Contents lists available at Scopus

ECONOMICS - Innovative and Economics Research Journal

Journal homepage: www.economicsrs.com

THE THRESHOLD EFFECT OF EXCHANGE RATE ON ECONOMIC GROWTH IN BRAZIL, RUSSIA, INDIA, CHINA AND SOUTH AFRICA (BRICS) COUNTRIES

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Received 27.02.2025. | Sent to review 16.03.2025. | Accepted 14.08.2025.

Original article

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JEL Classification:
C33, E32, F31, F41, F43

Doi: 10.2478/eoik-2025-0057

UDK: 339.732(100):[338.23:336.74

ABSTRACT

This article examines the threshold effect of exchange rates on economic growth in BRICS countries from 1994 - 2022. The paper employed the Panel Threshold regression (PTR) model to explore how exchange rate fluctuations influence economic growth across different regimes (lower regime or upper regime). The findings of this study confirm that economic growth exhibits a positive relationship with the exchange rate in the lower regime (EXCH < 5.164), while exchange rate beyond the threshold value in the upper regime (EXCH > 5.164) has a negative impact on growth. Moreover, when the exchange rate is beyond the threshold value in the upper regime, other control variables such as inflation rate, interest rate and trade openness negatively affect economic growth. These insights provide valuable guidance for BRICS nations and similar economic blocs in formulating more effective monetary and exchange rate policies and choosing the most appropriate exchange rate regime, which the New Development Bank can leverage to enhance economic stability and resilience. This study underscores the significant influence of exchange rates on economic growth in BRICS countries, providing valuable insights for policymakers to refine strategies during excessive exchange rate appreciation. It is one of the few analyses employing the PTR to investigate the threshold effects of exchange rates on growth and the first to do so specifically within the BRICS context.

Keywords: *exchange rate, economic growth, BRICS, regimes, Panel Threshold regression*

1. INTRODUCTION

The growth of any economy is pivotal to its development and sustainability. Achieving this kind of feat depends on various factors that include but are not limited to exchange rates. According to Khalid et al. (2023), exchange rates and their effect on economic growth have greatly interested governments, economists, and policymakers. Fluctuation of exchange rates has been identified as a cause for concern, especially in relation to the uncertainty it can bring to not only export and import prices (for instance, a stronger home currency can make imports cheaper for domestic consumers and exports more expensive for overseas buyers) but also the cost of investment into the country's economy (Guzman et al. 2018). According to Oladipupo (2011), the exchange rate is the price of a nation's domestic currency in terms of another nation's currency, for example, the South African Rand for the United States dollar (USD) and is amongst the most significant prices in an open economy. The currency rate plays an important role in international transactions, as highlighted by (Oladipupo 2011). The actual rate of exchange, which is the nominal rate of exchange adjusted for price levels, has re-emerged as a focal point in macroeconomic policy discussions and its influence on economic performance (Gottschalk et al. 2016).

Brazil, Russia, India, China and South Africa (BRICS) economies have experienced significant economic expansion, contributing over 25% of global GDP, yet growth trajectories remain uneven across member states (Bishop, 2022). While China and India have been the primary drivers of this growth, Brazil, Russia, and South Africa have exhibited more volatility. Exchange rate movements have played a crucial role in shaping these economies, influencing trade competitiveness, foreign direct investment (FDI), and macroeconomic stability (Caselli & Roitman, 2019). Despite their growing influence, BRICS nations continue to lag behind the G7, with a combined GDP of $30.8 trillion compared to the G7's $45.9 trillion (Bishop, 2022). In emerging economies like BRICS, achieving sustainable growth remains a key macroeconomic objective, yet persistent disparities in growth rates highlight the need for structural reforms (Duval & Furceri, 2019).

The impact of the exchange rate on economic growth in BRICS countries between 1994 and 2022 demonstrates the adaptability of their economic policies in the face of significant global events and each country's unique economic structures (Kuzu & Arslan, 2023). Numerous studies employing diverse methodologies such as Ordinary Least Squares (OLS), Autoregressive Distributed Lag (ARDL), Generalized Method of Moments (GMM) estimators, and Cointegration approaches and different control variables across varying contexts have examined the relationship between rates of exchange and growth, often yielding conflicting findings (see Adeniran *et al*., 2014; Ameziane & Benyacoub, 2022; Barguellil *et al*., 2018; Idiris 2019 and Ozata 2020; Akusta, 2024). These methods have provided insights. However, they struggle with data heterogeneity and fail to capture threshold effects. Lastly, GMM faces instrument validity issues (Mehrhoff, 2009). In addition, these studies predominantly focus on advanced economies and other emerging markets. The main aim of this study is to investigate the threshold effects of exchange rates on economic growth in BRICS countries. The Panel Threshold Regression (PTR) method offers a more robust framework, effectively capturing non-linearities and regime shifts, making it more suitable for this study. Given the structural differences and unique policy frameworks of BRICS nations, further research into exchange rate dynamics is essential for informing policy decisions and improving macroeconomic stability.

The BRICS bloc has emerged as a major force in the global economy, with its share of global GDP rising from 39.1% in 2000 to 55.8% in 2020 (Kondratov, 2021). China and India have been the primary contributors, while Brazil, Russia, and South Africa have faced economic fluctuations influenced by exchange rate regimes. Exchange rate policies have evolved in response to global events, such as the 1997 Asian Financial Crisis and the 2008 Global Financial Crisis (Caselli & Roitman, 2019). These policy shifts have shaped trade competitiveness, investment inflows, and overall economic performance, underscoring the importance of understanding the exchange rate-growth nexus.

Given the size and liquidity of the global foreign exchange market, averaging $5 trillion per day, exchange rate movements have far-reaching implications for economic growth and stability (Collins, 2018). Recent global events, such as the COVID-19 pandemic and geopolitical tensions, have heightened uncertainty in currency markets, prompting BRICS nations to prioritise exchange rate stability (Aliu et al. 2023, Bishop, 2022 and Carletti et al., 2020). Prior research has established the significant impact of exchange rate fluctuations on trade, financial markets, and investment (Gnagne & Bonga-Bonga, 2020; Kannaiah & Murty, 2017; Ruzima & Boachie, 2018; Shevchenko, 2023). However, existing studies have primarily focused on developed economies and have relied on linear models that may overlook threshold effects.

This study addresses a critical gap by employing PTR to examine the non-linear effects of exchange rates on economic growth in BRICS. Unlike conventional methods, PTR accounts for variables that are I(0), I(1), or fractionally integrated, offering a more comprehensive analysis. By identifying threshold effects, this study provides key insights into exchange rate levels that may trigger shifts in economic growth, contributing to macroeconomic policy formulation. The findings will add methodological depth to the literature and offer practical implications for policymakers in emerging markets. Finally, this study contributes to the scarce research on the exchange rate-growth nexus in BRICS economies and other emerging economies with major global importance. This emphasis is especially significant given these countries' distinct economic structures, exchange rate regimes, and growth paths. Furthermore, this study is one of the few studies investigating the threshold effect of exchange rates on economic growth and the first study in the BRICS context. The remainder of this paper is structured as follows: Section 2 provides the literature review, Section 3 outlines the data and methodology, Section 4 presents the empirical results, and Section 5 discusses the conclusion, policy implications, and recommendations.

2. LITERATURE REVIEW

Numerous empirical studies have been conducted in literature to investigate the relationship between economic growth and exchange rate levels, with most studies identifying a significant causal link. This section presents a rigorous review of both theoretical and empirical literature on the impact of exchange rate dynamics on economic growth in BRICS countries.

2. 1. THEORETICAL LITERATURE

This study examines the threshold effect of exchange rates on economic growth through key macroeconomic variables, focusing on specific theoretical frameworks. It applies the Purchasing Power Parity (PPP) theory, the Balassa-Samuelson hypothesis, the Balance of Payments-Constrained Growth (BPCG) and the Optimal Currency Area (OCA) theory to analyse exchange rate dynamics and its long-term relationship with economic growth. These theories provide a robust analytical foundation for understanding exchange rate variations and their macroeconomic implications.

2. 1. 1. PURCHASING POWER PARITY (PPP) THEORY

The Purchasing Power Parity (PPP) theory is fundamental in both fixed and flexible exchange rate systems, explaining inflation and exchange rate fluctuations (Umaru et al. 2018). It establishes a relationship between price levels and exchange rates, with Balassa (1964) arguing that consumer price differentials indicate currency misalignment (Genberg, 1978). Following the collapse of fixed exchange rates, PPP emerged as a key exchange rate determination mechanism, asserting that exchange rates should adjust based on relative price changes (Anyanwu et al. 2017). Absolute PPP, based on the law of one price, suggests that exchange rates align to equalize the cost of a basket of goods between countries (Adedoyin et al. 2016). For BRICS economies, PPP-based exchange rate assessments help determine currency misalignment, influencing trade balances, inflation, and economic growth. Overvaluation raises export costs and trade deficits, while undervaluation enhances trade competitiveness.

Different perspectives exist on currency depreciation: the traditional view sees it as a trade-expanding by making exports cheaper and imports expensive, while the structuralist view (Sherman, 2011) highlights potential negative effects on national income and aggregate demand. Kandil and Mirzaie (2002) argue that depreciation benefits exports but raises import costs, especially when the Marshall-Lerner condition is unmet. Although PPP exchange rates are relatively stable, market-driven rates are volatile and can distort aggregate growth measures. However, PPP does not account for factors such as taxes, tariffs, or market competition, limiting its real-world applicability.

2. 1. 2. BALASSA-SAMUELSON (B-S) THEORY

The Balassa-Samuelson (B-S) theory emerged in 1964 as an extension of the Purchasing Power Parity (PPP) theory, questioning its ability to determine exchange rate equilibrium (Moosa, 2012). The B-S hypothesis suggests a positive correlation between productivity growth in the tradable sector and real exchange rate appreciation (García-Solanes & Torrejón-Flores, 2009). It argues that rapidly growing economies experience real exchange rate appreciation, challenging the traditional view that depreciation fosters economic growth. This phenomenon was evident in Japan's post-World War II growth compared to the United States of America.

The B-S effect highlights how relative competitiveness and purchasing power change over time, making it relevant for policymakers. Balassa (1964) and Samuelson (1964) demonstrated that the absolute PPP model is flawed, as it assumes price equalization across economies through spatial arbitrage, which does not hold due to sectoral productivity differences (Asea & Corden, 1994).

Higher-income countries tend to have greater productivity advantages in tradable goods than in non-tradables. While tradable goods prices align globally, non-tradable remain influenced by domestic conditions. As productivity rises in the tradable sector, real wages increase, leading to higher non-tradable prices and a subsequent real exchange rate appreciation (Mercereau, 2006; Mihaljek & Klau, 2004).

The B-S effect predicts that developing economies will experience higher inflation than developed ones. As productivity and efficiency improve, wages rise across both tradable and non-tradable sectors, increasing overall price levels (Gubler & Sax, 2019; Ito et al., 1999). Conversely, developed economies with already high productivity tend to have lower inflation rates. However, empirical support for the B-S model remains mixed, with alternative explanations offered for real exchange rate movements.

2. 1. 3. BALANCE OF PAYMENTS-CONSTRAINED GROWTH (BPCG) MODEL

The Balance of Payments-Constrained Growth (BPCG) model, or Thirlwall's Law, was introduced by Anthony Thirlwall in 1979. According to Thirlwall (2004, 2012), the BPCG model posits that, in the long run, a country's sustainable rate of GDP growth is determined by the ratio of the growth rate of real exports to the income elasticity of demand for imports. This relationship holds under the assumption that real exchange rate effects are minimal or neutral, implying that external sector performance, particularly export growth and import responsiveness to income, fundamentally constrains a country's growth trajectory. In addition, the model suggests that when a country grows faster than its export capacity allows, it risks unsustainable trade deficits (Thirlwall, 2012). Essentially, the higher the reliance on imports compared to export earnings, the more constrained a country's growth becomes. This is particularly applicable to developing and emerging economies where external imbalances often undermine macroeconomic stability and sustainable growth prospects.

The model is based on several assumptions: that the current account must be balanced over time, that import and export elasticities demand remain constant, and that capital inflows cannot permanently resolve trade deficits (Thirlwall, 2012). It is a demand-driven model, focusing more on external demand rather than supply-side drivers like productivity or technological innovation. Additionally, it downplays the importance of price competitiveness and exchange rate movements, viewing global income trends as the main influence of trade performance. These assumptions define the framework within which the BPCG model operates and shape its analytical outcomes.

The approach is criticized as well as commended for its applicability to actual problems in emerging nations. However, it ignores how supply-side enhancements and contemporary financial integration might boost growth through capital inflows. Considering changing global trade dynamics, its static assumptions on trade elasticities are likewise viewed as being out of date. Furthermore, the model undervalues the flexibility of policy under floating exchange rate regimes as well as the corrective function of exchange rate changes. However, the BPCG model is still a useful instrument for examining the ways in which trade and outside factors impact growth, particularly in developing nations like the BRICS.

2. 1. 4. OPTIMAL CURRENCY AREA (OCA) THEORY

The Optimal Currency Area (OCA) Theory, developed by Mundell (1961) and extended by McKinnon (1963), is crucial in determining appropriate exchange rate regimes. It emphasizes the importance of factors such as shock symmetry, openness, and labour mobility. A fixed exchange rate can enhance trade and output growth by reducing exchange rate volatility and hedging costs and by encouraging investment through lower currency premiums. However, it may hinder growth if it delays necessary price adjustments. Adedoyin et al. (2016) highlight that modern exchange rate theories focus more on financial aspects, such as asset markets and portfolio balances, while traditional theories rooted in trade flows remain valuable for explaining long-term exchange rate movements (Salvatore, 2007).

McKinnon (1963) defines an optimal currency area as one where a unified monetary-fiscal policy and adjustable exchange rates can simultaneously support full employment, stable prices, and balanced international payments. These three goals, often considered in isolation, present complex trade-offs when pursued together. The removal of exchange rate uncertainty in a currency area fosters trade, investment, and production specialisation among member states. The OCA theory also posits that countries with synchronised business cycles are more suited for a shared currency, as they respond similarly to economic shocks. For BRICS countries, understanding cycle synchronisation can clarify how exchange rate stability might promote trade integration and GDP growth.

2. 2. EMPIRICAL LITERATURE

The literature on exchange rate regimes presents mixed views on which type promotes economic growth. Some studies argue for a fixed exchange rate, while others support a flexible exchange rate regime, as both have different advantages. The choice of regime is critical, as it influences the exchange rate and depends on the monetary policy a country adopts (Topić – Pavković, 2024). Although this study does not focus on exchange rate regimes, the prevailing theory in the literature suggests that exchange rate stability promotes economic growth. Furthermore, previous studies on the effect of exchange rates on economic growth have produced conflicting findings. For instance, some empirical studies have demonstrated how exchange rates influence growth. Other schools of thought contend that there is no correlation between exchange rates and economic growth (Tang, 2015).

A recent study by El-Khadrawi (2023) explored the relationship between exchange rate volatility and economic growth in a sample of 31 developing countries from 1992 to 2022, using the Generalised Method of Moments estimators (GMM). The findings indicated that both nominal and real effective exchange rate volatility have a negative impact on economic growth. Like El-Khadrawi (2023), Ameziane and Benyacoub (2022) examined the effect of exchange rate fluctuations on economic growth in 14 emerging countries between 1990 and 2020, using the Panel Cross-Sectional autoregressive distributed lag (CS-ARDL) analysis. The study results reveal that exchange rate volatility has a direct and indirect negative effect on the economic growth of these nations.

Similarly, Dubas (2012) employed panel dynamic Ordinary Least Squares (PDOLS) regression across 102 countries between 1971–2002 to investigate the effect of exchange rate misalignments on economic growth. Dubas' results indicated that overvalued exchange rates tend to have a negative effect on economic growth, whereas undervaluation positively impacts the economic growth of these countries. These results align with the findings of Abbasi and Iqbal (2021) and Akram and Rath (2017). Kamel and Kalai (2021) examined the asymmetric effect of real effective exchange rates (REER) on economic growth in the Arab Maghreb Union between 1980 and 2016 using the Panel Threshold regression model analysis. The study results revealed that a real effective exchange rate has the opposite effect on economic growth.

Using non-linear Autoregressive Distributed Lag (ARDL), Conrad and Jagerssar (2018) examined the impact of exchange rate misalignments on economic growth from 1960 to 2016 for the Trinidad and Tobago economy. According to the study results, both overvaluation and undervaluation hinder economic growth in Trinidad and Tobago. Khalid et al. (2023) also showed that both overvaluation and undervaluation affect Turkey's economic growth negatively using annual time-series data from 1980-2022. The study used a non-linear ARDL model to analyse the asymmetric effects of the real exchange rate on the growth dynamics of Turkey. These results are in line with Conrad and Jagerssar (2018). On the other hand, Idiris (2019) showed that the exchange rate had a positive effect on the economic growth of Nigeria between 1980 and 2017 when using the Johansen cointegration test and the Vector Error Correction Model (VECM). These results align with Aman et al. (2013)'s results.

A study by Akram and Rath (2017) analysing data from 1980 to 2014, concluded that an increase in the exchange rate negatively impacts economic growth in India, using the ARDL model. This finding contrasts with the results reported by Conrad and Jagerssar (2018). Similarly, Khandare (2017) investigated the effects of exchange rate fluctuations on India's economic growth using time-series data spanning 1987 to 2014. The study found that both exchange rates exert a negative effect on economic growth; however, these effects were not statistically significant over the study period when using correlation and multiple regression analysis of the ordinary least square.

Wang et al. (2017), employing a Vector Autoregressive (VAR) model, examined the impact of real effective exchange rate volatility on economic growth within the context of the Renminbi (RMB) internationalisation process from 1995 to 2014. The findings reveal that while an increase in the RMB's real effective exchange rate may positively influence economic growth in the short term, it exerts a negative impact over the long term. This suggests that the real exchange rate ultimately inhibits economic growth in the long run. Notably, Wang et al.'s (2017) findings align with those of Hua (2012), though the two studies differ in their methodological approaches.

Similar to Wang et al. (2017), Ndou et al. (2024) used quarterly data from 1985Q1 to 2019Q3 to evaluate the long-run impact of exchange rate depreciation on the economic growth of South Africa, as well as whether it altered following the 2008 financial crisis. The study used fully modified ordinary least squares (FMOLS), dynamic ordinary least squares (DOLS), and ordinary least squares (OLS). The long-run results revealed that a 1% decrease in the exchange rate improves economic growth by less than 1.4 %. This research results imply that exchange rate depreciation has a positive effect on economic growth. Similar results were obtained by Idiris (2019).

The empirical literature on the impact of exchange rates on economic growth, particularly in BRICS countries, remains limited and fragmented. Existing studies primarily explore exchange rate volatility's effects on economic growth and other macroeconomic variables, often focusing on individual BRICS countries using time-series data rather than examining the bloc as a whole with panel data. In addition, findings across both BRICS and non-BRICS contexts are mixed, with economic growth responding differently to currency overvaluation or undervaluation. While real exchange rate depreciation negatively impacts growth in some cases and has positive effects on others. Most studies, however, report a negative relationship between exchange rates and economic growth (e.g. Akram & Rath, 2017; Ameziane & Benyacoub, 2022; Conrad & Jagerssar, 2018; Dubas, 2012; Kamel & Kalai, 2021; Khalid *et al*., 2023). Divergences in results are attributed to differences in methodologies, estimation techniques, control variables, and data periods.

3. METHODOLOGY

This section describes the study's methodology, which includes data description, estimating approaches, and modelling procedures. It gives a full overview of the methods for rigorous analysis and reliable results. In conclusion, the methodology used in this study is designed to provide a comprehensive and in-depth analysis of the impact of exchange rates on economic growth in BRICS countries.

3. 1. SAMPLING AND DATA COLLECTION

The study precisely gathers annual panel data from the World Bank, covering the extensive period from 1994 to 2022. This comprehensive approach, which includes pre-and post-BRICS formation, meets the minimum requirement of 100 observations for empirical modelling. The study's unique longitudinal perspective allows for an in-depth examination of the impact of key global and regional economic events, such as the Asian financial crisis, the global financial crisis, and the COVID-19 pandemic, on the dynamic relationship between exchange rates and economic growth. By covering this extended timeframe, the analysis provides profound insights into the evolution of this relationship, influenced by global structural transformations and shifts in domestic economic policy across BRICS countries.

3. 2. ECONOMETRIC TECHNIQUE

This study uses the Panel Threshold regression developed by Hansen (1996, 1999) to analyse the effect of exchange rates on economic growth in BRICS countries across different regimes (lower and upper regimes). Threshold regression models allow for the segmentation of data into classes based on the values of specific observed variables, enabling nuanced insights into non-linear relationships within the data. Although threshold regression techniques hold considerable intuitive appeal, they remain a relatively nascent area in econometrics. The endogenous threshold regression approach presents two significant advantages over traditional models: (1) it bypasses the need to pre-specify a functional form for non-linearity, allowing the data to endogenously determine both the number and location of thresholds, and (2) it leverages asymptotic theory, facilitating the construction of valid confidence intervals. Furthermore, a bootstrap methodology enables statistical testing of the null hypothesis of linearity against a threshold alternative, thereby assessing the significance of threshold effects (Hansen, 1999, 2000).

To determine the asymptotic distribution of test statistics and assess the significance of threshold effects, Hansen (1999) proposed using a bootstrap method. Chan (1993) demonstrated that Ordinary Least Squares (OLS) estimation of the threshold is highly consistent and can yield the asymptotic distribution when the null hypothesis of no threshold effect is rejected, thereby confirming the existence of a threshold effect. However, this distribution is unconventional due to the presence of nuisance parameters. Hansen (1999) addressed this issue by deriving the asymptotic distribution through a simulated likelihood ratio test. The estimation process proceeds in two stages. In the first stage, the Sum of Squared Errors (SSE) is calculated for each potential threshold value (γ). In the second stage, the threshold is estimated by minimising the SSE (Meriem & Henchiri, 2024). Using this estimated threshold, the coefficients for each regime are subsequently determined, and the results are analysed. The single threshold model can be constructed as follows:

$$y_{it} = \mu_{it} + \theta_1' x_{it} + \varepsilon_{it}, \quad p_{it} \leq \gamma \tag{1}$$

$$y_{it} = \mu_{it} + \theta_2' x_{it} + \varepsilon_{it}, \quad p_{it} \geq \gamma \tag{2}$$

$y_{it} = (EXCH_{it}, INFL_{it}\, IR_{it}, TRAD_{it})$

$p_{it} = EXCH_{it}$ (Nominal exchange rate)

Where y_{it} represent the GDP (economic growth), p_{it} represent nominal exchange rate, which represents the threshold variable, and is used to split the sample into two groups, which may be called regimes, γ denote the specific estimated threshold value, μ_{it} is the country's individual effect and ε_{it} is a regression error. Another threshold regression model of (1) and (2) can be constructed as follows:

$$y_{it} = \mu_{it} + \theta_1' x_{it} + \alpha_1 p_{it} I(p_{it} \leq \gamma) + \alpha_2 p_{it} I(p_{it} > \gamma) + \varepsilon_{it} \tag{3}$$

where $I(p_{it} \leq \gamma)$ represents an indicator function and $y_{it} = \mu_{it} + \theta_{1,2}' x_{it} + \alpha_1 p_{it}(\gamma) + \varepsilon_{it}$ can be expressed as:

$$y_{it} = \mu_{it} + [\theta', \alpha'] \begin{bmatrix} x_{it} \\ p_{it}(\gamma) \end{bmatrix} + \varepsilon_{it}$$

$$y_{it} = \mu_{it} + \beta' x_{it}(\gamma) + \varepsilon_{it} \tag{4}$$

$$p_{it}(\gamma) = \begin{bmatrix} p_{it} I(p_{it} \leq \gamma) \\ p_{it} I(p_{it} > \gamma) \end{bmatrix}$$

Where $\alpha = (\alpha_1, \alpha_2)$`, $\beta\ (\theta`, \alpha`)$` and $d_{it} = (x_{it}`, p_{it}`(\gamma))$`. Divided into two regimes are the observations subject to whether the threshold variable is lesser or greater than the threshold value p_{it}. These regimes are distinguished on the foundation of the different regression slopes, . The known α_1 and α_2 are used to evaluate the parameters (γ, α, θ *and* σ^2).

To estimate the Threshold regression, note that the average of equation (4) is taken over the time index to derive:

$$y_{it} = \mu_{it} + \beta_2' \bar{p}_{it}(\gamma) + \bar{\varepsilon}_{it} \tag{5}$$

Where $\bar{y}_{it} = (1/J)\sum_{t=1}^{J} y_{it}$, $\bar{\varepsilon}_{it} = (1/J)\sum_{t=1}^{J} \varepsilon_{it}$ and

$$\bar{p}_{it}(\gamma) = \frac{1}{J}\sum_{t=1}^{J} p_{it}(\gamma) \begin{bmatrix} \frac{1}{J}\sum_{t=1}^{J} p_{it} I(p_{it} \leq \gamma) \\ \frac{1}{J}\sum_{t=1}^{J} p_{it} I(p_{it} > \gamma) \end{bmatrix}$$

When the difference between (4) and (5) is taken, it produces:

$$y_{it}^* = \alpha' p_{it}^*(\gamma) + \varepsilon_{it}^* \tag{6}$$

where $y_{it}^* = y_{it} - \bar{y}_{it}$, $p_{it}^*(\gamma)$ and $\varepsilon_{it}^* = \varepsilon_{it} - \bar{\varepsilon}_{it}$ and let:

$$y_{it}^* = \begin{bmatrix} y_{i2}^* \\ \vdots \\ y_{iJ}^* \end{bmatrix};\ p_{it}^*(\gamma) = \begin{bmatrix} p_{i2}^*(\gamma)' \\ \vdots \\ p_{iJ}^*(\gamma)' \end{bmatrix} \text{ and } \varepsilon_{it}^* = \begin{bmatrix} \varepsilon_{i2}^* \\ \vdots \\ \varepsilon_{iJ}^* \end{bmatrix}$$

We represent the arranged data and errors for a single, with one-time period removed. Then we let Y^*, $P^*(\gamma)$ and ε^* signify the stacked data over all individuals.

Thus:

$$Y^* = \begin{bmatrix} y_1^* \\ \cdot \\ \cdot \\ \cdot \\ y_i^* \\ \cdot \\ \cdot \\ \cdot \\ y_n^* \end{bmatrix} : P^*(\gamma) = \begin{bmatrix} p_1^*(\gamma) \\ \cdot \\ \cdot \\ \cdot \\ p_i^*(\gamma) \\ \cdot \\ \cdot \\ \cdot \\ p_n^*(\gamma) \end{bmatrix} \text{ and } \varepsilon^* = \begin{bmatrix} \varepsilon_1^* \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_i^* \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_n^* \end{bmatrix}$$

By means of this notation, (3) is equal to:

$$Y_{it}^* = P_{it}^*(\gamma)\alpha + \varepsilon_{it}^* \tag{7}$$

Equation (7) signifies the main estimation model for the threshold effect. For any given Y_{it}^*, the slope coefficient α can be projected by means of the OLS. That is,

$$\hat{\sigma}(\gamma) = (D^*(\gamma)'D^*(\gamma))^{-1}D^*(\gamma)'Y^* \tag{8}$$

The vector of the regression residuals is

$$\hat{\varepsilon}^*(\gamma) = Y^* - D^*(\gamma)\hat{\alpha}(\gamma) \tag{9}$$

and the SSEs is

$$SSE_1(\gamma) = \hat{\varepsilon}^*(\gamma)'^{\hat{\varepsilon}^*}(\gamma) = V^*(I - D^*(\gamma))(D^*(\gamma)'D^*(\gamma))^{-1}D^*(\gamma)')Y^* \tag{10}$$

Chan (1993) and Hansen (1999) suggested that employing the least squares in estimating γ. This is simply accomplished by decreasing the intense SSEs (10). Hence, the least square estimator of γ is

$$\hat{\gamma} = arg\ min\ SSE_1(\gamma) \tag{11}$$

When $\hat{\gamma}$ is attained, the slope coefficient estimate is $\hat{\alpha} = \hat{\alpha}(\hat{\gamma})$. The residual vector is $\hat{\varepsilon}^* = \hat{\varepsilon}^*(\gamma)$ and the estimator of residual variance is

$$\hat{\sigma}^2 = \hat{\sigma}^2(\hat{\gamma}) = \frac{1}{n(J-1)}\hat{\varepsilon}^{*'}(\hat{\gamma})\hat{\varepsilon}^*(\hat{\gamma}) = \frac{1}{n(J-1)}SSE_1(\hat{\gamma}) \tag{12}$$

where n indexes the number of the sample and J indexes the period of the sample.

This study hypothesizes that there is a threshold effect between debt ratio and company value when testing for a threshold, but it is crucial to ascertain whether it is statistically significant. The alternative and null hypotheses can each be represented as follows:

$$H_0: \alpha_1 = \alpha_2$$
$$H_0: \alpha_1 \neq \alpha_2$$

When the null hypothesis (the coefficient $\alpha_1 = \alpha_2$) holds, this specifies the threshold effect does not exist. On the other hand, the threshold effect between exchange rate and economic growth does exist when the alternative hypothesis (the coefficient $\alpha_1 \neq \alpha_2$) holds.

The model is as follows when there is no threshold.

$$y_{it} = \mu_{it} + \theta_1' x_{it} + \alpha` p_{it}(\gamma) + \varepsilon_{it} \tag{13}$$

Once the fixed-effect transformation is executed, the study has:

$$V_{it}^* = \alpha`_1 H_{it}^* + \varepsilon_{it}^* \tag{14}$$

When using the OLS to estimate the regression parameter, which yields an estimate $\tilde{\alpha}_1$, residuals $\tilde{\varepsilon}^*$ and the sum of the square errors $SSE_0 = \tilde{\varepsilon}^* / \tilde{\varepsilon}^*$. Hansen (1999) proposed that the applicable F-test approach and the Sup-Wald statistic be used to test for the threshold effect and to test the null hypothesis, respectively. That is,

$$F = sup\ F(\gamma) \tag{15}$$

And

$$F(\gamma) = \frac{(SSE_0 - SSE_1(\hat{\gamma}))/1}{SSE_1(\hat{\gamma})/n(T-1)} = \frac{SSE_0 - SSE_1(\hat{\gamma})}{\hat{\sigma}^2} \tag{16}$$

Under the null hypothesis, some coefficients, for instance the pre-specified threshold, γ, do not occur; consequently, a nuisance parameter presents itself. The testing statistic once more follows a nonstandard distribution due to the existence of nuisance factors, which is known as the Davies' Problem. Hansen (1996) demonstrated that a bootstrap technique produces a first-order asymptotic distribution, demonstrating the asymptotic validity of the p-values generated via the bootstrap. The regressors x_{it} and the threshold variable p_{it} are preserved as known, with their values held fixed in repeated bootstrap samples. The regression residuals $\hat{\varepsilon}^*_{it}$ it is gathered on the foundation of an individual: $\hat{\varepsilon}^*_i = (\hat{\varepsilon}^*_{i1}, \hat{\varepsilon}^*_{i2} \ldots\ldots \hat{\varepsilon}^*_{iT})$. The sample is treated as the empirical distribution to be used in our bootstrap procedures. The empirical distribution is utilized to construct a sample of size n, and these mistakes are then used to create a bootstrap sample under H_0. This sample is used to estimate the model under the null (14) and alternative (15), and the bootstrap values of the likelihood ratio statistic $F(\gamma)$ (16) are calculated. The number of draws for which the simulated statistic is greater than the actual is computed after many iterations of this technique. This is the bootstrap estimate of the asymptotic *p*-value of $F(\gamma)$ under H_0. The null of no threshold effect is rejected if the *p-value* is smaller than the desired critical value.

Thus,

$$K = K(\widetilde{F}(\gamma) > F(\gamma)/\delta) \tag{17}$$

where is the conditional mean of $\widetilde{F}(\gamma) > F(\gamma)$

Asymptotic distribution of the threshold estimates

Chan (1993) and Hansen (1999) exhibited that once there is a threshold effect, i.e. $\alpha_1 \neq \alpha_2$, $\hat{\gamma}$ is constant with γ_0 and the asymptotic distribution is highly nonstandard. Hansen (1999) argued that the best way to form confidence intervals for γ is to form a 'no-rejection region' by means of the prospect ratio statistic for tests on γ. To test the hypothesis

$$H_0: \gamma = \gamma_0$$
$$H_0: \gamma \neq \gamma_0$$

The researcher constructs the testing model as follows:

$$LR_1(\gamma) = \frac{SSE_1(\gamma) - SSE_1(\hat{\gamma})}{\hat{\sigma}^2} \tag{18}$$

Hansen (1999) pointed out that when $LR_1(\gamma_0)$ is too large, and the p-value exceeds the confidence interval, the null hypothesis is rejected. Hansen (1999) indicated that under some specific assumptions: $H_0: \gamma = \gamma_0$

$$LR_1(\gamma) = p\delta \tag{19}$$

as n, where δ is a random variable with the distribution function.

$$P(\delta \leq x) = \left(1 - exp\frac{-x}{2}\right)^2 \tag{20}$$

The asymptotic *p-value* can be projected by means of the likelihood ratio. Based on Hansen's (1999) results, the distribution function (19) has the inverse. Thus,

$$b(\alpha) = -2log\left(1 - \sqrt{1-\alpha}\right) \tag{21}$$

From this, it is easy to compute the critical values. For an assumed asymptotic level , the null hypothesis: $H_0: \gamma = \gamma_0$ is rejected if $LR_1(\gamma)$ surpasses $b(\alpha)$.

If there are two thresholds in a multiple threshold model, the model is updated as,

$$y_{it} = \mu_{it} + \theta_1' x_{it} + \varepsilon_{it}, \quad p_{it} \leq \gamma_1 \tag{22}$$

$$y_{it} = \mu_{it} + \theta_2' x_{it} + \varepsilon_{it}, \quad \gamma_1 < p_{it} \leq \gamma_2 \tag{23}$$

$$y_{it} = \mu_{it} + \theta_3' x_{it} + \varepsilon_{it}, \quad \gamma_2 < p_{it} \tag{24}$$

where the threshold value $\gamma_1 < \gamma_2$. The multiple threshold model can be expanded to include this. ($\gamma_1, \gamma_2, \gamma_3, \ldots, \gamma_n$).

Before conducting the Panel Threshold Regression (PTR), the estimation process involved several preliminary steps, including conducting descriptive statistics and linearity tests. The study utilised second-generation, non-linear panel unit root and cointegration tests to address cross-sectional dependence and non-linearity in the data. Specifically, the Ucar and Omay (2009) non-linear panel unit root test and the Cross-Sectionally Augmented IPS (CIPS) test developed by Pesaran (2007) were employed to check for stationarity. Additionally, cointegration was assessed using second-generation tests, such as Westerlund's (2007) cointegration test and Pedroni's (2004) cointegration test, to verify the existence of long-term relationships within the panel data.

4. RESULTS AND INTERPRETATION

This section presents a comprehensive analysis of the study's findings, providing a thorough interpretation of the results. The preliminary tests, such as descriptive tests, linearity tests, and non-linear unit root tests, are covered in this section. Table 1 presents the descriptive statistics for the series.

Table 1. Overall descriptive statistics for key variables

	GDP	EXCH	INFL	IR	TRAD
Mean	4.351	21.248	11.190	10.435	42.269
Median	4.500	8.278	5.784	4.871	45.185
Maximum	14.231	78.604	307.723	77.617	69.393
Minimum	-12.569	0.665	-1.401	-18.952	15.636
Std. Dev.	4.253	22.256	31.030	16.401	12.890
Skewness	-0.750	1.087	7.727	1.756	-0.218
Kurtosis	4.357	2.845	67.710	5.949	2.135
Jarque-Bera	24.731	28.675	26741.71	127.074	5.668
Probability	0.000	0.000	0.000	0.000	0.059
Sum	630.9286	3081.007	1622.576	1513.163	6129.130
Sum Sq. Dev.	2605.118	71328.73	138649.5	38736.29	23926.96
Observations	145	145	145	145	145

Source: Author's own calculation using EViews 12 software

From Table 1, the "Jarque–Bera statistic" rejects the null hypothesis of normal distribution at the 1% level for all variables except for trade openness, which rejects the null hypothesis at 10%. The skewness and kurtosis metrics vary across all variables. As shown in Table 1, GDP and TRAD exhibit negative skewness coefficients, indicating that their distributions are skewed to the left. In contrast, EXCH, INFL, and IR display positive skewness coefficients, suggesting their distributions are skewed to the right. The White neural linearity test and Tsay's nonlinearity test results on the key variables of this study are presented in Table 2.

Table 2. White linearity test and Tsay's nonlinearity test results

Test		GDP	EXCH	INFL	IR	TRAD
White Linearity test	Chi-squared	49.512	53.289	16.558	27.156	28.149
	DF	2	2	2	2	2
	P-value	0.000***	0.000***	0.000***	0.000***	0.000***
Tsay's Test for nonlinearity	F-stat	72.783	40.754	1.657	16.103	22.947
	P-value	0.000***	0.000***	0.022**	0.000***	0.000***

Notes: */**/*** represents statistical significance at 10%, 5% and 1% respectively

Source: Author's own calculations using R package software

Table 2 reveals that the hypothesis of linearity is rejected for all key variables at the 1% significance level, as confirmed by both the White test and Tsay's test for nonlinearity, with the sole exception of the INFL variable, which Tsay's test identifies as significant at the 5% level. These results highlight the presence of significant nonlinear behaviour across the variables. The statistical significance of these findings underscores the inadequacy of traditional linear estimation methods in capturing dynamic relationships among variables, particularly in the context of structural breaks, regime shifts, or asymmetric adjustments. Consequently, nonlinear modelling techniques, such as the Panel Threshold Regression (PTR) approach, are better suited for parameter estimation. By accommodating complex interactions and allowing for relationships to vary across different regimes, PTR offers a more flexible and accurate framework for analysing the data. The findings of Ucar and Omay's (2009) nonlinear panel unit root test results are presented in Table 3.

Table 3. Ucar and Omay's (2009) nonlinear panel unit root test results

Variable	Optimal lag	Coefficient	Std. Err	T-value	Conclusion
GDP	2	0.0064	0.000582	11.02232 (0.000)	Nonlinear Stationary
EXCH	1	1.80e-05	5.26e-06	3.423970 (0.000)	Nonlinear Stationary
INFL	1	1.79e-05	1.78e-06	10.10117 (0.000)	Nonlinear Stationary
IR	6	0.000143	3.29e-05	4.342981 (0.000)	Nonlinear Stationary
TRAD	1	9.19e-05	6.32e-06	14.53507 (0.000)	Nonlinear Stationary

Notes: Critical values of the Ucar and Omay (2009) test at the 1%, 5%, and 10% significant levels are -2.44, -2.20, and -2.08, respectively. Values in () are probabilities.

Source: Author's own calculations using EViews 12 software

The Ucar and Omay (2009) nonlinear panel unit root test was conducted after the best lags for each key variable were identified using the AIC. Table 3 provides a summary of the test results. The null hypothesis of a nonlinear unit root in all key variables was rejected at the 1 % significance level. The t-statistics for all key variables are greater than the critical values of -2.44 at the 1% significance levels, which forms the basis for this rejection. As a result, asymmetric and nonlinear stationarity is demonstrated by all key variables. The CIPS nonlinear panel unit root test findings at the level and first difference are shown in Tables 4 and 5, respectively.

Table 4. CIPS nonlinear panel unit root test results at level

With Nonlinear Trend			
Variables	Optimal Lag	CIPS T-stats	Conclusion
GDP	2	-4.071***	Nonlinear Stationary I(0)
EXCH	1	-1.552	Non-stationary
INFL	1	-4.361***	Nonlinear Stationary I(0)
IR	6	-3.875***	Nonlinear Stationary I(0)
TRAD	1	-1.155	Non-stationary

Notes: Critical test values at the 1%***, 5%** and 10%* significant levels are -2.57, -2.33 and -2.21, respectively.

Source: Author's own calculations using Stata 17 software

The results in Table 4 indicate that the null hypothesis of non-stationarity is rejected for GDP, INFL, and IR at the 1% significance level, as their test statistics fall below the critical value of -2.57. Conversely, the null hypothesis that EXCH and TRAD contain unit roots in their level form cannot be rejected, as their test statistics exceed the critical value across the 1%, 5%, and 10% significance levels. Furthermore, Table 4 confirms that GDP, INFL, and IR are nonlinearly stationary in their level form at lags 2, 1, and 6, respectively, as determined by the Akaike Information Criterion (AIC) at the 1% significance level. In contrast, EXCH and TRAD require further testing for nonlinear stationarity at their first differences. The results of the CIPS nonlinear panel unit root tests at first differences are presented in Table 5.

Table 5. CIPS nonlinear panel unit root test results at first difference

With Nonlinear Trend			
Variables	Optimal Lag	CIPS T-stats	Conclusion
EXCH	1	-4.459***	Nonlinear Stationary I(1)
TRAD	1	-3.349***	Nonlinear Stationary I(1)

Notes: Critical test values at the 1%***, 5%** and 10%* significant levels are -2.57, -2.33 and -2.21, respectively.

Source: Author's own calculations using Stata 17 software

The CIPS results in Table 5 indicate that the null hypothesis of non-stationarity for EXCH and TRAD is rejected at the 1% significance level after first differencing, as their test statistics are below the critical value at this significance level. These findings confirm that EXCH and TRAD become nonlinearly stationary in their first-difference form at lag 1, as determined by the AIC, at the 1% significance level. Consequently, the CIPS nonlinear unit root test establishes that GDP, INFL, and IR are integrated of order I(0), while EXCH and TRAD are integrated of order I(1). To ensure that asymmetric cointegrating exists among the key variables, the second generation of panel cointegration, such as Westerlund's (2007) cointegration and Pedroni's (2004) cointegration tests, were employed in this study. Tables 6 and 7 present Westerlund's (2007) cointegration and Pedroni's (2004) cointegration test results.

Table 6. Westerlund (2007) cointegration test results

Statistics	Value	Z-value	P-value	Robust P-value
Gt	-5.533	-6.579	0.000***	0.000***
Ga	-27.179	-2.539	0.000***	0.000***
Pt	-11.360	-5.489	0.000***	0.000***
Pa	-26.267	-3.215	0.001***	0.000***

Note: *10% statistically significant, **5% statistically significant, ***1% statistically significant, Optimal lag and lead lengths (0) and Bootstrap is set to 50.

Source: Author's own calculation using STATA 17 software

Null hypothesis: No cointegration

As shown in Table 6, the results for both group mean statistics (Gt and Ga) and panel statistics (Pa and Pt) robustly reject the null hypothesis of no cointegration at the 1% significance level. This confirms that all key variables (economic growth, exchange rate, inflation, interest rates, and trade openness) are strongly cointegrated, as all test statistics indicate the rejection of the null hypothesis. The detailed results of Pedroni's (2004) cointegration test are presented in Table 7.

Table 7. Pedroni (2004) cointegration tests (second generation) results

Tests	Statistics	P-value
Modified Phillips-Perron	-1.495	0.068*
Phillips-Perron	-5.139	0.000***
Augmented Dickey-Fuller	-4.895	0.000***

Note: *10% statistically significant, **5% statistically significant, ***1% statistically significant

Source: Author's own calculation using STATA 17 software, using xtcoittest pedroni command

Null hypothesis: No cointegration

The Pedroni (2004) results in Table 7 indicate that the Modified Phillips-Perron test statistic rejects the null hypothesis of no cointegration at the 10% significance level, while the Phillips-Perron and Augmented Dickey-Fuller test statistics reject the null at the 1% significance level. Based on the cointegration results from Westerlund (2007) and Pedroni (2004), this paper concludes that the key variables exhibit strong cointegration, as the test statistics from both methodologies consistently reject the null hypothesis of no cointegration. The paper employs Hassen's (1999) methodology to determine the number of thresholds. To assess the presence of a threshold effect, it is essential first to investigate the existence of a single threshold and potential multiple effects. This study adopts the bootstrap approach to estimate F-statistics and derive corresponding p-values. Each panel threshold test undergoes 5,000 bootstrap iterations. The empirical results of the test for single threshold effects are presented in Table 8.

Table 8. Threshold effects test results

Threshold description	Threshold estimate
Single threshold effect test	4.299
LM-test for no threshold	23.031
Bootstrap p-value	0***

Note: F-Statistics and p-value results of repeating the bootstraps 5000 times. *10% statistically significant, **5% statistically significant, ***1% statistically significant

Source: Author's own calculation using STATA 17 software

The results in Table 8 reveal that the bootstrap p-value rejects the null hypothesis of no threshold at the 1% significance level when the exchange rate (EXCH) variable is used as the threshold variable. Additionally, the findings confirm that the single threshold effect is statistically significant at the 1% level, providing robust evidence that the relationship between economic growth (GDP) and the explanatory variables varies across the identified threshold. Consequently, the study concludes that the exchange rate exhibits a single threshold effect on economic growth in BRICS countries during the period 1994–2022. Table 9 details the panel threshold estimation results.

Table 9. Panel threshold estimation results

Description	Threshold estimate
	5.164
95% Confidence interval	[3.077, 8.474]
Heteroskedasticity test (p-value)	0.112

Note: *10% statistically significant, **5% statistically significant, ***1% statistically significant

Source: Author's own calculation using STATA 17 software

According to Table 9, the estimated exchange rate threshold is 5.164, with a 95% confidence interval ranging from [3.077 to 8.474]. Additionally, the results indicate that the p-value from the heteroskedasticity test is statistically insignificant, confirming the failure to reject the null hypothesis of homoscedasticity. Table 10 presents the results of the panel threshold for two regimes (a lower regime where and upper regimes where).

Table 10. Panel threshold results for two regimes

Variables	Coefficients	T-statistics
Lower regime		
EXCH	2.769	5182***
INFL	-0.073	-6.235***
IR	-0.007	-0.210
TRAD	0.339	2.525**
Upper regime		
EXCH	-0.035	-2.101**
INFL	-0,072	-2.788**
IR	-0.386	-5.168***
TRAD	-0.102	-3.317***

Note: *10% statistically significant, **5% statistically significant, ***1% statistically significant.

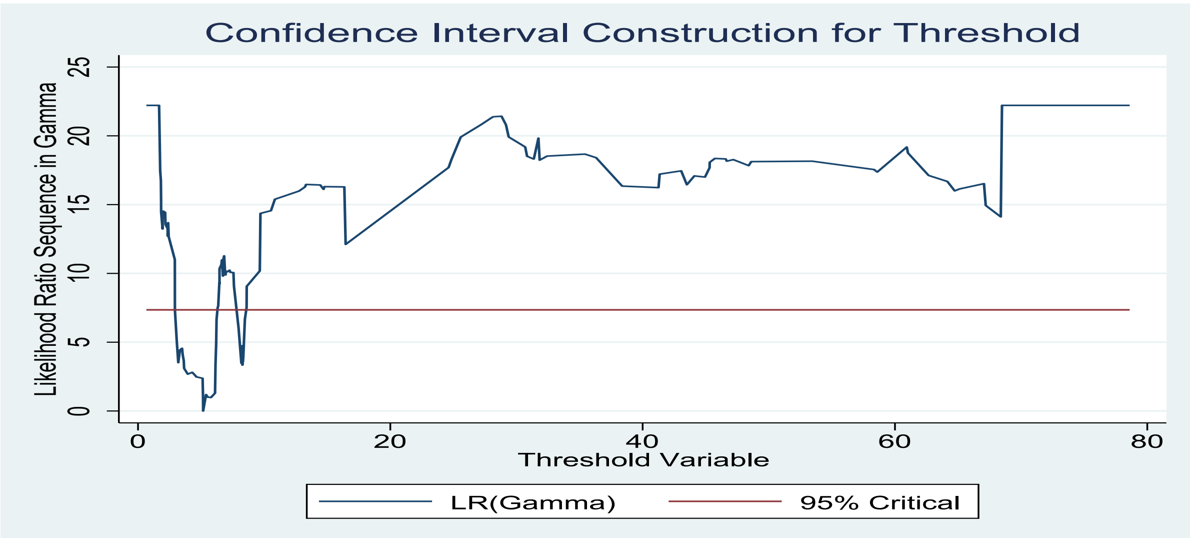
Source: Author's own calculation using STATA 17 software

The panel threshold regression results in Table 10 reveal a non-linear relationship between exchange rates and economic growth in BRICS countries, with a threshold value identified at 5.164. In the lower regime, where the exchange rate is below the threshold value of 5.164 (EXCH < 5.164), the exchange rate has a positive and statistically significant impact on economic growth. Specifically, an increase in the exchange rate below this threshold value results in a 2.769% rise in economic growth. This suggests that a relatively undervalued exchange rate promotes economic growth, possibly by enhancing the competitiveness of exports and encouraging foreign investment. These findings contradict the results of Kamel and Kalai (2021), who found a negative impact of the exchange rate on economic growth at a lower threshold of 4.519 for the Arab Maghreb Union. In addition, control variables such as inflation and interest rates exert a negative influence on economic growth, although only inflation is statistically significant at the 1% level. A 1% increase in inflation leads to a 0.073% decline in economic growth, which is consistent with the findings of Kamel and Kalai (2021). Trade openness, on the other hand, has a positive and statistically significant effect on economic growth in this regime, aligning with the findings of Barguellil (2021), although their study used a PARDL approach.

In the upper regime, where the exchange rate exceeds 5.164 threshold (EXCH > 5.164), the relationship between the exchange rate and economic growth becomes negative. In this scenario, economic growth declines by 0.034% for every unit increase in the exchange rate beyond the threshold. This indicates that while exchange rate undervaluation supports growth, overvaluation beyond the optimal level is detrimental. Control variables such as inflation, interest rates, and trade openness also have a statistically significant negative effect on economic growth in the upper regime. These contrasting results between the lower and upper regimes underscore a non-linear relationship, where the exchange rate positively contributes to growth only up to the threshold level of 5.164. Beyond this point, further increases in the exchange rate hinder economic performance. This stands in contrast to Kamel and Kalai (2021), who observed a negative impact of the exchange rate on growth in the lower regime and a positive impact in the upper regime for the Arab Maghreb Union, highlighting regional differences in exchange rate dynamics.

Based on these findings, several policy recommendations can be drawn. First, BRICS policymakers should aim to maintain the exchange rate at or below the optimal threshold value of 5.164 to sustain and promote economic growth. A moderately undervalued exchange rate appears to be beneficial for the economic performance of these countries. Second, efforts should be made to avoid currency overvaluation, as an exchange rate above the threshold value negatively impacts growth. This can be managed through prudent monetary and foreign exchange policies. Third, since inflation significantly reduces growth in the lower regime, maintaining price stability should be a priority. This requires effective inflation targeting and monetary discipline. Fourth, the positive role of trade openness in the lower regime highlights the importance of continuing to liberalise trade, reduce barriers, and encourage regional and international trade partnerships. Fifth, although the interest rate's impact on growth is not statistically significant, careful calibration of interest rate policies is necessary to balance inflation control and economic stimulation. Lastly, given the regional differences in the exchange rate-growth relationship, exchange rate management should be tailored to the unique economic conditions of BRICS countries. Structural reforms aimed at improving infrastructure, governance, and innovation capacity can further strengthen the positive effects of an optimal exchange rate policy on long-term growth. Figure 1 below shows the normalised sequence statistics likelihood ratio results.

Figure 1. The likelihood ratio's normalised sequence statistics



Source: Author's own calculation using STATA 17 software

Figure 1 presents the normalised sequence statistics of the likelihood ratio corresponding to the exchange rate threshold, confirming the significance of the first threshold at 5.164. The non-linear Panel Threshold Regression (PTR) model identifies this threshold as statistically significant at the 1% level. Despite the economic heterogeneity among BRICS nations, maintaining the exchange rate below the threshold of 5.164 is crucial to mitigating the negative effects of exchange rate overvaluation on economic growth.

5. CONCLUSION

This paper used the Panel Threshold regression model to investigate the effect of exchange rates on economic growth in BRICS countries. The results of this study favour the PTR proposed by Hansen (1999). The study found that economic growth is positively connected with the exchange rate at the lower regime (EXCH < 5.164) and negatively linked with the exchange rate at the upper regime (EXCH > 5.164). This study validates the conventional view among economists, showing a trade-off relationship between control variables and economic growth with a given amount of exchange rate as the exchange rate will have a favourable impact on economic growth at the lower regime. When the exchange rate falls below the identified threshold, there exists a trade-off between exchange rate movements and economic growth. Specifically, excessive appreciation of the exchange rate beyond the optimal threshold value can suppress economic growth by eroding export competitiveness and reducing external demand. Moreover, such appreciation may generate adverse spillover effects on key macroeconomic indicators, including investment, employment, and the current account balance, thereby compounding its negative impact on overall economic performance in BRICS countries.

To improve economic growth in BRICS countries, policymakers should prioritise maintaining exchange rates below the threshold value of 5.164. This range supports positive economic growth and fosters a favourable trade-off between key macroeconomic variables, such as inflation, interest rates, and trade openness. Policies aimed at stabilising the exchange rate below this level, such as targeted monetary interventions and exchange rate management, are critical to avoid the detrimental effects of excessive devaluation.

In cases where the exchange rate exceeds the threshold, proactive measures should be implemented to mitigate the negative effects on growth and macroeconomic stability. These measures may include tightening inflation controls, ensuring competitive trade practices, and promoting structural reforms to enhance economic resilience against exchange rate shocks. Adopting these strategies will help sustain robust economic growth and macroeconomic stability within the BRICS economies. The findings of this study would help policymakers create effective exchange rate policies and choose the most appropriate exchange rate regime.

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