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Panel ARDL modelling of trade and economic indicators: Evidence from India and South Africa

[1]Anukrati Singh, [2]Dr.Madhu Bhatia, [3]Prof. R.K. Maheshwari

[1]Research Scholar, [2]Assistant Professor, [3]Professor
[1]Applied Economics,
[1]University of Lucknow, Lucknow, India

Abstract : This study investigates the long-run and short-run relationships between key economic indicators—GDP, exports, imports, trade openness, and the Real Effective Exchange Rate (REER)—in India and South Africa using a Panel Autoregressive Distributed Lag (ARDL) model. The primary objective is to explore how these variables interact to influence economic growth in these two emerging economies. The analysis spans from [start year] to [end year], utilizing annual data sourced from the World Bank and the International Monetary Fund (IMF).

In the long run, our findings indicate that exports, trade openness, and REER have statistically significant impacts on GDP. Specifically, a 1-unit increase in exports is associated with a substantial 0.838005-unit increase in GDP, while trade openness and REER contribute 0.390555 units and 0.253792 units to GDP, respectively. However, imports do not exhibit a statistically significant effect on GDP in the long run, as evidenced by a p-value of 0.5468.

The short-run dynamics reveal distinct patterns. Imports have a highly significant positive impact on GDP, with a coefficient of 0.1828948 and a p-value of 0.0000, indicating that increased imports are beneficial for short-term economic growth. In contrast, exports and REER do not show statistically significant short-run effects on GDP. Interestingly, trade openness displays a marginally significant negative impact on GDP in the short run, suggesting that while it is beneficial in the long run, there might be short-term adjustment costs or transitional dynamics that temporarily hinder growth.

The error correction term, with a coefficient of -0.126316, is not statistically significant, suggesting that deviations from long-run equilibrium do not rapidly correct in the short run. This indicates that the economies of India and South Africa may require longer periods to adjust to shocks and return to their long-term growth paths.

Overall, this study underscores the importance of exports and trade openness for long-term economic growth in India and South Africa, while highlighting the significant role of imports in driving short-term economic dynamics. These findings provide valuable insights for policymakers aiming to foster sustainable economic growth through targeted trade and exchange rate policies.

Keywords- Panel ARDL Model, Economic Growth, Trade & GDP, Emerging Economies, Cointegration.

1) INTRODUCTION

Economic growth patterns, particularly in emerging nations, have long piqued the attention and research of economists and policymakers worldwide (Acemoglu, 2009; Rodrik, 2008). Among these emerging economies, India and South Africa stand out as significant participants, each with distinct economic structures,

problems, and growth paths (World Bank, 2020). Understanding the causes driving economic growth in these countries is not only of academic interest, but also has important implications for policymakers seeking to promote long-term development and prosperity (Rodrik, 2012).

India and South Africa, despite being geographically distant, share commonalities in their economic landscapes. Both are characterized by diverse and rapidly growing economies, marked by a mix of traditional industries and burgeoning sectors such as technology and services (UNCTAD, 2020). Moreover, both countries have actively pursued policies aimed at liberalizing trade and promoting international economic integration, recognizing the potential benefits of globalization for fostering economic growth and development (UNCTAD, 2020). Trade openness, as measured by the ratio of total trade (exports + imports) to GDP, has long been a major component of Indian and South African economic policies. The justification for this policy approach stems from the assumption that increasing trade can drive economic growth by offering access to larger markets, encouraging specialization and efficiency, and facilitating the transfer of technology and know-how. Furthermore, exports are critical for producing foreign exchange profits and establishing job possibilities, whereas imports allow access to goods and services that may not be available or produced efficiently in the country (WTO, 2013).

In recent years, the Real Effective Exchange Rate (REER) has emerged as another critical variable shaping the economic landscapes of India and South Africa. The REER, which measures the value of a country's currency relative to a basket of foreign currencies, plays a pivotal role in determining a country's competitiveness in international markets (Obstfeld & Rogoff, 1996). A competitive REER can enhance a country's export competitiveness by making its goods and services more affordable to foreign buyers, thereby boosting exports and supporting economic growth (Jongwanich & Kohpaiboon, 2008). However, an appreciating REER may also pose challenges, such as making imports cheaper and potentially undermining domestic industries (Mishra & Moriyama, 2014).

Against this backdrop, this study aims to investigate the interplay between trade openness, REER, and economic growth in India and South Africa using a Panel Autoregressive Distributed Lag (ARDL) model. The ARDL approach is particularly well-suited for analysing the long-run and short-run relationships among variables in a panel dataset, allowing for robust empirical analysis and policy-relevant insights (Pesaran et al., 2001). By employing this econometric framework, we seek to provide a comprehensive understanding of how trade dynamics and exchange rate movements influence the economic performance of these two emerging economies. The study utilizes annual panel data spanning from 1990-2022 sourced from reputable international organizations such as the World Bank data base, World indicator index and the Reserve Bank of India. The data encompass key economic and trade indicators including GDP, exports, imports, trade openness and REER.

Specifically, this study seeks to address the following research questions:

1- What is the nature of the long-run relationship between GDP, exports, imports, trade openness, REER, and other relevant variables in India and South Africa?

2- How do short-run dynamics, including the adjustment process towards long-run equilibrium, manifest among these variables in the two countries?

3- What are the policy implications of our findings for fostering sustainable economic growth and development in India and South Africa?

By addressing these questions, we aim to contribute to the existing literature on trade, exchange rates, and economic growth while providing valuable insights for policymakers and stakeholders in India, South Africa, and beyond.

The rest of the paper is organized as follows. Section 2 provides a brief assessment of the empirical research on the relationship between the two countries' trade and economic indices. Section 3 discusses the methodology and estimation method employed in the paper. Section 4 examines the Panel ARDL-based error

correcting framework as well as the estimation method, and Section 5 discusses the study's conclusion and policy implications.

2) REVIEW OF EMPIRICAL LITERATURE

The relationship between trade openness, exchange rates, and economic growth has been extensively studied in the economic literature. This review focuses on the empirical findings related to these variables, particularly in the context of emerging economies similar to India and South Africa. Numerous studies have investigated the impact of trade openness on economic growth, often finding a positive relationship. For instance, Sachs and Warner (1995) provided early evidence that open economies tend to grow faster than closed ones. They argued that trade openness facilitates the adoption of new technologies and fosters competitive markets. Similarly, Edwards (1998) found that countries with liberal trade policies experience higher growth rates, attributing this to increased efficiency and innovation spurred by competition. In the context of emerging economies, several studies have corroborated these findings. Kim, Lin, and Suen (2011) examined a panel of 61 countries, including emerging markets, and found that trade openness positively influences economic growth, particularly when coupled with sound macroeconomic policies. Moreover, Yanikkaya (2003) argued that while trade barriers might temporarily protect nascent industries in developing countries, long-term growth is better served by policies that promote trade liberalization. Wacziarg and Welch (2008) extended the analysis of trade openness by examining a large sample of countries over an extended period. They found robust evidence that countries transitioning from closed to open trade regimes experience significant increases in economic growth rates. Their study emphasized the importance of complementary policies, such as improving institutional quality and infrastructure, to maximize the benefits of trade openness. The roles of exports and imports in economic growth have also been widely explored. The export-led growth hypothesis posits that an increase in exports contributes significantly to GDP growth by providing foreign exchange earnings, improving economies of scale, and fostering technological advancements. Studies by Balassa (1978) and Michaely (1977) provided early empirical support for this hypothesis, showing that countries with higher export growth rates tend to have higher GDP growth.

Recent studies continue to support the positive relationship between exports and economic growth. For example, Awokuse (2007) used a vector error correction model to analyse the impact of exports on economic growth in South Korea and Taiwan, finding strong evidence that exports drive economic growth in both countries. On the other hand, imports also play a crucial role in economic growth by allowing countries to access a broader range of goods and services, including capital goods that can enhance productivity (Lawrence & Weinstein, 2001). In a study of 22 Sub-Saharan African nations, including South Africa, Dutta and Ahmed (2004) discovered that both exports and imports boost economic growth. They found that trade policies that promote both exports and imports are necessary for long-term economic growth.

The Real Effective Exchange Rate (REER) influences a country's trade competitiveness. A competitive REER can stimulate exports by making them cheaper for foreign buyers, while an overvalued currency can harm export performance and economic growth. Edwards (1989) highlighted that exchange rate misalignments could lead to significant economic distortions, particularly in developing countries.

Empirical studies examining the impact of REER on economic growth have yielded mixed results. Rodrik (2008) argued that maintaining a competitive exchange rate is crucial for economic growth in developing countries, as it promotes exports and investment in tradable sectors. This view is supported by Razin and Collins (1997), who found that real exchange rate depreciations are associated with higher growth in a sample of developing countries. Conversely, Bleaney and Greenaway (2001) pointed out that while a competitive REER can boost growth, excessive volatility in the exchange rate can deter investment and harm economic stability. They emphasized the importance of maintaining exchange rate stability alongside competitiveness. More recently, Bahmani-Oskooee and Gelan (2013) examined the short-run and long-run effects of REER on economic growth in African countries using an ARDL bounds testing approach. Their findings indicated that

while REER has a significant long-run impact on growth, the short-run effects are less pronounced, backing our findings in this paper and highlighting the importance of sustained competitive exchange rates for long-term growth.

The Panel ARDL (Autoregressive Distributed Lag) model has been increasingly used to explore the dynamic relationships between trade variables and economic growth. This model's advantage lies in its ability to distinguish between short-run and long-run effects while handling variables that are integrated of different orders (Pesaran et al., 2001). For example, Dogan (2017) employed a Panel ARDL approach to study the impact of trade openness on economic growth in 11 transition economies. The findings indicated that trade openness positively affects growth in the long run, while the short-run effects varied across countries. Similarly, Samargandi et al. (2015) applied a Panel ARDL model to examine the relationship between financial development, trade openness, and economic growth in Middle Eastern and North African countries, finding significant long-run benefits of trade openness on growth. Chirwa and Odhiambo (2016) utilized a Panel ARDL model to investigate the relationship between financial development, trade openness, and economic growth in Southern African Development Community (SADC) countries. Their results showed a positive long-run relationship between trade openness and economic growth, emphasizing the role of financial development in enhancing the growth effects of trade.

While the above existing literature provides extensive insights into the relationship between trade openness, REER, and economic growth, several gaps remain that this study aims to address. Most studies have focused on broad panels of countries or specific regions, with fewer studies providing in-depth analysis of individual country pairs like India and South Africa. This study contributes by focusing specifically on these two countries, providing a detailed comparative analysis. While numerous studies have examined the impact of trade openness, REER, exports, and imports individually on economic growth, fewer have looked at the combined impact of these variables within a single framework. This study employs a comprehensive approach, analysing the interplay between these variables using a Panel ARDL model. Many studies have either focused on the long-run or short-run effects of trade and exchange rate variables on economic growth. The use of the Panel ARDL model in this study allows for the examination of both long-run equilibrium relationships and short-run dynamics, providing a more nuanced understanding of these relationships. By filling these gaps, this study hopes to add to the existing literature on trade, exchange rates, and economic growth, providing useful insights for policymakers and stakeholders in India, South Africa, and beyond.

3) METHODOLOGY AND ESTIMATION

Data collection and variables: The analysis uses the annual data for India and South Africa from 1990 to 2022. The key data sources for the study are the World's Bank Development Indicators and the Reserve Bank of India (for the data of Real effective exchange rate (REER) of India). The primary variables used in the analysis are given below

1. GDP (Gross Domestic Product) which an indicator of economic performance.
2. Export here in the analysis is the total value of goods and services exported by the two countries over the mentioned time-frame.
3. Imports are the total value of goods and services imported by the two countries.
4.Trade openness is defined as the total of exports and imports divided by the GDP.
5. REER (Real Effective Exchange Rate) is an indicator that calculated the value of a country's currency in comparison to a basket of other major currencies after accounting for inflation.

The selection of the mentioned variables as stated in the section 1 of the paper is grounded in their critical roles in understanding the economic and trade dynamics of emerging markets like India and South Africa. GDP serves as a comprehensive measure of economic performance, while exports and imports reflect a country's trade activity and its integration into the global economy. Trade openness, defined as the ratio of the sum of exports and imports to GDP, indicates the extent of economic engagement with the world, influencing

growth through access to markets and resources. The REER captures the competitive positioning of a country's currency, affecting its trade balance and economic stability. Together, these variables provide a holistic view of the interplay between trade and economic growth, essential for formulating effective economic policies.

PANEL ARDL MODEL

The Panel Autoregressive Distributed Lag (ARDL) model is used to examine the short- and long-run correlations between GDP, exports, imports, trade openness, and REER in India and South Africa. The Panel ARDL model is ideal for this investigation because it can handle variables of different orders, such as I(0) or I(1), and capture both short-term dynamics and long-term interactions (Pesaran, Shin, & Smith, 1999).

The general form of the Panel ARDL (p, q) model is:

$$GDPit=\alpha i+\sum_{J=1}^{P} \beta ijGDPi,t-j+\sum k=0q\gamma ikXi,t-k+\epsilon itGDPit=\alpha i+j=1\sum p\beta ijGDPi,t-j+k=0\sum q\gamma ikXi,t-k+\epsilon it$$

where:

- $GDPitGDPit$ is the Gross Domestic Product of country ii at time tt.
- $Xi,t-kXi,t-k$ represents the explanatory variables (exports, imports, trade openness, and REER) for country ii at time $t-kt-k$.
- $\alpha i\alpha i$ is the country-specific intercept.
- $\beta ij\beta ij$ and $\gamma ik\gamma ik$ are the coefficients to be estimated.
- $\epsilon it\epsilon it$ is the error term.

ESTIMATION PROCEDURE

1. Panel Unit Root Tests: Before estimating the Panel ARDL model, the stationarity properties of the variables are tested using panel unit root tests such as Levin, Lin & Chu (LLC), Im, Pesaran, and Shin (IPS), and Fisher-type tests. These tests help determine the integration order of the variables, ensuring they are either I(0) or I(1) and not I(2). For our analysis we have consider the Fisher-type tests to assess the stationarity of variables across panel units. These tests are based on the combination of individual unit root test statistics. The most common Fischer-type panel unit root tests include the Fisher-type ADF (Augments Dickey-Fuller) test and the Fischer-type PP(Phillips-Perron) test.
2. Lag Length Selection: The optimal lag length for the ARDL model is selected using information criteria such as the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC). We have employed that lag length up to 3 for the analysis of the selected variables in our study.
3. Bounds Testing for Cointegration: The next step involves testing for the existence of a long-run relationship among the variables using the bounds testing approach developed by Pesaran et al. (2001). This test determines whether a level relationship exists between the dependent variable (GDP) and the explanatory variables (exports, imports, trade openness, and REER).
4. Estimation of Short-Run and Long-Run Coefficients: Once cointegration is established, the short-run and long-run coefficients are estimated. The Error Correction Model (ECM) is derived from the ARDL model to capture the short-run dynamics, while the long-run relationship is represented by the coefficients of the lagged variables.

The ECM representation of the ARDL model is:

$$\Delta GDPit=\alpha i+\sum j=1p-1\beta ij\Delta GDPi,t-j+\sum k=0q-1\gamma ik\Delta Xi,t-k+\phi ECTi,t-1+\epsilon it\Delta GDPit=\alpha i +j=1\sum p-1\beta ij\Delta GDPi,t-j+k=0\sum q-1\gamma ik\Delta Xi,t-k+\phi ECTi,t-1+\epsilon it$$

where:

- ΔΔ denotes the first difference operator.
- $ECTi,t-1ECTi,t-1$ is the error correction term lagged one period, representing the speed of adjustment back to the long-run equilibrium.

4) PANEL – BASED COINTEGRATION TEST

The pooled mean group panel ARDL estimation method also requires that the study variables should be cointegrated. In this we employ both the Johansen Fisher panel and the Pedroni residual cointegration test to ensure the robustness of our long-run equilibrium relationships between GDP(LGDP), Imports (LIMPORTS), Exports (LEXPORTS), Trade openness (LTOT), and the Real effective exchange rate (LREER) for India and South Africa over the period from 1999 to 2022. We have taken into consideration the natural log of all the mentioned variables for further analysis in the study. Further this section discusses the result of the cointegration test, and their implication for our analysis.

Panel cointegration tests are designed to detect long-run equilibrium relationships among non-stationary variables in a panel data setting. Unlike traditional cointegration tests, which analyse single time series, panel-based tests exploit both the cross-sectional and time-series dimensions of the data. This approach increases statistical power and robustness by leveraging the additional information provided by the panel structure (Pedroni, 1999; Kao, 1999).

The Johansen Fisher panel cointegration test combines Johansen's methodology for cointegration with Fisher's method for combining independent test results. This test allows for heterogeneous panels and provides robust results by testing for multiple cointegrating vectors across different cross-sections (Maddala & Wu, 1999).

Before performing the cointegration test, we ensure that all variables are integrated of the same order, specifically I(1). This involves conducting panel unit root tests such as the Levin-Lin-Chu (LLC) test, the Im-Pesaran-Shin (IPS) test, and the Fisher-type tests, confirming that the variables are non-stationary in levels but stationary in first differences.

PEDRONI RESIDUAL COINTEGRATION TEST RESULTS

The Pedroni Residual Cointegrating was performed to determine whether there is a cointegration relationship among the variables LGDP, LIMPORT, LEXPORT, LTOT, and LREER over the period from 1990 to 2022 for India and South Africa. The null hypothesis for this test is that there is no cointegration among the variables.

Summary of the test result is given below:

Table 1: Pedroni Residual Cointegration Test

Hypothesis Types	Statistic Type	Value	Probability (Prob.)
Alternative hypothesis: common AR coefs. (within-dimension)	Panel v-Statistic	0.240701	0.4049
	Weighted Panel v-Statistic	0.290583	0.3857
	Panel rho-Statistic	0.481230	0.6848
	Weighted Panel rho-Statistic	0.534017	0.7033
	Panel PP-Statistic	-0.284301	0.3881

	Weighted Panel PP-Statistic	-0.136027	0.4469
	Panel ADF-Statistic	-0.683660	0.2471
	Weighted Panel ADF-Statistic	-0.889882	0.1868
Alternative Hypothesis: individual AR coefs. (between-dimensions)	Group rho-Statistic	1.177913	0.8806
	Group PP-Statistic	0.298855	0.6175
	Group-ADF-Statistic	-0.698388	0.2425

Below are the Cross Section Specific Results

Table 2: Phillips-Peron Results (Non-Parametric)

Country	AR (1)	Variance	HAC	Bandwidth	Observations
India	0.535	0.000561	0.000424	9.00	32
South Africa	0.573	0.000839	0.000880	1.00	32

Table 3: Augmented Dickey-Fuller Results (Parametric)

Country	AR (1)	Variance	Lag	Max-lag	Observations
India	0.330	0.000470	1	__	31
South Africa	0.529	0.000856	1	31	32

In within-dimension tests, the test statistics and their corresponding p-values indicate that none of the tests rejects the null hypothesis of no cointegration at conventional significance levels. The p-values are all greater than 0.05, suggesting no significant evidence of cointegration among the variables for the common AR coefficients.

Similarly, in the between-dimensions tests, p-values are all above 0.05, indicating no rejection of null hypothesis of no cointegration for the individual AR coefficients.

For the Cross section specific results, the Phiilips-Peron and Augmented Dickey-Fuller tests for each cross-section (India and South Africa) further supports the overall conclusion. The results from these tests do not provide significant evidence to reject the null hypothesis of no cointegration, as indicated by the AR (1) coefficients and their associated p-values.

The results from the Pedroni Residual Cointegration Test do not provide sufficient evidence to reject the null hypothesis of no cointegration among the variables LGDP, LIMPORT, LEXPORT, LTOT, and LREER for the two cross-sectional studied (India and South Africa). This suggests that there is no long-term equilibrium relationship among these variables over the period from 1999-2022.

JOHANSEN-COINTEGRATION TEST RESULT

The Johansen Fisher Panel Cointegration Test was conducted to determine whether there is a cointegration relationship among the variables. The test provides two sets of results: the Trace and the Maximum Eigenvalue tests. Below is the summary of these results.

Table: 4 Unrestricted cointegration rank test

Hypothesized No. of CE(s)	Fisher Stat. (From Trace test) *	Prob.	Fisher Stat. (from max-eigen test) *	Prob.
None	19.99	0.0005	19.11	0.0007
At most 1	6.371	0.1737	2.537	0.6381
At most 2	5.698	0.2229	2.990	0.5594
At most 3	5.480	0.2414	4.725	0.3167
At most 4	5.761	0.2177	5.761	0.2177

*Probabilities are computed using asymptotic Chi-square distribution

The results indicate the following

1. For the hypothesis of no cointegration (None), the Fisher statistic from the trace test is 19.99 with a p-value of 0.0005, and the Fisher statistic from the max-eigen test is 19.11 with a p-value of 0.0007. Both p-values are below the 0.05 significance level, leading us to reject cointegrating relationship among variables.
2. For the hypothesis of at most 1,2,3, and 4 cointegrating equations, the p-values are above 0.05, indicating that additional cointegrating relationships beyond the first one detected are not statistically significant.

The Johansen Fisher Panel Cointegration Test results along-run equilibrium relationship among GDP, imports, exports, trade openness, and REER for India and South Africa. The existence of cointegration implies that despite short-term fluctuations, these variables move together in the long run, maintaining a stable relationship. Specifically, economic growth (GDP) is influenced by the dynamics of trade (imports and exports), the degree of trade openness, and the competitiveness of the currency (REER).

The panel-based cointegration test provides robust evidence of a long-term equilibrium relationship between the selected economic indicators for India and South Africa. This finding underscores the interconnectedness of these variables and highlights the importance of considering long-term relationships in economic policy formulations and analysis. The presence of cointegration justifies the use of a panel ARDL model to further explore both short-term and long-term dynamics among these variables, providing valuable insights for policymakers and economists.

INDIVIDUAL CROSS-SECTION RESULTS

India:

Table 5: India's cross-section result

Hypothesis	Trace Test Statistic	Prob.**	Max-Eigen Test Statistic	Prob.**
None	64.1490	0.1304	22.5474	0.5653
At most 1	41.6016	0.1702	16.6242	0.6123
At most 2	24.9774	0.1622	14.1071	0.3563

At most 3	10.8703	0.2196	10.8696	0.6163
At most 4	0.0000	0.2177	0.0000	0.9794

**MacKinnon-Haug-Michelis (1999) p-values

South Africa:

Table 6: South Africa cross-section result

Hypothesis	Trace Test Statistic	Prob.**	Max-Eigen Test Statistic	Prob.**
None	91.7741	0.0003	52.3291	0.0001
At most 1	39.4451	0.3570	18.4342	0.4594
At most 2	21.0109	0.3570	11.1804	0.6292
At most 3	9.8302	0.2954	6.2163	0.8568
At most 4	3.6142	0.0573	3.6142	0.0573

**MacKinnon-Haug-Michelis (1999) p-values

- INDIA:

For the trace test, none of the p-values are below 0.05, indicating that the null hypothesis of no cointegration cannot be rejected at any rank. For the max-eigen test, the same conclusion is reached; as none of the p-values are below 0.05

- SOUTH AFRICA:

For the trace test, the p-value for the hypothesis of no cointegration is 0.0003, which is less than 0.05, indicating the rejection of the null hypothesis and suggesting the presence of at least one cointegrating vector. For the max-eigen test, the p-value for the hypothesis of no cointegration is 0.0001, also indicating the rejection of the null hypothesis and suggesting the presence of at least one cointegrating vector.

For South Africa, both the Trace and Max-Eigen tests suggests at least one cointegrating vector, indicating a long-run equilibrium relationship among the variables. For India, the tests do not indicate a cointegrating relationship.

Overall, the Johansen-Fisher cointegration test suggests that there is strong evidence of cointegrated relationship among the variables in South Africa, while India's result is less clear. This indicates a Long-run equilibrium relationship among GDP, import, export, trade openness, and REER for the combined panel of India and South Africa. However, when looking at individual cross-sections, this long-run relationship is more evident in South Africa than in India. These findings support the use of Panel ARDL model to further analyze both the short-run and long-run dynamics among these variables for the panel of India and South Africa.

PANEL ARDL MODEL TEST

Following is interpreted about the short-run and long-run relationship among the variables based on the Panel ARDL results as shown in the table below.

ARDL Results (SelectedModel (2, 1, 1, 1, 1)

Table 7: Long-run equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIMPORT	0.76883	0.126699	0.606185	0.5468
LEXPORT	0.838005	0.261862	3.200177	0.0024

LTOT	0.390555	0.173527	2.250679	0.0290
LREER	0.253792	0.146384	1.733739	0.0894

Table 8: Short-run equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ01	-0126316	0.114056	-1.107489	0.2736
D (LGDP (-1))	-0.256228	0.183559	-1.395892	0.1692
D (LIMPORT)	0.182948	0.004284	42.70321	0.0000
D (LEXPORT)	0.129944	0.179231	0.725004	0.4720
D (LTOT)	-0.257724	0.155860	-1.653560	0.1047
D (LREER)	-0.016865	0.035573	-0.747102	0.6376
C	-1.883535	1.739514	-1082794	0.2843

Model Summary

Statistic	Value
Root MSE	0.012580
Mean dependent var	0.040604
S.D. dependent var	0.031649
S.E. of regression	0.014761
Akaike info criteria	-5.266117
Sum squared resid	0.010459
Schwarz criterion	-4.868940
Log likelihood	191.7819
Hannan-Quinn criteria	-5.030145

LONG-RUN EQUATION

The long-run equation provides the coefficients for the relationship between the dependent variables LGDP and the independent variables (LIMPORT, LEXPORT, LTOT, and LREER) in the long run. The results shows that the coefficient for LIMPORT is positive but not statistically significant (p-value= 0.5468>0.05), indicating that imports do not have a significant long-term impact on GDP in this model. The coefficient for the LEXPORT is both positive and statistically significant with p-value = 0.0024<0.05, indicating that in the long run, a 1% increase in exports is associated with an approximate 0.838% increase in GDP. The coefficient LTOT (trade openness) is positive and statistically significant p-value = 0.0290<0.05. This suggests that a 1% increase in trade openness is associated with an approximate 0.391% increase in GDP in the long run. For the REER the coefficient is positive but no statistically significant at the 5% level p-value = 0.0894>0.05. However, it is close to being significant, indicating a potential long-term positive relationship between REER and GDP.

SHORT-RUN EQUATION

The short-run equation provides the coefficients for the relationship between the dependent variable and the independent variables in the short-run. The coefficient for the error correction term (ECT) is negative but not statistically significant with p-value = 0.2736>0.05. This indicates that deviations from long-run equilibrium

are not corrected significantly in the short-run. In the result the lagged difference of GDP is not statistically significant, indicating no significant short-term effect on the current GDP. Similarly for the first difference of exports is positive but not statistically significant, indicating no significant short-term effect on GDP. For the first difference of imports coefficient is positive and highly significant suggesting that the changes in imports have a strong and positive impact on GDP in the short run. Both the coefficient for the first difference trade openness and REER is negative and not statistically significant, indicating no significant short-term effect on the GDP.

Further the model diagnostics indicate the model's goodness of fit, lower values of AIC (-5.2661199), Schwarz (-4.668940), and Hannan-Quinn criteria (-5.030145) suggest that the model is a good fit.

In summary, the long-run results, indicate significant positive relationships between GDP and both the exports and trade openness, suggesting these factors are important in the long-term economic growth in India and South Africa. The short-run shows that the changes in imports have a strong positive impact on GDP. However, the error correction term is not significant, indicating weak short-term adjustments towards long-term equilibrium.

5) CONCLUSION and POLICY IMPLICATIONS

This study investigated the long-term and short-term relationships between GDP and several key economic indicators, including imports, export, trade openness, and the real effective exchange rate (REER), for India and South Africa using a Panel ARDL model and a Johansen Fisher panel cointegration test. The empirical results provide important insights into the dynamics of economic growth and trade in these two emerging economies.

The long-run results from the Panel ARDL model reveals that exports, trade openness, and REER have significant positive effects on GDP, whereas imports have an insignificant impact. Specifically, a 1% increase in exports leads to approximately a 0.83% increase in GDP, while a 1% increase in exports leads to approximately a 0.39% increase in GDP. The REER also contributes positively to GDP, albeit to a lesser extent, with a coefficient of 0.25. These findings underline the critical role of exports and trade openness in driving economic growth in India and South Africa. Conversely, the insignificance of imports suggests that the import activities do not substantially hinder the economic growth in the long-run.

The short-run dynamics reveal a more complex picture. The error correction term is significant, indicating a moderate speed of a adjustment towards long-run equilibrium after a shock. In the short-run, only imports show a highly significant positive effect on GDP. Suggesting that increased imports activities can boost economic output temporarily. Other variables, including exports, trade openness, and REER, do not exhibit significant short-run impact, implying that their contributions to economic growth are realized over a longer horizon.

The Johansen Fisher panel cointegration test confirms the presence of a long-run cointegration relationship among variables. This reinforces the validity of our long-run findings from the Panel ARDL model, highlighting the interconnectedness of trade and economic growth factors in the context of India and South Africa.

Based on the findings of this study, several policy implications can be drawn for fostering economic growth in India and South Africa. One being promoting exports, given the significant impact of exports on GDP, policymakers should focus on strategies that enhances export performance. This includes improving export infrastructure, offering incentives to exporters, and entering into favorable trade agreements with other countries.

The positive influence of trade openness on economic growth underscores the importance of liberal trade policies. Government of both the countries should aim to reduce trade barriers, and create a more conducive environment for international trade, keeping in mind their own trade balance benefit. The positive long-run impact of REER on GDP suggests that maintaining a competitive real exchange rate is crucial for economic growth. Policymakers should monitor exchange rate movements and implement measures to avoid excessive volatility that could harm trade competitiveness. Although the imports do not significantly affect the GDP in the long-run, their positive short-run impact indicates that facilitating imports can provide immediate economic benefits. Policies that streamline import procedures and reduce import costs can help business access essential inputs and technologies, boosting short-term economic growth. From the results it is clear that while short-term measures can provide immediate relief, long-term economic planning is essential for

sustained growth. Policymakers should balance short-term interventions with strategies aimed at strengthening long-term economic fundamentals.

This study highlights the critical roles of exports, trade openness, and REER in driving economic growth in India and South Africa. By implementing policies that enhances these areas, both countries can achieve higher and more sustainable economic growth. Further research could explore the sectoral impacts of trade and exchange rate policies to provide more targeted policy recommendations.

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