational reality of monetary policy and, as such, the surplus in CA is accompanied by both appreciation of exchange rate and accumulation of foreign currency assets. The surpluses in CA contributed to the accumulation of foreign currency assets in China and Russia. These surpluses led China to explore the opportunities for both short-term portfolio (equities and bonds) and long-term direct investments overseas.

Brazil, India and South Africa witnessed recurrent deficits in their current accounts, and they borrow capital from international financial markets/institutions to fund their investment and foster their expansion (Table 1). The deficits in CA are not necessarily bad so long as they are not caused by persistent inability and perpetual incompetence to compete in international goods and services markets. These deficits arise from low exports, large imports, and/or low saving relative to investment. South Africa did run surpluses in CA, but only for the limited periods of 1980–89 and 2020–2022.

India guarded its current account through heavy tariff and non-tariff restrictions on imports until the onset of economic reforms (July 1991 onwards). The CAD as a percentage of GDP averaged at 0.87% in the 1950s, 1.67% in the 1960s and 0.08% in the 1970s (Table 2). The CAD rose to 1.78% of GDP in the 1980s and, as a result, the usual sources of financing, such as loans, withdrawals from the International Monetary Fund (IMF), and depletion of foreign exchange reserves, were supplemented by a negotiation (November 1981) of SDR 5 billion loan with the IMF under the Extended Fund Facility. The balance of payments (BOP) crisis surfaced in the beginning 1990s and this triggered the onset of a wide-ranging economic reforms. The dismantling of quantitative and tariff restrictions on imports during reforms unleashed imports and led to significant spurts in trade deficits, from 2.76% of GDP in the 1990s to 5.24% in the 2000s and 7.38% in the 2010s (2010–2011 to 2018–2019). The substantial surge in net invisible surplus from 1.52% of GDP in the 1990s to 4.71% in the 2000s and then to 5.13% in the 2010s helped finance sizeable proportions of trade deficits and thereby contain CADs at 1.24% of GDP in the 1990s, 0.53% in the 2000s and 2.25% in the 2010s (2010–2011 to 2018–2019) (Table 2).

The rebalancing of CADs requires careful considerations about the type of capital inflows. The reliance on short-term investment inflows (equities and bonds) to finance CADs and imports tends to make the borrowing country vulnerable to their sudden stops and stochastic reversals. These reversals could trigger from a range of factors including overvalued real exchange rate, inadequate foreign exchange reserves, excessive domestic credit, adverse terms of trade, glacial economic growth, and higher rates of returns in other countries. The FDI inflows

Table 2
Balance of payments position in India, 1950–51–2018–19 [As percentage of GDP at current market prices].

Item	1950–1951 to 1959-1960	1960–1961 to 1969-1970	1970–1971 to 1979-1980	1980–1981 to 1989-1990	1990–1991 to 1999-2000	2000–2001 to 2009-2010	2010–2011 to 2018-2019
(A) Merchandise exports, f.o.b.	5.10	3.26	4.24	4.55	7.73	11.95	14.30
(B) Merchandise imports, c.i.f.	6.81	5.15	5.37	7.67	10.49	17.18	21.68
I. Trade balance (A – B)	-1.71	-1.89	-1.14	-3.12	-2.76	-5.24	-7.38
II. Invisibles, net	0.84	0.22	1.05	1.34	1.52	4.71	5.13
III. Current account (I+II)	-0.87	-1.67	-0.08	-1.78	-1.24	-0.53	-2.25
(1) Foreign investment	0.10	0.10	0.04	0.05	0.91	2.66	2.54
(2) External assistance, net	0.34	1.66	0.65	0.61	0.48	0.06	0.12
(3) Commercial borrowings, net			0.11	0.41	0.47	0.52	0.22
(4) Rupee debt service					-0.27	-0.06	@
(5) NRI deposits, net			0.07	0.43	0.39	0.35	0.60
(6) Other capital	-0.06	-0.09	-0.30	0.03	0.23	-0.22	-0.40
IV. Capital account (1 to 6)	0.38	1.68	0.57	1.53	2.21	3.31	3.06
V. Overall balance (III+IV)	-0.49	0.00	0.49	-0.25	0.98	2.78	0.81
(7) Reserves [increase (–) or decrease (+)]	0.47	-0.03	-0.52	0.16	-0.96	-2.78	-0.81
(8) IMF, net	0.02	0.01	-0.02	0.08	-0.02	@	
(9) SDR allocation		0.02	0.05	0.01		-0.04	
Monetary movements (7 +8 +9)	0.49	0.00	-0.49	0.25	-0.98	-2.78	-0.81

Source: Author's calculations based on the data collected from the Reserve Bank of India Bulletin, and the Handbook of Statistics on the Indian Economy, Reserve Bank of India.

Notes: (1) All items are measured as percentage of GDP at current market prices (base year: 2004–2005); (2) Sub-items may not exactly add up to totals because of statistical discrepancy and/or rounding; (3) @ indicates negligible; (4) The data on current account presented here in Table 2 may not exactly match with the data presented in previous Table 1 because of the difference in the sources of these data.

are more stable and they mitigate the short-term vulnerabilities of the host countries to sudden stops and large reversals, as compared to the debt-financing portfolio investment inflows. The BRICS bloc remains an attractive destination for FDI inflows, due to the availability of cheap labour, large market, and abundant natural resources. The bloc attracted 20.12% of the world FDI inflows, constituted 10.02% of the world FDI inward stock, contributed 16.67% to global FDI outflows, and constituted 9.41% of the world FDI outward stock in 2018 (United Nations Conference on Trade and Development, UNCTAD, 2019).

3. The model

Consider a small open economy inhabited by a continuum of forward-looking optimizing agents, who can borrow and lend resources in the international financial markets. The current period budget constraint for such economy with no government can be written as

$$Y_t + (B_t - B_{t-1}) = C_t + I_t + r_t B_{t-1} \tag{1}$$

In equation (1), Y_t denotes aggregate output, B_t international borrowing, C_t consumption, I_t investment, and r_t the time-varying world rate of interest at time t. The current period budget constraint equation (1) can be iterated forward in time to form the IBC.

$$B_t = -TB_t + (1 + r_t)B_{t-1} \tag{2}$$

In equation (2), $(1 + r_t)B_{t-1}$ is the initial level of external debt and $TB_t = (X_t - M_t) = (Y_t - C_t - I_t)$ is the trade balance; where X_t denotes exports and M_t imports at time *t*. By recursively solving equation (2), the forward-looking solution for external borrowings can be obtained as

$$B_{t+1} = -TB_{t+1} + (1 + r_{t+1})B_t$$

$$\begin{aligned} B_{t+n} = & -TB_{t+n} - (1 + r_{t+n})TB_{t+n-1} \\ & - \ldots - (1 + r_{t+2})\ldots(1 + r_{t+n-1})(1 + r_{t+n})TB_{t+1} \\ & + \ldots + (1 + r_{t+1})\ldots(1 + r_{t+n-1})(1 + r_{t+n})B_t \end{aligned}$$

$$B_t = \sum_{i=1}^{\infty} \beta_i TB_{t+i} + \lim_{n\to\infty} \beta_n B_{t+n};$$

where $\beta_i = \prod_{j=1}^{i} \left(\frac{1}{1 + r_{t+j}}\right)$.

Using $TB_t = (X_t - M_t) = (Y_t - C_t - I_t)$, equation (2) can be written as $(X_t - M_t) = -B_t + (1 + r_t)B_{t-1}$. This can be further transformed and sequentially forwarded in time for *n* periods to obtain

$B_{t+1} = Z_{t+1} - X_{t+1} + (1 + r)B_t$; where $Z_t = M_t + (r_t - r)B_{t-1}$

$$\begin{aligned} B_{t+n} = & Z_{t+n} - X_{t+n} + (1 + r)(Z_{t+n-1} - X_{t+n-1}) \\ & + (1 + r)^2(Z_{t+n-2} - X_{t+n-2}) + \ldots + (1 + r)^5(Z_t - X_t) \\ & + (1 + r)^{n+1}B_{t-1} \end{aligned}$$

$$B_{t-1} = \sum_{j=0}^{n} \delta^{1+j}(X_{t+j} - Z_{t+j}) + \delta^{n+1}B_{t+n};$$

where $\delta = \frac{1}{(1 + r)}$.

The above process iterated forward for an infinite time horizon with limit $n \to \infty$ yields

$$B_{t-1} = \delta(X_t - Z_t) + \delta \sum_{j=1}^{\infty} \delta^j \left(\Delta X_{t+j} - \Delta Z_{t+j}\right) + \delta \sum_{j=0}^{\infty} \delta^{1+j} \left(X_{t+j} - Z_{t+j}\right) + \ldots + \lim_{n\to\infty} \delta^{n+1} B_{t+n} \tag{3}$$

Equation (3), after some algebraic transformations, can be represented as

$$rB_{t-1} + Z_t = X_t + \sum_{j=1}^{\infty} \delta^j \left(\Delta X_{t+j} - \Delta Z_{t+j}\right) + r \lim_{n\to\infty} \delta^{n+1} B_{t+n} \Bigg| \because \delta = \frac{1}{(1+r)} \Rightarrow r = \left(\frac{1-\delta}{\delta}\right) \tag{4}$$

Stochastic variables, $X_t \sim I(1)$ and $Z_t \sim I(1)$, are assumed to be random walks with drifts so that the data generating processes follow the AR(1) representations, $X_t = \alpha_1 + X_{t-1} + \varepsilon_{1t}$ and $Z_t = \alpha_2 + Z_{t-1} + \varepsilon_{2t}$. Eq. (4) can thus be transformed into stochastic form as

$$X_t = M_t + r_t B_{t-1} + \left(\frac{\alpha_2 - \alpha_1}{r}\right) + \sum_{j=1}^{\infty} \delta^j (\varepsilon_{2t+j} - \varepsilon_{1t+j}) - r \lim_{n\to\infty} \delta^{n+1} B_{t+n} \tag{5}$$

The transversality condition limits the borrowing over an infinite time horizon to zero so that $r \lim_{n\to\infty} \delta^{n+1} B_{t+n} = 0$. By letting import index $MM_t = M_t + r_t B_{t-1}$, $\alpha = (\alpha_2 - \alpha_1)/r$ and $\varepsilon_t = \sum_{j=1}^{\infty} \delta^j (\varepsilon_{2t+j} - \varepsilon_{1t+j})$, the tractable rendition of Eq. (5) can be specified as

$$X_t = \alpha + \beta MM_t + \varepsilon_t; \ \ \varepsilon(t) \sim iid(0, \sigma_\varepsilon^2); \ \ t \in [1, \ldots, T] \tag{6}$$

The CA is sustainable and IBC is solvent when the long-run relationship between imports, MM_t, and exports, X_t, in model (6) converges towards equilibrium, $\varepsilon_t \sim I(0)$. The presence of cointegration is a necessary, but not a sufficient condition. The sufficient condition for the sustainability of CA and solvency of IBC requires the cointegrating vector to be $[1, \ -1]$ when the trade flows are measured as a ratio to GDP.

3.1. Data sources and variable descriptions

Model (6) is estimated on annual data for the period 1960–2018 for Brazil, India, China and South Africa, and 1989–2018 for Russia. The current account comprises balance of trade (exports net of imports of goods and services), net factor income from abroad (such as interest and dividends from foreign investments or remittances of workers), and net transfers from abroad (such as foreign aid). The exports and imports are commonly a major component of current account. The study estimates model (6) using exports, X, and imports, MM, of goods and services as percentages of GDP; all at current prices. All of the data used in the study are sourced from the (1) World Development Indicators (Online), The World Bank, and the (2) Reserve Bank of India Bulletin, and Handbook of Statistics on the Indian Economy, Reserve Bank of India.

4. Empirical results

4.1. Unit root tests

The unit root tests are performed to examine the time-series properties of the model series. The unreported results (available on request) from DF-GLS and DF-GLSu tests (Elliott, Rothenberg, & Stock, 1996; Elliott, 1999) generally do not reject the null hypothesis of a unit root for the series in levels but reject the null hypothesis for the series in their first-difference. The structural break unit root tests of Lumsdaine and Papell (1997) and Lee and Strazicich (2003, 2004) cross-validate the evidence and generally do not reject the null hypothesis of a unit root for the series of exports and imports in levels but reject the null hypothesis for these series in their first-difference (Table 3). The unit root analysis provides dominant support for I(1) properties of the model series.

4.2. Baseline one-regime estimates

The study estimates the model first in a baseline one-regime setting using the dynamic OLS (DOLS) estimator of Saikkonen (1991) and Stock and Watson (1993), the non-linear least squares (NLLS) estimator of Phillips and Loretan (1991), and the fully-modified OLS (FMOLS) estimator of Phillips and Hansen (1990). The DOLS estimator augments the standard long-run model in levels with the lags and leads of $\Delta X(t)$.

$$Y(t) = \alpha + \beta X(t) + \sum_{j=-k}^{k} \delta(j)\Delta X(t-j) + \xi(t) \tag{7}$$

The lags and leads of $\Delta X(t)$ resolve the endogeneity of $X(t)$; however, they do not necessarily eliminate all serial-correlation and heteroscedasticity in $\xi(t)$. Phillips and Loretan (1991) suggest augmenting model (7) with the lagged levels of $[Y(t) - \alpha - \beta X(t)]$.

$$\begin{aligned} Y(t) &= \beta_0 + \beta X(t) + \sum_{j=-k}^{k} \delta(j)\Delta X(t-j) \\ &\quad + \sum_{j=1}^{k} \varphi(j)[Y(t-j) - \alpha - \beta X(t-j)] + \zeta(t) \end{aligned} \tag{8}$$

The DOLS and NLLS estimations are carried out using the lags and leads structures of $k = \{-2, 0, +2\}$ and $k = \{-3, 0, +3\}$ for the first-differenced dynamic regressors. Standard errors of the parameters in DOLS and NLLS are adjusted using the heteroscedasticity and autocorrelation consistent (HAC) estimator of Newey and West (1987). The results are consistent in terms of the numerical magnitude and statistical significance of the coefficient of imports across DOLS, NLLS and FMOLS estimates (Table 4). These results support the sustainability of CA and solvency of IBC. The coefficient of imports, β, varies between 0.56 and 0.72 for South Africa, and hovers around unity for the BRIC countries.

4.3. Structural breaks

The structural breaks are inherent to the models estimated on longer time spans. Several factors — random shocks to productivity and technology, removal of barriers to international trade, spurt or slump in economic growth, exogenous global shocks to domestic goods and financial markets, and endogenous government policy responses to current account position — could affect exports and imports and thus cause structural breaks in their equilibrium

Table 3
Unit root tests.

Country	Level series				First-differenced series			
	X	MM	X	MM	ΔX	ΔMM	ΔX	ΔMM
	One structural break							
	Lumsdaine-Papell		Lee-Strazicich		Lumsdaine-Papell		Lee-Strazicich	
Brazil	-5.95*** (11)	-4.17 (0)	-5.93*** (11)	-4.34* (11)	-4.68 (5)	-9.41*** (0)	-5.52*** (0)	-3.40 (10)
	[1994]	[1980]	[1981]	[1982]	[2008]	[1974]	[2005]	[1979]
Russia	-5.00* (1)	-5.76*** (9)	-3.92 (8)	-3.18 (4)	-12.17*** (1)	-12.19*** (0)	-7.63*** (1)	-7.45*** (0)
	[1998]	[2014]	[2001]	[2008]	[1995]	[1993]	[2007]	[2004]
India	-4.58 (10)	-3.75 (1)	-3.67 (10)	-5.65*** (8)	-4.93* (9)	-7.00*** (0)	-4.75** (9)	-7.50*** (0)
	[1994]	[2003]	[2001]	[2002]	[2003]	[2003]	[1992]	[2012]
China	-4.71 (1)	-5.51** (1)	-3.84 (10)	-3.80 (1)	-7.73*** (0)	-7.05*** (1)	-6.79*** (0)	-6.40*** (1)
	[2002]	[2002]	[2000]	[2003]	[2007]	[2006]	[2006]	[2005]
South Africa	-4.37 (1)	-4.61 (0)	-3.77 (6)	-3.76 (11)	-7.02*** (3)	-7.78*** (2)	-5.78*** (3)	-5.92*** (11)
	[1988]	[1982]	[1998]	[1987]	[1980]	[1993]	[1991]	[1983]
	Two structural breaks							
	Lumsdaine-Papell		Lee-Strazicich		Lumsdaine-Papell		Lee-Strazicich	
Brazil	-7.96*** (11)	-5.01 (0)	-7.13*** (11)	-6.17*** (11)	-5.51 (5)	-10.13*** (0)	-7.76*** (1)	-6.44*** (0)
	[1982, 2003]	[1972, 1990]	[1981, 1993]	[1982, 1997]	[1994, 2004]	[1974, 2001]	[1998, 2007]	[1978, 2000]
Russia	-9.14*** (1)	-7.86*** (9)	-9.61*** (1)	-8.39*** (7)	-30.75*** (1)	-19.49*** (0)	-8.07*** (1)	-9.85*** (0)
	[1994, 1998]	[2006, 2014]	[2002, 2013]	[2002, 2008]	[1996, 2000]	[1993, 1997]	[2008, 2016]	[2001, 2004]
India	-5.89 (10)	-6.07 (1)	-7.54*** (9)	-6.55*** (8)	-6.73* (9)	-7.09** (0)	-8.85*** (0)	-8.28*** (4)
	[1996, 2010]	[1998, 2009]	[1992, 2011]	[1985, 2002]	[1984, 2010]	[1980, 2003]	[2006, 2012]	[1980, 2010]
China	-5.96 (1)	-6.63* (1)	-7.31*** (10)	-5.14 (8)	-8.50*** (0)	-8.03*** (1)	-7.22*** (11)	-7.51*** (1)
	[1974, 2002]	[1980, 2002]	[1980, 2002]	[1981, 2000]	[1997, 2006]	[1995, 2006]	[1993, 2000]	[1995, 2004]
South Africa	-5.05 (1)	-5.37 (0)	-4.81 (8)	-5.27 (11)	-8.11*** (3)	-8.63*** (2)	-6.87*** (6)	-7.17*** (2)
	[1973, 1988]	[1973, 1994]	[1988, 2008]	[1983, 2004]	[1980, 1995]	[1981, 2008]	[1978, 2008]	[1983, 1993]

Notes: (1) All tests are performed including a constant and a trend in the model; (2) Figures in parentheses are the autoregressive (AR) lags; (3) Figures in square brackets are the breakpoints (break years); (4) ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 4
Optimal single-equation estimates of the model (slope parameter, β).

	DOLS		NLLS		FMOLS	
Country	k{-3, 0, +3}	k{-4, 0, +4}	k{-3, 0, +3}	k{-4, 0, +4}	lw = 1	lw = 4
Brazil	0.78***(4.48)	0.77***(3.91)	0.89***(2.53)	0.60(1.19)	0.76***(5.75)	0.81***(4.67)
Russia	1.43**(2.25)	1.63***(7.47)	1.33***(2.84)	2.20**(1.95)	1.31***(7.35)	1.28***(5.70)
India	0.86***(36.95)	0.88***(32.80)	0.88***(11.65)	0.98***(12.11)	0.85***(42.15)	0.86***(33.38)
China	1.21***(35.28)	1.20***(34.36)	1.21***(23.89)	1.20***(21.08)	1.19***(36.76)	1.19***(30.86)
South Africa	0.66***(7.30)	0.63***(8.16)	0.72***(5.33)	0.64***(7.55)	0.56***(5.36)	0.58***(5.03)

Notes: (1) All estimations are carried out including an intercept (a constant) term in the model; (2) Figures in parentheses are t-values; (3) *** and ** indicate statistical significance at the 1% and 5% levels, respectively. Some of the t-values are on the border line of critical region and thus strictly do not reject the null hypothesis at the indicated level of significance; (4) lw denotes the lag window in FMOLS; (5) NLLS estimations for Russia are carried out using the lag, contemporaneous and lead structures of k{-1, 0, +1} and k{-2, 0, +2}.

relationship and model parameters. This section extends the analysis and examines the sustainability of CA and solvency of IBC in the presence of multiple structural breaks that could occur over *long* as well as *short* time periods.

4.3.1. Long-period structural breaks

4.3.1.1. Endogenous structural breaks. The structural break tests of Kejriwal and Perron (2008, 2010) are performed to endogenously determine the breakpoints in the equilibrium relationship and model parameters. Kejriwal and Perron (2008, 2010) allow I(1) as well as I(0) regressors in the cointegrating regression and suggest conducting three tests to determine m number of unknown breaks and implied $m+1$ number of regimes — (1) Sup-Wald test for the null hypothesis of no structural break ($m = 0$) against $m = L$ number of arbitrarily fixed breaks, (2) double maximum (UDmax) test for the null hypothesis of no structural break ($m = 0$) against an unknown number of breaks between one and some upper bound M, such that $1 \leq m \leq M$, and (3) sequential $SEQ_T(L + 1)/L$ test for the null hypothesis of L against the alternative hypothesis of $L+1$ breaks. These tests are performed on the DOLS model (7), estimated using the lags and leads structure of $k = \{-3, 0, +3\}$ for the first-differenced I(0) regressors. Both intercept and slope parameters of the model are allowed to change across regimes. The coefficients of the lagged, contemporaneous and lead I(0) regressors are not allowed to break and thus are considered fixed and invariant over time. The maximum number of breaks are set at 5 each for Brazil, India, China and South Africa and at 3 for Russia.

The results suggest that the Sup-F(m) test rejects the null hypothesis of no structural break ($m = 0$) against the alternative hypothesis of (1) $m = L = 1$ to $m = L = 5$ breaks for Brazil, China and India, (2) $m = L = 1$ to $m = L = 3$ breaks for Russia, and (3) $m = L = 3$ to $m = L = 5$ breaks for South Africa (Panel I, Table 5). The UDmax statistics are significant at 5% level for Brazil and South Africa, and at 1% level for Russia, India and China. The $SEQ_T(L + 1)/L$ test rejects the null hypothesis of $L=4$ breaks and suggests the presence of five breaks and implied six number of regimes for Brazil, India, China and South Africa (Panel II). The test rejects the null hypothesis of $L=2$ breaks and suggests the presence of three breaks and implied four regimes for Russia. The evidence obtained from the $SEQ_T(L + 1)/L$ test is generally consistent with the evidence obtained from the RSS, BIC and LWZ tests (Panel III). The breakpoints vary across countries (Panel IV) and the slope coefficient of level regressor shifts across regimes (Panel V).

4.3.1.2. Exogenous structural breaks. The break years determined by the $SEQ_T(L + 1)/L$ test of Kejriwal and Perron (2008, 2010) are used to set the exogenous break dummies in the vector autoregression (VAR) model, and the maximum-likelihood system estimator of Johansen, Mosconi and Nielsen (JMN) (2000) is used to estimate the model and test the null hypothesis of no cointegration among the level variables. The critical values used for the standard cointegration test of Johansen (1988, 1991) are not valid for the JMN test. The asymptotic distribution of the rank test and the critical values for λ-trace statistics are simulated using the response surface approximation suggested by Johansen, Mosconi, and Nielsen (2000). The simulations are performed using 10,000 replications, with the length of random walks set at 500 for each country.

Both asymptotic λ-trace and λ-trace adjusted for small-sample consistently suggest the presence of one cointegrating vector for each country (Table 6). The long-run coefficient of the first cointegrating vector, normalised on exports, X, carries the theoretically predicted positive sign for imports, MM. The coefficient of imports, MM, is close to unity for Brazil, India and South Africa, and counter-intuitively more than unity for China and Russia.

Table 5
Kejriwal and Perron tests for multiple structural breaks in cointegrated regression models.

Country	**Panel I: Sup-F(m) test:** H_0 : m = 0; H_l: m = L					
	Sup-F(1|0)	Sup-F(2|0)	Sup-F(3|0)	Sup-F(4|0)	Sup-F(5|0)	UDmax(L)
Brazil	15.38**	13.46**	12.12**	16.04***	14.35***	16.04** (4)
Russia	27.18***	14.70**	36.22***			36.22*** (3)
India	18.92***	14.05**	14.82***	18.03***	16.71***	18.92*** (1)
China	13.52*	16.99***	15.33***	15.69***	18.58***	18.58*** (5)
South Africa	6.23	10.85	13.72***	14.80***	17.54***	17.54** (5)
	Panel II: $SEQ_T(L+1)/L$ **statistics**; H_0 : L breaks; H_l: L + 1 breaks					Number of
	Sup-F(1|0)	Sup-F(2|1)	Sup-F(3|2)	Sup-F(4|3)	Sup-F(5|4)	Breaks
Brazil	15.38*	26.91***	36.35***	64.14***	71.75***	5
Russia	27.18***	29.39***	108.66***			3
India	18.92**	28.09***	44.46***	72.12***	83.53***	5
China	13.52	33.98***	45.99***	62.75***	92.92***	5
South Africa	6.23	21.70***	41.15***	59.20***	87.69***	5
	Panel III: Minimized test statistics					
	RSS (L)	BIC (L)	LWZ (L)			
Brazil	24.78 (5)	1.15 (4)	2.09 (4)			
Russia	9.69 (3)	1.29 (3)	2.51 (3)			
India	1.61 (5)	-1.57 (5)	-0.61 (4)			
China	10.78 (5)	0.33 (5)	1.40 (5)			
South Africa	31.64 (5)	1.41 (5)	2.47 (5)			
	Panel IV: Breakpoints (Break years)					
	m=1	m=2	m=3	m=4	m=5	
Brazil	1973	1982	1994	2001	2006	
Russia	1996	2003	2007			
India	1974	1978	1984	1990	1999	
China	1981	1985	1989	1996	2006	
South Africa	1972	1976	1980	1984	1988	

	Panel V: Slope parameter, β, by regime period						
		Regime 1	Regime 2	Regime 3	Regime 4	Regime 5	Regime 6
Brazil	Regime	≤ 1973	≤ 1982	≤ 1994	≤ 2001	≤ 2006	> 2006
	β	0.72	0.25	0.51	1.09	0.72	0.77
Russia	Regime	≤ 1996	≤ 2003	≤ 2007	> 2007		
	β	-5.48	2.80	-2.58	1.77		
India	Regime	≤ 1974	≤ 1978	≤ 1984	≤ 1990	≤ 1999	> 1999
	β	0.20	-1.98	-0.25	1.01	0.59	0.68
China	Regime	≤ 1981	≤ 1985	≤ 1989	≤ 1996	≤ 2006	> 2006
	β	0.93	-0.17	1.19	0.55	1.08	1.87
South Africa	Regime	≤ 1972	≤ 1976	≤ 1980	≤ 1984	≤ 1988	> 1988
	β	-1.30	0.04	1.43	0.32	-1.17	0.77

Notes: (1) All estimations are carried out including an intercept (a constant) term in the model; (2) Figures in parentheses associated with the minimized values of RSS, BIC and LWZ statistics are the *L* number of structural breaks; (3) ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

4.3.2. Short-period structural breaks

The power of the structural break estimators tends to decline as the breakpoint moves towards the end of the sample space. The end-of-sample cointegration breakdown tests of Andrews and Kim (2006) are now performed to assess the sustainability of CA and solvency of

Table 6
Johansen-Mosconi-Nielsen test for cointegration with multiple structural breaks.

H_0	H_1	Eigenvalues	λ-trace	λ-trace@	Simulated 95% CV
Brazil; VAR lag k = 2; Five breaks; Break years: 1973, 1982, 1994, 2001, 2006					
r = 0	r ≥ 1	0.55	64.64**	61.59**	48.65
r ≤ 1	r = 2	0.29	19.52	19.24	25.25
Cointegrating vector: [X MM] = [1 –0.825]					
Russia; VAR lag k = 3; Three breaks; Break years: 1996, 2003, 2007					
H_0	H_1	Eigenvalues	λ-trace	λ-trace@	Simulated 95% CV
r = 0	r ≥ 1	0.99	124.82**	116.50**	37.21
r ≤ 1	r = 2	0.29	9.21	8.88	19.08
Cointegrating vector: [X MM] = [1 –8.174]					
India; VAR lag k = 5; Five breaks; Break years: 1974, 1978, 1984, 1990, 1999					
H_0	H_1	Eigenvalues	λ-trace	λ-trace@	Simulated 95% CV
r = 0	r ≥ 1	0.50	55.74**	55.74**	46.99
r ≤ 1	r = 2	0.28	17.85	17.85	24.38
Cointegrating vector: [X MM] = [1 –0.746]					
China; VAR lag k = 2; Five breaks; Break years: 1981, 1985, 1989, 1996, 2006					
H_0	H_1	Eigenvalues	λ-trace	λ-trace@	Simulated 95% CV
r = 0	r ≥ 1	0.60	66.93**	62.71**	46.78
r ≤ 1	r = 2	0.23	15.21	14.32	23.72
Cointegrating vector: [X MM] = [1 –1.323]					
South Africa; VAR lag k = 3; Five breaks; Break years: 1972, 1976, 1980, 1984, 1988					
H_0	H_1	Eigenvalues	λ-trace	λ-trace@	Simulated 95% CV
r = 0	r ≥ 1	0.66	70.25**	66.06**	43.46
r ≤ 1	r = 2	0.17	10.39	9.90	22.38
Cointegrating vector: [X MM] = [1 –0.742]					

Notes: (1) r denotes the number of cointegrating vectors. CV denotes critical values. The asymptotic critical values are simulated using 10,000 replications, with the length of random walks set at 500 for each country; (2) Long-run coefficients of the first cointegrating vector are normalised on exports, X; (3) @ indicates λ-trace corrected for small-sample; (4) ** indicates statistical significance at the 5% level; (5) The unreported coefficients of break dummies are available upon request.

IBC in the presence of short-period breaks. These tests involve splitting total sample size, $t = 1, \ldots, T + m$, into first T and last *m* observations, and then estimating the model,

$$y_t = \begin{cases} x'_t \beta_0 + u_t;\ t \in \{1, \ldots, T\} \\ x'_t \beta_t + u_t;\ t \in \{T + 1, \ldots, T + m\} \end{cases} \tag{9}$$

Under the null hypothesis, H_0, the model is a well-specified cointegrating regression for all $t \in \{1, \ldots, T + m\}$.

$$H_0: \begin{cases} \beta_t = \beta_0 \text{ for all } t = T + 1, \ldots, T + m \text{ and} \\ \{u_t: t = 1, \ldots, T + m\} \text{ are stationary and ergodic} \end{cases}$$

Under the alternative hypothesis, H_1, the model is a well-specified cointegrating regression for all $t \in \{1, \ldots, T\}$, but the cointegration breaks down for $t \in \{T + 1, \ldots, T + m\}$.

$$H_l: \begin{cases} \beta_t \neq \beta_0 \text{ for some } t \in \{T+1, ..., T+m\} \text{ and/or the distribution of} \\ \{u_{T+1}, ..., u_{T+m}\} \text{ differs from the distribution of } \{u_l, ..., u_m\} \end{cases}$$

The sets of $P \in \{P_a, P_b, P_c\}$ and $R \in \{R_a, R_b, R_c\}$ tests are performed on both fully-modified OLS (FMOLS) (Table 7) and full-information maximum-likelihood (FIML) (Table 8) estimates of the model. These tests suggest that the cointegrating relationship between exports and imports predominantly prevails and implied IBC holds for all the countries. Most of the tests do not reject the null hypothesis of cointegration against the alternative hypotheses of cointegration breakdowns during 2000–2018 (Model I), 2005–2018 (Model II), 2010–2018 (Model III), 2014–2018 (Model IV) and 2016–2018 (Model V) (Table 7 and Table 8). The coefficient of imports for the full, $\hat{\beta}_{Full}$, as well as for a number of sub-sample periods, $\hat{\beta}_{1-T}$ and $\hat{\beta}_{1-[T+(m/2)]}$, is close to unity for almost all the countries.

5. Policy perspectives

The stylized precursor supports the sustainability of CA and solvency of IBC for the BRICS countries. The movements in imports closely track the movements in exports and there is a long-run convergence between outflows and inflows of resources. The current account imbalances are only a short-run phenomenon and are balanced by future surpluses/deficits. The intertemporal solvency of CA, with current deficits covered by future surpluses in CA, however, does not necessarily imply sustainability if a country is unable to obtain necessary funding to finance its CADs. The CADs beyond a threshold level become unsustainable and warrant policy corrections; there is, however, no universally accepted level of threshold. The pressures for policy correction tend to mount when the CADs hover around 5% of the GDP (Milesi-Ferretti and Razin, 1996). The policy corrections differ depending on the nature of current account position, state of macroeconomic environment, and financing needs of the individual countries. This section provides policy perspectives for the sustainability of CA and solvency of IBC.

5.1. Short-term management policies

The countries with surpluses in CA finance the deficits in other countries. The surplus in CA puts an upward pressure on the external value of domestic currency. Strong currency weakens the competitiveness of exports, induces the propensity to import, and imperils the sustainability of CA. The CA is a counterpart of the gap between domestic saving and investment (Salvatore, 2006). The policy makers in the countries with surpluses in CA, such as China and Russia, need to (1) manage upward pressure on domestic currency to maintain the competitiveness of exports, (2) create an economic climate conducive to domestic investment, and (3) seek opportunities for outward FDI. The outward FDI would help siphon off excess foreign exchange reserves and ease upward pressure on domestic currency. China encouraged its outward FDI alongside the pursuit of its export promotion policies. The central bank needs to actively intervene in the foreign exchange (FOREX) market and buy foreign currency in exchange for domestic currency to soak out the upward pressure on exchange rate caused by capital inflows. The increase in money supply resulting from the intervention in FOREX market needs to be sterilized (fully or partially) through the countervailing open market operations (sale of securities, such as government bonds) in the money market.

Brazil, India and South Africa experienced recurrent deficits in their current accounts, and they borrow capital from international financial markets/institutions. The reliance on short-term

Table 7
Fully-Modified OLS (FMOLS) estimates of the model and the Andrews and Kim tests for cointegration breakdowns over short time periods.

	H_0: Cointegration prevails for the full-sample period, 1960–2018								
Country	$\hat{\beta}_{Full}$	$\hat{\beta}_{1-T}$	$\hat{\beta}_{1-[T+(m/2)]}$	Pa	Pb	Pc	Ra	Rb	Rc
	1960–2018	1960–1999	1960–2008	Model I: H_1: Cointegration breaks down during 2000–2018, m = 19					
Brazil	0.82	-0.04	0.85	515.70*** (0.00)	66.71 (0.95)	69.44 (1.00)	56234.83*** (0.00)	636.02 (1.00)	962.08 (0.95)
India	0.87	0.86	0.80	27.28* (0.09)	31.59** (0.05)	27.93*** (0.00)	129.31 (0.95)	1514.67* (0.09)	201.74 (0.14)
China	1.20	1.13	1.26	94.99 (0.36)	63.77 (0.59)	60.26 (0.45)	3645.22 (0.64)	1239.31 (0.77)	311.50 (0.91)
South Africa	0.64	1.06	0.67	257.06 (0.91)	35.84 (1.00)	30.44 (1.00)	32582.39 (0.14)	1617.37 (0.95)	707.81 (1.00)
	1960–2018	1960–2004	1960–2011	Model II: H_1: Cointegration breaks down during 2005–2018, m = 14					
Brazil	0.82	0.71	0.77	48.76 (1.00)	39.67 (1.00)	38.38 (0.97)	566.69 (0.97)	153.27 (1.00)	103.20 (1.00)
India	0.87	0.88	0.75	24.80* (0.06)	38.34** (0.03)	20.40*** (0.00)	414.04 (0.47)	2114.66** (0.03)	171.11 (0.53)
China	1.20	1.15	1.23	80.54 (0.31)	46.47 (0.69)	52.41 (0.47)	831.93 (0.69)	442.01 (0.75)	273.93 (0.78)
South Africa	0.64	0.95	0.69	150.96 (0.75)	23.15 (1.00)	14.85 (1.00)	9089.00 (0.22)	818.18 (0.81)	298.52 (1.00)
	1960–2018	1960–2009	1960–2013	Model III: H_1: Cointegration breaks down during 2010–2018, m = 9					
Brazil	0.82	0.76	0.80	10.74 (1.00)	11.21 (1.00)	11.62 (0.93)	47.74 (1.00)	40.50 (1.00)	39.81 (1.00)
India	0.87	0.80	0.81	16.86 (0.12)	14.59 (0.21)	15.14 (0.12)	312.51 (0.29)	203.43 (0.52)	24.49 (0.88)
China	1.20	1.24	1.22	18.21 (0.76)	12.13 (0.83)	9.53 (0.86)	410.17 (0.50)	237.31 (0.64)	161.76 (0.64)
South Africa	0.64	0.68	0.65	11.27 (1.00)	7.58 (1.00)	6.69 (1.00)	201.39 (0.88)	100.41 (0.93)	76.32 (0.95)
	1960–2018	1960–2013	1960–2015	Model IV: H_1: Cointegration breaks down during 2014–2018, m = 5					
Brazil	0.82	0.80	0.76	8.31 (0.80)	8.78 (0.80)	8.17 (0.78)	37.65 (0.80)	51.99 (0.78)	31.45 (0.80)
Russia@	1.23	1.19	1.21	22.62 (0.86)	21.50 (0.86)	19.76 (0.86)	66.82 (0.86)	55.94 (0.86)	39.31 (0.90)
India	0.87	0.81	0.87	7.98 (0.24)	3.04 (0.76)	2.87 (0.74)	52.45 (0.38)	8.12 (0.82)	6.73 (0.82)
China	1.20	1.22	1.21	7.20 (0.74)	6.70 (0.78)	6.05 (0.74)	47.81 (0.66)	42.40 (0.70)	34.96 (0.70)
South Africa	0.64	0.65	0.63	2.60 (1.00)	1.97 (1.00)	2.24 (1.00)	6.13 (1.00)	2.80 (1.00)	4.03 (1.00)
	1960–2018	1960–2015	1960–2016	Model V: H_1: Cointegration breaks down during 2016–2018, m = 3					
Brazil	0.82	0.76	0.72	5.96 (0.67)	6.95 (0.59)	4.17 (0.81)	29.79 (0.56)	34.81 (0.52)	20.78 (0.63)
Russia@	1.23	1.21	1.22	18.93 (0.72)	17.93 (0.72)	17.69 (0.72)	17.11 (0.84)	14.40 (0.84)	13.78 (0.84)
India	0.87	0.87	0.87	1.82 (0.70)	1.76 (0.70)	1.79 (0.65)	1.05 (0.89)	1.13 (0.89)	1.07 (0.89)
China	1.20	1.21	1.21	4.83 (0.56)	4.75 (0.56)	4.32 (0.52)	22.00 (0.46)	21.57 (0.46)	19.21 (0.43)
South Africa	0.64	0.63	0.64	0.19 (1.00)	0.16 (1.00)	0.16 (1.00)	0.23 (1.00)	0.14 (1.00)	0.12 (1.00)

Notes: (1) All estimations are carried out including an intercept (a constant) term in the model. The unreported estimates of intercept term are available upon request; (2) *m* denotes the number of observations in the breakdown period; (3) @ Null hypothesis for Russia is H_0: cointegration prevails for the full-sample period, 1989–2018; (4) Figures in parentheses are p-values; (5) ***, ** and * indicate statistical significance and implied rejection of the null hypothesis at the 1%, 5% and 10% levels, respectively; (6) Some of the p-values are on the border line of critical region and thus strictly do not reject the null hypothesis at the indicated level of significance.

Table 8
Full-Information Maximum-Likelihood (FIML) estimates of the model and the Andrews and Kim tests for cointegration breakdowns over short time periods.

	H_0: Cointegration prevails for the full-sample period, 1960–2018								
Country	$\hat{\beta}_{Full}$	$\hat{\beta}_{1-T}$	$\hat{\beta}_{1-[T+(m/2)]}$	Pa	Pb	Pc	Ra	Rb	Rc
	1960–2018	1960–1999	1960–2008	Model I: H_1: Cointegration breaks down during 2000–2018, m = 19					
Brazil	1.08	-0.95	1.40	1610.10*** (0.00)	132.45 (0.47)	70.30 (0.95)	191525.11*** (0.00)	8216.20 (0.47)	754.59 (0.95)
India	0.86	0.85	0.68	26.00 (0.11)	115.64*** (0.00)	25.82*** (0.00)	111.18 (0.95)	14655.87*** (0.00)	116.45 (0.79)
China	1.20	1.15	1.30	83.30 (0.74)	71.01 (0.84)	61.66 (0.58)	2512.10 (0.79)	2345.36 (0.79)	402.84 (0.89)
South Africa	0.62	0.67	0.87	31.42 (0.95)	79.52 (0.95)	27.74 (0.95)	775.99 (0.95)	7362.57 (0.84)	103.89 (0.95)
	1960–2018	1960–2004	1960–2011	Model II: H_1: Cointegration breaks down during 2005–2018, m = 14					
Brazil	1.08	7.11	1.09	8416.52 (0.14)	45.49 (0.90)	43.50 (0.97)	637068.04* (0.07)	1029.33 (0.90)	730.67 (0.97)
India	0.86	0.83	0.74	15.89 (0.41)	39.29* (0.07)	18.36** (0.03)	68.07 (0.93)	2204.06* (0.10)	101.35 (0.69)
China	1.20	1.26	1.22	44.09 (0.97)	48.32 (0.97)	55.29 (0.59)	389.06 (0.97)	319.94 (0.97)	277.11 (0.83)
South Africa	0.62	0.66	0.66	15.27 (0.97)	13.53 (0.97)	10.14 (0.97)	328.08 (0.86)	226.94 (0.86)	34.60 (0.97)
	1960–2018	1960–2009	1960–2013	Model III: H_1: Cointegration breaks down during 2010–2018, m = 9					
Brazil	1.08	1.18	0.98	41.42 (0.90)	18.85 (0.97)	25.18 (0.97)	725.90 (0.77)	160.70 (0.95)	300.59 (0.85)
India	0.86	0.78	0.77	18.54 (0.18)	21.49 (0.13)	13.91 (0.21)	387.90 (0.23)	505.40 (0.18)	26.13 (0.87)
China	1.20	1.19	1.20	8.69 (0.79)	9.38 (0.79)	7.98 (0.77)	141.55 (0.74)	156.67 (0.74)	114.72 (0.54)
South Africa	0.62	0.64	0.65	5.02 (0.97)	5.32 (0.97)	4.08 (0.97)	28.53 (0.97)	32.54 (0.97)	10.24 (0.97)
	1960–2018	1960–2013	1960–2015	Model IV: H_1: Cointegration breaks down during 2014–2018, m = 5					
Brazil	1.08	0.98	1.00	9.79 (0.87)	9.95 (0.87)	12.32 (0.77)	10.27 (0.96)	10.41 (0.96)	14.61 (0.98)
Russia@	3.84	3.88	3.75	64.54 (0.94)	49.40 (0.94)	45.16 (0.94)	594.82 (0.94)	422.16 (0.94)	374.12 (0.76)
India	0.86	0.77	0.84	13.52 (0.17)	4.54 (0.60)	3.22 (0.62)	104.56 (0.26)	20.91 (0.68)	9.63 (0.72)
China	1.20	1.20	1.20	5.97 (0.72)	5.92 (0.72)	5.33 (0.74)	33.90 (0.68)	33.30 (0.68)	26.50 (0.70)
South Africa	0.62	0.65	0.63	1.76 (0.98)	1.54 (0.98)	1.42 (0.98)	1.60 (0.98)	1.96 (0.98)	2.56 (0.98)
	1960–2018	1960–2015	1960–2016	Model V: H_1: Cointegration breaks down during 2016–2018, m = 3					
Brazil	1.08	1.00	1.02	1.37 (0.92)	1.14 (0.94)	0.69 (0.96)	5.96 (0.92)	4.72 (0.92)	1.99 (0.90)
Russia@	3.84	3.75	4.14	30.79 (0.81)	40.09 (0.76)	28.39 (0.76)	122.35 (0.86)	172.48 (0.71)	109.40 (0.57)
India	0.86	0.84	0.86	2.20 (0.57)	1.77 (0.63)	1.83 (0.61)	2.00 (0.76)	1.04 (0.86)	1.06 (0.84)
China	1.20	1.20	1.20	4.21 (0.57)	4.03 (0.57)	3.72 (0.55)	18.56 (0.41)	17.64 (0.45)	15.89 (0.43)
South Africa	0.62	0.63	0.64	0.58 (0.98)	0.49 (0.98)	0.68 (0.98)	1.84 (0.90)	1.45 (0.94)	2.28 (0.88)

Notes: (1) All estimations are carried out including an intercept (a constant) term in the model. The unreported estimates of intercept term are available upon request; (2) *m* denotes the number of observations in the breakdown period; (3) @ Null hypothesis for Russia is H_0: cointegration prevails for the full-sample period, 1989–2018; (4) Figures in parentheses are p-values; (5) ***, ** and * indicate statistical significance and implied rejection of the null hypothesis at the 1%, 5% and 10% levels, respectively; (6) Some of the p-values are on the border line of critical region and thus strictly do not reject the null hypothesis at the indicated level of significance.

foreign loan liabilities to finance CADs and imports and sustain the external position in a financially globalised world makes the borrowing country vulnerable to financial disturbances in the global capital market. The foreign lenders inject debt and equity capital so long as the risk-adjusted rates of returns in the borrowing (host) country are higher than those in the rest of the world. Any disturbance in the global capital market could trigger sudden and large reversals of capital inflows and thereby cause financial upheavals and economic calamities. The central bank needs to actively intervene in the FOREX market and sell foreign currency in exchange for domestic currency to absorb the downward pressure on exchange rate caused by capital outflows. The decrease in money supply resulting from the intervention in FOREX market needs to be sterilized (fully or partially) through the countervailing open market operations (purchase of securities, such as government bonds) by the central bank in the money market. The reversals of capital inflows pose severe challenges for the central banks with inadequate foreign exchange reserves and thus limited capacity to withstand the pressure of massive capital outflows and defend the external value of domestic currency. It is important to reduce the reliance on short-term capital inflows, and instead encourage long-term FDI inflows. India witnessed a full-circle reversal in its orientation towards FDI since the onset of economic reforms (July 1991 onwards). The inflow of FDI contributed considerably to the accumulation of foreign exchange reserves in India.

Severe CADs need early correction to ensure the sustainability of external position and prevent the default on foreign debt. The longer the correction of payments imbalances is delayed, the larger and more painful becomes the eventual adjustment, as the accumulated stock of foreign debt would require a larger depreciation of real exchange rate to negate the effects of its past and current misalignments (Hughes Hallett and Martinez Oliva, 2015). The policy makers need to boost exports, bolster domestic saving, and/or dampen domestic investment and imports. The stimulus to exports requires the provision of export subsidies and incentives (such as subsidised loans, rebates, and tax allowances), devaluation/depreciation of domestic currency, and reduction in inflation. However, the export subsidies are useful only when their benefits in terms of the stimulus to exports and the generation of foreign exchange reserves outweigh their costs to the taxpayers. These subsidies cause moral hazard problem and inflict disincentives to improve the competitiveness of exports. Also, the export subsidies impinge upon the investible resources of the government, and they make the households pay (through taxes) for the inefficiencies of export industries. The subsidies to exports and protective tariffs on imports often provoke retaliations by the trading partners and, as such, are not the viable strategies. Many subsidies are also inconsistent with the international trade rules of the World Trade Organisation.

Inflation erodes the competitiveness of exports and causes (1) the overvaluation of domestic currency under the fixed exchange rate regime and (2) the depreciation of domestic currency under the flexible exchange rate regime. The depreciation of domestic currency offsets the adverse effects of inflation and helps maintain the competitiveness of exports. The proportionate pass-through of inflation to exchange rate is, however, a theoretical possibility that tends to materialise in the long run under the purchasing power parity doctrine. In the short to medium run, inflation damages the competitiveness of exports and worsens the CADs. Brazil experienced hyperinflation during the mid-1980s to the 1990s, South Africa had high inflation during the mid-1970s to the mid-1990s, and India had high inflation (more than 10% per annum) on several occasions during 1960 through 2021. Inflation in India caused continual depreciations of domestic currency, notwithstanding the influx of foreign capital since the onset of economic reforms.

The depreciation of exchange rate reduces the profits of foreign firms in terms of their local currencies and the rates of returns on domestic financial assets held by international investors, causing disincentive to the inflow of foreign capital. The foreign loans of the developing countries are known to be denominated in the lenders' (foreign) currencies. The depreciation of exchange rate and the resultant rise in the value of foreign loan liabilities (in terms of domestic currency) discourages the utility-maximizing households and the profit-maximizing firms to borrow from international financial markets/institutions. It becomes necessary to ratchet up the domestic interest rates to offset the adverse effects of depreciation on the rates of returns on financial assets and thus to attract the inflow, or prevent the outflow, of foreign capital. The ratcheting up of interest rates, however, adversely affects domestic investment and eventually proves counterproductive.

The countries experiencing BOP crisis, such as India in 1991, seek financial assistance from the IMF. Since there is no tangible collateral that IMF can use to make up for its resources in the event of a default, the IMF negotiates a set of policy conditions (IMF loan conditionality) with the borrowing country. These conditions serve the twin objectives of (1) ensuring improvements in the external accounts of the borrowing country and (2) facilitating the recovery of the IMF loans. The IMF policy conditions depend on the structural weaknesses that led to the BOP crisis. In general, they encompass a complex set of policy covenants including ceilings on credit, restrictions on public-sector deficit, privatization of public enterprises, dismantling of tariff restrictions on imports, mitigation of systemic risk, acceleration of economic growth, reduction in inflation, and improvement in external viability. The devaluation of currency is often a key component of the IMF-supported structural adjustment program designed for the borrowing country.

The policy-driven devaluations and the market-driven depreciations of domestic currency provide implicit subsidies to exports and impose latent tariffs on imports and, as such, serve as the substitutes for policy protection provided conventionally through subsidies to exports and tariffs on imports. The reduction in tariffs (which raises imports) was accompanied (preceded) by discernible devaluation of Rupee (which reduces imports) by 18–19% against major international currencies in July 1991 in India. The devaluation of Rupee made imports expensive and thus negated (fully or partially) the positive effects of reduction in tariffs on imports. Also, the positive effects of devaluation on exports surpassed its adverse effects on imports and thereby resulted in an improvement in trade and current account positions. The devaluations/depreciations of domestic currency boost exports only for a finite time-horizon, however. They cause cost-push inflation and eventually become self-fulfilling prophecies in an environment with inflation and inflationary expectations. The policy focus should be to reduce inflation and improve the productivity of export industries, rather than rely on exchange rate devaluations/depreciations, to stimulate exports and sustain CA. The reduction in inflation, however, comes at the cost of its short-run trade-off with unemployment.

5.2. Long-term structural policies

The CADs become a cause of concern when they arise from the increase in consumption or a decline in domestic saving. These CADs, however, are not a cause of concern when they stem from the increase in domestic investment. Higher investment contributes to the accumulation of capital, creation of productive capacity, and an improvement in economic growth. High economic growth contributes to the rebalancing of CADs and the amortisation and servicing of external debts. Higher productivity is a substitute for higher investment

and, as such, it needs to be improved to save on the investible resources. It is also important to improve the quality of export products, develop high value-added industries, and diversify trade across a variety of products and a wider set of world markets. The improvements in the quality of export products and the development of high value-added industries would contribute to the improvements in exports and resultantly in trade and current account positions. The diversification of trade would help boost reciprocal demand, bid up the prices of exports, bid down the prices of imports and thereby help improve terms of trade and external position (Singh, 2023).

The policies to promote productivity and boost exports should be accompanied by the policies to provide tax concessions and saving incentives to bolster household (private) saving. These concessions raise after-tax returns and incentivise households to save more. The efficacy of tax incentives and saving schemes, however, hinges on their net contributions to saving (Singh, 2010). The saving incentives augment saving only when the contributions are financed through abstinence from consumption and/or increase in income, rather than through reshuffling of existing portfolio towards tax-favoured assets. The saving incentives and tax concessions on a particular saving instrument may incite only a reshuffling and rebalancing of the portfolio of assets by switching the existing saving towards tax-favoured instruments, without making any net contribution to saving. The saving schemes and tax incentives should, therefore, be designed such that they make net contributions to saving.

6. Conclusions

This study has undertaken a descriptively comprehensive and statistically robust assessment of the sustainability of current account and solvency of intertemporal budget constraint in the BRICS countries. The long-run model estimated in one-regime setting with no structural break and in sample-split setting with multiple structural breaks provides dominant support to the sustainability of CA and solvency of IBC. The intertemporal sustainability is not necessarily a self-corrective or market-driven mechanism, and it needs to be supported by appropriate economic policies. These policies differ depending on the nature of current account position, state of macroeconomic environment, and financing needs of the individual countries. The policy makers in the countries with surpluses in CA, such as China and Russia, need to manage upward pressure on domestic currency, encourage domestic investment, and seek opportunities for outward FDI. The central bank interventions in FOREX market, accompanied by both short-term portfolio and long-term direct investments overseas, would help relieve upward pressure on domestic currency and make productive use of foreign exchange reserves.

The policy focus in the countries with deficits in CA, such as Brazil, India and South Africa, should be to accelerate productivity, boost exports, bolster saving, and implement fiscal consolidation (fiscal austerity) to ensure the sustainability of CA and solvency of IBC. The stimulus to exports requires the provision of export incentives (such as subsidised loans, rebates, and tax allowances), reduction in inflation, surge in productivity, improvement in the quality of export products, development of high value-added industries, diversification of trade across a variety of products and a wider set of world markets, and expansion of regional and global supply chain and sub-chain networks. The short-term capital inflows tend to be speculative and have potentially destabilizing effects. It is important to facilitate long-term FDI inflows, alongside the pursuit of export-promotion policies and saving-generation strategies. The inflow of FDI and its assimilation across a range of industries and sectors underline the need to develop a well-

functioning and efficient infrastructure and to create an economic environment conducive to business and investment.

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References

Andrews, D. W. K., & Kim, J.-Y. (2006). Tests for cointegration breakdown over a short time period. *Journal of Business & Economic Statistics, 24*(4), 379–394.

Chen, L., & De Lombaerde, P. (2014). Testing the relationships between globalization, regionalization and the regional hubness of the BRICs. *Journal of Policy Modeling, 36*(Supplement 1), S111–S131.

Elliott, G. (1999). Efficient tests for a unit root when the initial observation is drawn from its unconditional distribution. *International Economic Review, 40*(3), 767–784.

Elliott, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient tests for an autoregressive unit root. *Econometrica, 64*(4), 813–836.

Hughes Hallett, A., & Martinez Oliva, J. C. (2015). The importance of trade and capital imbalances in the European debt crisis. *Journal of Policy Modeling, 37*(2), 229–252.

Husted, S. (1992). The emerging U.S. current account deficit in the 1980s: A cointegration analysis. *The Review of Economics and Statistics, 74*(1), 159–166.

International Monetary Fund (2022), External sector report: Pandemic, war, and global imbalances, Washington, DC, August.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2–3), 231–254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica, 59*(6), 1551–1580.

Johansen, S., Mosconi, R., & Nielsen, B. (2000). **Cointegration analysis in the presence of structural breaks in the deterministic trend**. *The Econometrics Journal, 3*(2), **216–249**.

Kejriwal, M., & Perron, P. (2008). The limit distribution of the estimates in cointegrated regression models with multiple structural changes. *Journal of Econometrics, 146*(1), 59–73.

Kejriwal, M., & Perron, P. (2010). Testing for multiple structural changes in cointegrated regression models. *Journal of Business & Economic Statistics, 28*(4), 503–522.

Lee, J., & Strazicich, M. C. (2003). Minimum Lagrange Multiplier unit root test with two structural breaks. *The Review of Economics and Statistics, 85*(4), 1082–1089.

Lee, J. and M.C. Strazicich (2004), Minimum LM unit root test with one structural break, Working Paper, No. 04–17, Department of Economics, Appalachian State University.

Lumsdaine, R. L., & Papell, D. H. (1997). Multiple trend breaks and the unit-root hypothesis. *Review of Economics and Statistics, 79*(2), 212–218.

Milesi-Ferretti, G. M., & Razin, A. (1996). *Current-account sustainability. Princeton Studies in International Finance, 81*. Princeton, New Jersey: Princeton University.

Phillips, P. C. B., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I(1) processes. *The Review of Economic Studies, 57*(189), 99–125.

Phillips, P. C. B., & Loretan, M. (1991). Estimating long-run economic equilibria. *The Review of Economic Studies, 58*(195), 407–436.

Saikkonen, P. (1991). Asymptotically efficient estimation of cointegration regressions. *Econometric Theory, 7*(1), 1–21.

Salvatore, D. (2006). Twin deficits in the G-7 countries and global structural imbalances. *Journal of Policy Modeling, 28*(6), 701–712.

Singh, T. (2007). Intertemporal optimizing models of trade and current account balance: A survey. *Journal of Economic Surveys, 21*(1), 25–64.

Singh, T. (2010). Does domestic saving cause economic growth? A time-series evidence from India. *Journal of Policy Modeling, 32*(2), 231–253.

Singh, T. (2016). Rhetorics of saving–investment correlations and the international mobility of capital: A survey. *The Journal of International Trade & Economic Development: An International and Comparative Review, 25*(5), 636–690.

Singh, T. (2019). On the flow of funds accounts and inter-sectoral mobility of capital in India. *Applied Economics, 51*(46), 4993–5011.

Singh, T. (2023). Do terms of trade affect economic growth? Robust evidence from India. *Economics of Transition and Institutional Change, 31*(2), 491–521.

Stiglitz, J. E. (2016). An agenda for sustainable and inclusive growth for emerging markets. *Journal of Policy Modeling, 38*(4), 693–710.

Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica, 61*(4), 783–820.

The World Bank (2016), Global economic prospects: Slow growth, policy challenges, January, Washington, DC.

The World Bank (2020a), Global economic prospects: Slow growth, policy challenges, January, Washington, DC.

The World Bank (2020b), Trading for development in the age of global value chains, World Development Report, Washington, DC.

United Nations Conference on Trade and Development (UNCTAD) (2019), Handbook of statistics, United Nations, Geneva.