BRICS JOURNAL OF ECONOMICS
https://www.brics-econ.org/archive/2021.Vol.2.No.1/2/
2021 Volume 2 Number 1
https://doi.org/10.38050/2712-7508-2021-27

Dynamic linkage between trade openness and sustainable development: Evidence from the BRICS countries

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Reference to this paper should be made as follows: **Sheikh, M. A., Malik, M. A., & Masood, R. Z.** (2021). Dynamic linkage between trade openness and sustainable development: Evidence from the BRICS countries. *BRICS Journal of Economics, 2*(1), 23–39. https://doi.org/10.38050/2712-7508-2021-27

Abstract

The link between trade and sustainable development has been largely analyzed on a piecemeal basis. A comprehensive study simultaneously examining economic, social and environmental aspects of sustainable development is needed to ensure coherence between the competing results of previous studies. This study aims to examine the relevance of trade openness in defining sustainable development, with special focus on five emerging countries known as BRICS, using the dynamic panel autoregressive distributed lag (ARDL) approach. The results indicate that economic growth has a tendency to enhance sustainability in both the long and short run. However, trade openness, energy consumption and foreign direct investment are extremely detrimental for sustainable development.

Keywords: trade openness, sustainable development, panel ARDL, BRICS.

JEL: F10, Q01, C23.

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Introduction

The world is in constant flux, especially after the second phase of globalization. The world's population is growing, as is technological progress. Material well-being has also improved, and the world has largely integrated via capital flows and exchange of goods and services. The increasing integration into the global trading system is viewed as a fundamental condition for sustenance and development of countries. In recent decades, the growth of trade flows has undoubtedly led to a surge in economic activities. However, despite stimulating economic activities, increasing economic integration can negatively influence society, livelihood and environment (Gallagher & Werksman, 2002). Various studies do point to a subsequent catastrophe that may be unleashed by reckless growth of production. For instance, Trainer (2012) states that radical changes in economic activities threaten the planet's ability to withstand the increasing pace of resource consumption. The surge in global production is really damaging to the quality of the environment, putting enormous pressure on the resource capacity of various countries. In addition, incremental economic activities were mutually accompanied by high energy demands with ecological footprints (Copeland & Taylor, 2013). Meadows et al. (1972) in their study "The Limits to Growth" questioned the current model of development and considered it incompatible with maintaining environmental well-being. Ranis et al. (2000), Sachs (2001), and Mariano and Rebelatto (2013) stated that measuring the progress of human societies in material terms, such as GDP, was an important but insufficient condition for overall well-being. The depletion of natural resources and energy consumption at an alarming pace has led the world to a catastrophic situation and requires human action.

Considering the environmental and social costs of economic growth, economists tried to examine the socio-economic performance of various countries through the lens of social and environmental welfare (Santana et al., 2014). In recent years, much attention is given to intergenerational development rather than just higher gross domestic product (GDP). Thus, the transition from economic growth to development and, more specifically, to sustainable development (SD) emerged as an idea of progress in addressing social and environmental concerns. Sustainable development is a multidimensional concept aimed at improving economic, social, and environmental conditions. This concept of overall balanced development received widespread support only a few decades ago and means different things to different people. However, there is considerable agreement on its definition as intergenerational well-being (Pezzey, 1989; 1992; Solow, 1992; Heal, 1998; Asheim, 2003). Nowadays, SD manifests itself as a global priority due to widespread concerns about the growth of global population, depletion of non-renewable resources, excessive exploitation of renewable resources, and deterioration of the environmental and social situation. Zhang et al. (2007) and Pope et al. (2004) stress the need of simultaneously considering economic, social and environmental aspects to assess human welfare and sustainability of a country.

It is widely believed that heralding economic growth as a universal remedy to environmental and social problems is unsustainable and may have catastrophic implications. To address these problems, among other measures, a coherent policy at both national and international level is quintessential. Among the vast array of national and international strategies, trade policy is increasingly viewed as an instrument for addressing social and environmental concerns. Various international organizations highlight the positive role of trade openness in achieving sustainability, especially by combating poverty and hunger and providing decent employment. Integration into the global economy is aimed to reverse the negative trend of marginalization of developing countries (Moosa, 2002). As Suppan (2005) puts it, trade openness, through its market expansion function, can be an effective tool for reducing disparity between developed and developing countries. Therefore, the role of international trade in achieving sustainable development is an issue of growing importance. Against this backdrop, the focus of this paper is on the empirical study of the impact of trade openness on the sustainable development of the BRICS countries. In particular, the relationship between trade openness and sustainable development is more relevant to the BRICS economies due to their globally increasing economic importance and various sustainability issues that these countries are grappling with. Although there is an extensive literature defining a causal link between trade and sustainability in a multivariate framework, it suffers from a number of limitations, which reduces its validity and reliability in policy formulation. To address these problems, this study focuses on overall sustainability by giving equal weight to all three dimensions using a panel data set. We present fresh data from a panel of five emerging economies that are on high growth trajectories and are located in different regions of the world. Our approach focuses on the broader aspects of natural, economic and social aspects that are embedded in the intergenerational well-being.

Section 1 of the article provides an overview of the empirical literature, and section 2 is devoted to the research methodology and econometric tools applied. Section 3 presents an analysis and interpretation of the empirical results. The final section summarizes the concluding remarks.

1. Literature review

Although the existing literature has produced mixed results regarding the implications of trade openness, the predominant message is that outward-oriented trade policies improve standard of living and economic performance (Kim, 2011). A large number of studies (Frankle & Romer, 1999; Antweiler et al., 2001; Cole & Elliot, 2003; Boulatoff & Jenkins, 2010; Shabaz et al., 2013) identify trade openness as a means of achieving economic, social and environmental prosperity.

Zhang et al. (2007) used a computable general equilibrium (CGE) model with two scenarios of partial and deep trade liberalization and found that trade liberalization growth was augmenting, albeit the distribution of gains was largely shifting towards industrialized countries. In terms of measurement, trade openness, which leads to economic prosperity, deteriorates social development and has adverse environmental consequences, is contingent upon the level of income of a particular country. Kirkpatrick and George (2004) also found similar results while assessing major negotiations, such as multilateral trade liberalization in the Doha Declaration of the WTO, and their consequential impact on the sustainable development of developing countries. However, the favorable effect of trade openness on economic growth was criticized for high energy demands leading to environmental degradation (Dar & Asif, 2018). While examining trade-environment relationship in a holistic framework and considering the environmental Kuznetz curve (EKC) hypothesis, Le et al. (2016) found that trade openness was beneficial for developed countries, but deteriorative for developing ones. For poorer countries, trade openness is deteriorative due to their increasing dependence on primary products, leading them to a "specialization trap." Ropke (1994) and Zakarya et al. (2015) examined the determinants of environmental pollution by CO_2 emissions. It was found that trade openness, along with FDI inflows, increased pollutant emissions and therefore caused environmental damage. However, Frankle and Rose (2005) argued that the negative impact of trade on environmental quality indicated by the earlier studies was due to endogeneity rather than causality. The duo attempted to tackle the endogeneity issue by means of exogenous geographic instrumental variable (IV). The IV was constructed using a gravity model to assess the undisturbed impact of trade on the environment. The results contradicted the results of previous studies, according to which trade had a positive impact on various measures of air pollution, such as NO_2 and SO_2.

Dependency theorists took a much tougher stance on the effects of international trade, calling it a form of neo-colonialism. Amin (1990) argued that trade openness destroyed democracy and social relationships. Periodic shocks associated with openness put vulnerable sections of society in greater jeopardy (Desai & Rudra, 2018). In addition, trade openness reduces social protection coverage, creates unnecessary demand, and lets MNCs repatriate resources from the underdeveloped world (Bornschier & Chase-Dunn, 1985).

In particular, with regard to the BRICS countries, various sustainability issues were examined in the literature. These issues range from urbanization process to food, energy, and water. The severity of these problems was analyzed by Shen et al. (2017) and Ozturk (2015), who called for immediate intervention at the policy level to combat reckless resource consumption. In addition, the degree of sustainability of their growth and financial development trajectories was thoroughly examined by Azevedo (2018) and Tamazian et al. (2009). The results of these studies call for a clear, sustainable mechanism to combat the growing pollution caused by economic growth and financial development. However, the effect of trade openness remains largely unexplored. Although these countries were included in one study or another, hardly any specific study of these countries examined the impact of trade openness on sustainable development.

Although both within BRICS and in their global trade, there has been a consistent and steep upward trend over the years, the empirical debate is far from incontrovertible. This is partly due to the fact that economic growth achieved through open trade is recognized as a universal remedy for social and environmental issues. Since growth in terms of raising GDP fails to account for many important aspects of sustainability, Stiglitz (2010) states that GDP, though it measures mainly market production, is often equated with the measurement of economic well-being. It can be a serious misconception to conflate market production with economic well-being to show how well-off people are. It also misses out on several critically important issues, such as the disorganized market, the distribution of economic goods, pollution costs, etc. (Costanza et al., 2009).

2. Research methodology and data

This section is divided into three subsections. Since the objective of this study is to investigate the impact of trade openness on overall sustainability, the unavailability of time series data over a sufficiently long period of time was a constraint. To overcome this, a composite indicator was constructed indicating overall sustainability, as described in subsection 2.1. Subsection 2.2 presents the model specification and briefly discusses the explanatory variables. This is followed by a brief overview of the ARDL approach to cointegration in subsection 2.3.

2.1. Construction of a composite sustainable index (CSI)

The construction of an aggregate index of sustainable development is based on the methodology adopted by Sheikh et al. (2020) (for details, see Tokos et al., 2012). Since sustainable development is a tri-dimensional concept, a set of representative indicators is taken from all three dimensions (Table 1).

Table 1. Indicators selected to measure the composite sustainability index

1. Economic indicators	Proxy
Economic level	GDP per capita
Economic potential	GDP growth
Labor market	Employment rate
Industrial structure	Service value added
2. Social indicators	**Proxy**
Social quality	Gini index
Medical treatment	Life expectancy
Infrastructure	Improved sanitation
Education level	Tertiary school enrollment
3. Environmental indicators	**Proxy**
Air pollution	CO_2 per capita
Land degradation	Forest land area
Water quality	Improved water access
Resource consumption	Electricity consumption per capita

Source: compiled by the authors.

These indicators represent various important aspects of economic, environmental and social sustainability. The selection was based on the previous literature. After selecting the sustainability indicators, they are transformed into dimensionless sub-indices by normalizing them with their corresponding benchmarks. The “Distance to the Reference" method developed by the OECD (2008) was used with the underlying idea of measuring the relative position of a given indicator in relation to a reference. The benchmark for each indicator is the average value of the top five out of thirty developing countries in 2015. The description of each normalized indicator is given by equations (1) and (2):

$$NI_{itd}^{+} = \frac{NI_{itd}}{BM_{itd}}, \tag{1}$$

$$NI_{itd}^{-} = \frac{BM_{itd}}{NI_{itd}}, \tag{2}$$

where NI_{itd}^{+} is the normalized indicator *i* of a particular dimension *d* that has a positive influence on sustainable development at time *t,* and NI_{itd}^{-} is the normalized indicator *i* of a particular dimension *d* that has a negative influence on sustainable development at time *t*. BM_{itd} is the benchmark for each indicator *i* in the respective time periods *t.*

Computation of sub-indices and the composite sustainability index. The next step is to aggregate corresponding normalized indicators (NI_{itd}) to construct sub-indices pertaining to their dimension. The existing literature provides numerous aggregation techniques to form composite indicators. However, the additive method, though plunged with certain limitations, is often preferred for its simplicity and transparency (ESI, 2005). The procedure of aggregating indicators (normalized) into sub-indices is given as follows.

The sub-index for economic, environmental, and social sustainability is defined by equations (3), (4), and (5), respectively.

$$SUS_{ec} = \sum_{i=1}^{nec} NI_{itd}, \tag{3}$$

$$SUS_{en} = \sum_{i=1}^{nen} NI_{itd}, \tag{4}$$

$$SUS_{so} = \sum_{i=1}^{nso} NI_{itd}, \tag{5}$$

where SUS_{ec}, SUS_{en} and SUS_{so} represent economic, environmental, and social sustainability respectively; $i = 1, 2, 3, 4$ represents the indicator in a particular sub-index. Finally, all the sub-indices representing different dimensions of sustainable development are combined into a composite sustainability indicator through equation (6):

$$CSI_{t} = SUS_{ect} + SUS_{ent} + SUS_{sot}, \tag{6}$$

where *CSI* represents the composite sustainability indicator at time *t.*

2.2. Model specification

We started with the following general formulation to establish the relationship between the *CSI* estimated from equation (5) and its determinants:

$$CSI_{it} = \alpha_{it} + \beta TO_{it} + \lambda W_{it} + \varepsilon_{it}, \tag{7}$$

where *CSI* is the composite sustainable indicator calculated by equation (6), *TO* is trade openness, and *W* is the *K*1* vector of conditional variables *(K = 4)*. Conditional variables include *GDP*, *FDI*, *EC*, *and POP*. Trade openness is represented by *(TO)* indicating the degree of integration of a particular economy into the global economy and measured by a dependency ratio *(import +export/GDP)*. On the one hand, trade openness is believed to affect sustainable development by incentivizing reckless production and creating inexistent demand. On the other hand, trade allows for technological sophistication, which, in turn, helps mitigate negative effects. *GDP* represents the growth rate of individual countries during the sample period. It is generally believed that high and unprecedented economic growth deteriorates the environment and social fabric to a certain threshold, and then positively affects sustainable development. The level of financial integration indicated by *FDI* points out the inflow of *MNCs* to a country. The effect of *FDI* may fluctuate in either direction, depending upon the nature of the recipient country. *FDI* attracted by lax environmental regulation and resource exploitation has a negative impact on sustainability. However, sustainability can improve if the technological effect outweighs other negative effects. Energy consumption *(EC)* has ecological footprints and is expected to have a negative impact on sustainable development. Finally, population growth rate *(POP)* affects sustainable development by putting additional pressure on existing but limited resources. *GDP, TO, FDI* and *EC* are taken in log form to unify the units of measurement.

2.3. The ARDL approach

To examine the magnitude of the impact of the corresponding independent variable on sustainable development, equation (8) is estimated using a dynamic panel estimation technique called Pooled Mean Group (PMG). PMG, an extended version of the Autoregressive Distributed Lag (ARDL) model, was developed by Pesaran Smith (1995) and Pesaran, Shin and Smith (1999). This technique is desirable in order to take care of panel heterogeneity and a smaller number of cross-sectional units. PMG also estimates the speed with which any short run deviation converges towards a long-term equilibrium. Besides, any possible endogeneity is estimated through lags of independent variables in the error correction specification. In particular, the equation can be written as:

$$\Delta Y_{it} = \Phi_i \left(\gamma_{i\,t-1} - \lambda_i X_{i\,t-1}\right) + \sum_{j=1}^{p-1} \varphi_{ij} \Delta Y_{i\,t-1} + \sum_{j=1}^{q-1} \omega_{i\,t-1} \Delta X_{i\,t-1} + \upsilon_i + \pi_{it}, \tag{8}$$

where *y* is the dependent variable *CSI*, $\left(\gamma_{i\,t-1} - \lambda_i X_{i\,t-1}\right)$ represents the degree of divergence from long-term equilibrium at time period *t* for any cross-sectional unit *I*, Φ_I indicates the speed of convergence of any deviation from long-term equilibrium. Vector ω represents the short run coefficients. υ_i captures the unobserved country-specific but constant effects, and finally, π_{it} is the error term.

3. Results and discussion

3.1. Cross-sectional dependence

The BRICS countries are growing at a differential pace, with an average growth rate ranging from 1.06% in Russia to 9.87% in China (Bhat, 2018). This indicates the implicit heterogeneity of the individual cross-sections. In addition, individual countries also differ in terms of openness, population growth rate, and energy consumption. Following the outward-oriented strategy, particularly after the 1990s, the BRICS countries have largely integrated into the global economy. Such interconnectedness has exposed them to common global shocks that have a contagious effect on each other. For this reason, the cross-sectional dependence, if unaccounted, can generate errors and inefficient estimation. To check its presence, Pesaran's (2007) cross sectional dependence (CD) test is used. The results are given in Table 2.

Table 2. Pesaran's cross-sectional dependence test

Variables					
CSI	***GDP***	***PGR***	***TO***	***FDI***	***EC***
12.55	4.17	8.24	15.05	8.29	5.26
0.00*	0.00*	0.00*	0.00*	0.00*	0.00*

*, **, *** indicate statistical significance at the 1%, 5%, 10% levels, respectively.

Note: CSI stands for composite sustainability indicator; *GDP* — for growth rate; *PGR* — for population growth rate; *FDI* — for foreign direct investment; *TO* — for trade openness; *EC* — for energy consumption.

Source: calculated by the authors.

As can be seen from Table 1, the hypothesis that variables in different countries are uncorrelated is not rejected. Simply put, the events taking place in these countries do have an influence beyond their borders. These results seem plausible and reflect the interconnectedness of the BRICS economies.

3.2. Stationarity tests

The unit root criterion, which is fundamental for the time series analysis, is indispensable to verify the necessary conditions of stationarity of data. Stationarity of data is characterized by the fact that the mean, variance, and autocorrelation structure do not change over a certain period of time. Precisely, it means a flat looking series with constant variance, no trend, and no periodic fluctuations (Enders, 2008). In this study, we applied multiple unit root tests. Firstly, LLC (a panel ADF test) developed by Levine et al. (2002) was applied. This test restricts the heterogeneity of the dynamic autoregressive coefficients of all cross-sectional units. Given the heterogeneous nature of the sample data, we applied the IPS test developed by Im et al. (2003), which generates heterogeneous autoregressive coefficients. The results of applying these tests in the appropriate functional form with zero non-stationarity are shown in Table 3.

Table 3. Panel unit root test

Variable	Test	Levels	*p-value*	Difference	*p-value*
CSI	IPS	T= –1.370 T t= –1.274 Z = 0.442	0.671	–6.231 –3.770 –6.700	0.000
	LLC	0.46	0.67	–5.34	0.000
GDP	IPS	–0.373 –0.332 3.129	0.999	–3.025 –2.507 –3.089	0.001
	LLC	4.12	1.00	–0.361	0.358
PGR	IPS	–1.891 –1.440 –0.0382	0.486	–1.559 –1.445 –0.055	0.478
	LLC	–2.981	0.0014	--	--
FDI	IPS	–2.343 –2.142 –2.037	0.020		
	LLC	–5.138	0.000	--	--
EC	IPS	–0.841 –0.733 1.984	0.9765	–3.558 –2.871 –4.130	0.000
	LLC	–0.162	0.435	–2.430	0.007
TO	IPS	–1.791 –1.691 –0.750	0.226	–4.626 –3.344 –8.488	0.000
	LLC	–2.20	0.013	–3.450	0.000

Note: CSI stands for composite sustainability indicator; *GDP* — for growth rate; *PGR* — for population growth rate; *FDI* — for foreign direct investment; *TO* — for trade openness, and *EC* — for energy consumption.

Source: calculated by the authors.

Table 3 indicates that all variables, except *FDI,* are *I(1),* that is, non-stationary at levels. Both LLC and IPS tests verified the presence of a unit-root in the dataset as the *p-value* stood higher than the threshold *p-value* of *0.05*, thereby not rejecting the null, the stationarity assumption is upheld for all variables. All variables are equal to *I(0)* at the first difference, as indicated by the lower *p-value* than its threshold *p-value* of *0.05*.

3.3. Panel cointegration

The overview of the data confirms the order one *I(1)* integration of all variables, except *FDI*. The next step is to analyze the presence of long run equilibrium relationships between the variables under study. For this purpose, we employed Pedroni's (1999; 2004) residual-based heterogeneous panel cointegration test. The application of this test takes into account the heterogeneity of individual cross sections in our panel of the BRICS countries. The seven-sister test distributed asymptotically normal with the null of no cointegration accounts for both within and between the groups cointegration. Besides, the Kao (1999) test was also applied to validate the results of Pedroni's test. The results are given in Table 4.

Table 4. Panel Cointegration Test

Pedroni's test			
Within dimensions		Statistic	*p-value*
	Panel V-static	–0.175	0.357
	Panel ρ-static	–0.129	0.112
	Panel PP-static	–7.29	0.071
	Panel ADF-static	–2.42	0.003
Between dimensions	Group ρ-static	0.625	0.092
	Group PP-static	–8.25	0.010
	Group ADF-static	–2.61	0.009
Kao test		*t-statistic*	*p-value*
ADF		7.54	0.081

Source: calculated by the authors.

As can be seen from Table 4, the p-values associated with the coefficients of all but two test statistics reject the null of no cointegration. The evidence of long run cointegration is found in five out of seven indicators. On the contrary, the p-values of coefficients of panel V and panel ρ static indicate the lack of a long-term association. However, the results of the other five tests will suffice for long run cointegration between *CSI* and other explanatory variables. The results of the Kao (1999) test also confirm the presence of cointegration. It should be borne in mind that Pedroni's test only indicates the presence or absence of cointegration between variables. Since it does not provide precise estimates for the long run, the next section is devoted to estimating the magnitude of the relationship between variables.

3.4. Long-run elasticity coefficients

After the pre-testing procedures, the results received using the model employed for the present study must necessarily be discussed in relation to economic propositions in relevant literature. Therefore, this section is devoted to a comprehensive study of the results generated by the panel *ARDL* model using the composite sustainability index as a dependent variable. The estimated regression coefficients, standard errors and *p-values* corresponding to each explanatory variable regressed against the composite sustainability indicator *(CSI)* are shown in Table 5.

Table 5. Error correction model (PMG Estimation 1990–2016)

Dependent variable: *CSI*			
Variables	**Coefficient**	**Standard error**	***p-value***
GDP	0.170	0.021	0.00*
POP	0.032	0.006	0.00*
TO	–0.017	0.029	0.05**
FDI	–0.001	0.001	–0.30
EC	–0.704	0.370	0.05**
Short run equation			
Error correction	–0.37	0.184	0.04**
GDP (D1)	0.323	0.184	0.00*
POP (D1)	0.030	0.065	0.643
TO (D1)	0.067	0.029	0.023**
FDI (D1)	0.002	0.002	1.28
EC (D1)	0.012	0.121	0.10***
Constant	–1.69	0.835	–2.03
Log Likelihood = 409.444 Number of observations = 128 Average = 25.6			

*, **, *** indicate the statistical significance at 1%, 5%, 10% level respectively.

Note: CSI stands for composite sustainability indicator; *GDP* — for growth rate; *POP* — for population growth rate; *FDI* — for foreign direct investment; *TO* — for trade openness, and *EC* — for energy consumption.

Source: calculated by the authors.

Table 5 encapsulates the statistical values of different parameters that are instrumental in investigating the nature, direction, and magnitude of relationships between the sustainability indicator and five explanatory variables. These statistics pertain to equation (8), which was studied for 27 years — from 1990 to 2016. The statistics that indicate the nature of the relationship between the composite sustainability indicator and five explanatory variables assumed to be important are briefly discussed below.

In line with the results presented in Table 5, a positive relationship between economic growth and sustainable development is confirmed in the case of the BRICS countries. The regression coefficient, which is estimated as 0.170, means that sustainability of the BRICS countries will exhibit a variation of approximately 0.170 percentage points due to the corresponding one percentage point variation in economic growth. This correlation is also declared significant, because the calculated p-value of 0.000 is much less than the standard value of 0.05. The estimated relationship is also in tune with the economic rationale asserting that the development process in the BRICS economies will be more sustainable if they continue to expand their economic prosperity. This is in line with the United Nations University International Human Dimensions Programme (2014); Kurniawan and Managi (2018), and Mukherjee and Chakraborty (2013).

Population growth is generally believed to worsen sustainability by putting additional pressure on the resource base available to the country. However, contrary to this belief, our study shows that population has a positive influence on sustainability. Few underlying causes can elucidate the reasons for such results. Firstly, owing to the high growth rates of developing economies, these countries are profiting from their youth population, which is a significant productive demographic resource (UNFPA 2012). Further, the overall population is growing at a decreasing rate. Since 1990, Russia has even experienced a significant period of negative population growth.

A negative analogy is drawn between trade openness and sustainable development, which is statistically significant. The estimated p-value of 0.05 stands equal to the standard value calculated at the 5 percent level of significance. The regression coefficient of –0.17 captures approximately a 0.17 percent change in sustainability of BRICS due to a congruous percentage change in trade openness. The impact of trade openness on sustainable development is small, but statistically significant. The negative association of trade openness and sustainable development vindicates the stance of environmentalists who harbor the fear of destruction of the biosphere due to the increased industrial production. Our results are contrary to Sheikh and Malik (2021), but support Rosenberg (1994), Malik et al. (2021) who also came to similar conclusions.

Similarly, the estimated results establish a significant negative association between energy consumption and sustainability in the BRICS countries. The regression coefficient of –0.704 shows that sustainable development will witness a change of 0.704 percent if there is a one percent change in energy consumption. These results are in line with the economic rationale that more energy consumption (having ecological footprints) will have an adverse effect on the environment. These results support the findings of Dar and Asif (2018). Energy consumption assumes a major share of the accepted predictors in explaining the variation in sustainability in the sample of countries.

According to the estimated results presented in Table 4, a negative relationship between foreign direct investment and sustainable development has been verified. The regression coefficient for such an association asserts that the percentage change in FDI will be followed by a variation of approximately 0.001% in sustainable development. On the one hand, there is an assumption that higher FDI leads to greater sustainability through technological sophistication. The estimated results seem to contradict the economic rationale. However, on the other hand, the pollution heaven hypothesis (PHH) states that FDI retards sustainable development through the migration of polluting firms from developed to developing countries. However, our results support the later view; its insignificance precludes any further comment.

The bottom panel of Table 4 presents the short run results. In the short run, the estimated coefficient of economic growth also indicates a positive and significant impact on sustainable development. The population growth rate once again shows a positive impact on the overall sustainability of the BRICS countries. Such relationships can be driven by the huge demographic dividend available to these countries. Despite the presence of a positive relationship, it is nullified by the calculated p-value, which declares such an association statistically insignificant. Like the population growth rate, foreign direct investment also has a positive impact on sustainable development. FDI can have a positive impact on sustainability through short term investment shocks. However, any such relationship lacks statistical significance and therefore stands nullified.

Contrary to the long-term results, trade openness exhibits a positive and statistically significant association with sustainable development in the short run. This type of relationship may prevail due to the income effect of trade. An increase in disposable income and, therefore, environmental and social consciousness may lead to positive effects of trade openness in the short run. Similarly, energy consumption also positively and significantly affects sustainable development in the short run. This relationship may exist due to the positive correlation between economic growth and energy consumption. Higher energy consumption can stimulate economic activities and thereby positively affect sustainability through economic growth. However, such relationships last for a shorter span of time as the long-term results present the opposite picture.

The long-term equilibrium relationship between the variables under study is again confirmed by the error correction term (ECT). The negative sign of the error correction term validates the presence of cointegration. Along with long run cointegration, ECT also estimates the speed with which any short run deviations (following an exogenous shock) revert to their long run equilibrium. For ECT, a negative sign is required to restore the equilibrium and it must fall within the range of 0 and 1 (Asongu, 2014). As established by the estimated results shown in Table 5, the calculated coefficient of ECT is –0.37, which means that any such deviation is corrected within 2.7 years[1] at a speed of 37% per year.

Conclusion

With the dawn of economic reforms, the BRICS external sector has undergone a metamorphosis due to increased competition and paradigm shifts in the policy and

[1] Inverse of absolute value of ECT.

operational environment during the last three decades. Over time, the external sector in these countries has remarkably learnt to shift its focus from exporting primary commodities to manufactured goods. Despite their rapid development, these countries are struggling with low incomes and high population growth. Consequently, these countries put enormous pressure on natural capital. The depletion of natural capital through reduction of forest lands, increased industrialization, and commercialization the sacred resources has devastating effects. This pressure comes from both domestic industry and MNCs. Reckless specialization and export of natural resource-based products has made developing countries increasingly vulnerable to climate changes. The transition from closed and highly regulated economies to outward-oriented ones necessitates a sound economic, social, and environmental policy.

Although the concept of sustainable development was globally publicized, given the negative consequences of reckless production, little progress was made, especially in developing countries. The recent health emergency in the Indian capital city of New Delhi and the burning of the Amazon forests in Brazil are clear evidence of this. Unless substantial policy initiatives are executed, the global economy will be unsustainable — economically, environmentally, and socially. All these conditions together oblige both developed and developing countries to search for an alternative to trade-oriented economic growth.

The study examines both the short- and long-term effects of trade openness on sustainable development. Both effects were empirically studied along with other factors that tend to influence sustainable development. We used a reliable panel cointegration technique for the BRICS countries in the period of 1990–2016. Besides, given the panel heterogeneity and cross-sectional dependence, our results indicate a long run cointegration between the respective variables. Additionally, in the long run, trade openness, foreign direct investment, and energy consumption share a negative association, while economic growth and population growth improve sustainability.

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