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THE DYNAMICS OF THE FDI-PRODUCTIVITY NEXUS IN BRICS: A WAVELET COHERENCE STUDY

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Abstract. The current study investigates the interrelationship between FDI inflows and total factor productivity (TFP) in BRICS economies comprising Brazil, Russia, India, China, and South Africa, along with newly added members Egypt, Ethiopia, Iran, Saudi Arabia, and the UAE. Previous research has often overlooked the country-specific factors that influence how productivity impacts FDI inflows. To address this gap, the study introduces methodological innovation by employing the Method of Moments Quantile Regression (MM-QR) with fixed effects, using annual data from 2012 to 2022. This method accounts for unobserved heterogeneity, allowing for a detailed analysis of how TFP affects FDI across different countries and quantiles. The study adds novelty by utilising wavelet coherence analysis to explore co-movements and causal relationships between FDI and key macroeconomic variables at different time scales. The results show that FDI inflows have a positive and significant relationship with GDP and trade openness while exhibiting a negative association with TFP. Over the long term (16–32 weeks), coherence remains relatively weak, but TFP demonstrates a more consistent impact on FDI inflows compared to the other variables. The study recommends that BRICS nations should enhance FDI's impact by improving trade integration and regional cooperation to attract high-value investments and foster sustainable growth.

Keywords: BRICS nations, FDI inflows, Method of Moments Quantile Regression (MM-QR), wavelet coherence analysis, total factor productivity.

JEL Classification: C22, F43, F63, O47.

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1. Introduction

Globalisation has significantly reshaped the economic landscapes of developing nations, transforming their economic structures and growth trajectories. In recent decades, the forces of globalisation have accelerated the integration of these economies into the global market (Sahu, 2021). This integration has fostered increased interconnectedness and interdependence between developing economies and advanced nations (Gries & Redlin, 2020). The enhanced connectivity has opened new avenues for trade, investment, and technology transfer, collectively spurring economic growth and development in emerging nations (Tuluy, 2016; Akorsu & Okyere, 2023). This progression has been accompanied by a substantial rise in total capital flows, encompassing various forms of cross-border investments such as foreign direct investments (FDI), portfolio investments, remittances, and other financial asset transfers (Athari et al., 2020). Among these, FDI inflows have become a fundamental driver of economic

development strategies due to its stable and long-term nature. FDI inflows have been instrumental in bridging the investment gap by providing the much-needed capital for investment in infrastructure, industry, and services (Joshua et al., 2020; Arvin et al., 2021). The influx of foreign capital has facilitated the expansion of productive capacities, enhanced access to advanced technologies, and improved managerial expertise. These elements are essential for boosting economic efficiency and productivity, thereby contributing to sustainable economic growth (Bruhn et al., 2020).

The advantages of FDI inflows extend beyond mere capital accumulation. One of the significant benefits is the transfer of technology and knowledge, which can lead to substantial improvements in total factor productivity (TFP) (Yalçınkaya et al., 2017). TFP measures the efficiency with which labour and capital are utilised in the production process. It captures the impact of factors other than input quantities on economic output, such as technological innovation, organisational improvements, and skill enhancements (Herzer & Donaubauer, 2018). Higher TFP implies better use of resources, leading to sustainable economic growth without a proportional increase in input. When multinational corporations invest in developing countries, they often bring advanced technologies and innovative practices. This phenomenon, known as technology spillover, can significantly boost the host country's TFP (Essel, 2023). Technology spillover occurs through various channels, including direct technology transfer to local firms, the demonstration effect, where local firms emulate the practices of foreign firms, and labour mobility, where employees trained by foreign firms bring new skills and knowledge to local companies (Abdullah & Chowdhury, 2020). Moreover, FDI can enhance TFP by fostering competition in the domestic market. The entry of foreign firms often intensifies competition, compelling local firms to innovate and improve their efficiency to maintain market share (Liang, 2017). This competitive pressure can lead to better utilisation of resources, adoption of new technologies, and overall productivity gains (Zhao et al., 2024). Additionally, FDI can stimulate research and development (R&D) activities within the host country, further driving technological advancements and productivity improvements (Tsamadias et al., 2019).

In the context of BRICS nations, understanding the impact of total factor productivity on FDI inflows is crucial for formulating effective economic policies. The original BRICS group included Brazil, Russia, India, China, and South Africa. In 2024, five additional members joined the group: Egypt, Ethiopia, Iran, Saudi Arabia, and the United Arab Emirates (UAE). This expansion has significantly enhanced the global influence and economic reach of BRICS countries. The group now encompasses approximately 3.5 billion people, representing 45% of the world's population. The economies of its members collectively exceed USD 30.1 trillion, accounting for around 28% of the global economy, as presented in Table 1.

From 1990 to 2015, BRICS' share of global economic output grew from 5.85% to 21.6%, highlighting their rapid economic transformation. Among the group members, China led with an economy valued at 19.4 trillion dollars, followed by India and Brazil with 3.7 and 2.1 trillion dollars, respectively. Moreover, the inclusion of Iran, Saudi Arabia, and the UAE is particularly impactful, as these nations together contribute approximately 44% of global crude oil production. This expansion underscores the growing economic and geopolitical significance of BRICS, positioning it as a formidable bloc in the global landscape.

Table 1. Nominal and PPP-adjusted GDP for BRICS and G7 countries (source: International Monetary Fund [IMF], 2024)

Country/Group	Membership	Nominal GDP (in trillion dollars, 2023)	GDP PPP (in trillion dollars, 2023)
Canada	G7	2.1	2.4
France	G7	2.9	3.9
Germany	G7	4.3	5.6
Italy	G7	2.2	3.2
Japan	G7	4.4	6.5
UK	G7	3.2	3.9
USA	G7	26.9	26.9
Brazil	BRICS	2.1	4.0
China	BRICS	19.4	33.0
India	BRICS	3.7	13.0
Russia	BRICS	2.1	5.0
South Africa	BRICS	0.4	1.0
Egypt	BRICS	0.3	2.1
Ethiopia	BRICS	0.2	3.4
Iran	BRICS	0.4	1.6
Saudi Arabia	BRICS	1.0	2.0
UAE	BRICS	0.5	8.0
G7 Total		46.0	52.4
BRICS Total		30.1	73.1

Further, the chart in Figure 1 illustrates the global GDP share in purchasing power parity (PPP) for BRICS and G7 countries (Canada, France, Germany, Italy, Japan, United Kingdom and the United States) from 2000 to 2024. Over this period, the BRICS countries experienced a significant increase in their share of global GDP, rising from 21.37% in 2000 to a projected 35.43% in 2024.

Conversely, the G7 countries saw a decline in their share, dropping from 43.28% in 2000 to an anticipated 29.64% in 2024. This trend reflects the rapid economic expansion within BRICS nations, driven by their large and growing populations. The BRICS group benefits significantly from the inclusion of India and China, the two most populous countries in the world. India and China, with a population of approximately 1.44 billion and 1.43 billion, respectively, as of 2024, represent a substantial demographic advantage. This provides them with an ample workforce and consumer base, fuelling economic growth. Additionally, these nations possess abundant natural resources, contributing to their economic strength (Cochrane & Zaidan, 2024). Moreover, BRICS countries have implemented significant economic reforms and policies to enhance productivity, attract foreign investment, and foster sustainable development. The favourable investment climate is augmented by stable political environments, strategic economic policies, and growing domestic markets that offer lucrative opportunities for both short-term gains and long-term growth (Antony, 2023). These factors make them an attractive choice for investors from all around the globe. The steady rise in foreign capital flows into these nations over the past two decades indicates their increasing global economic power.

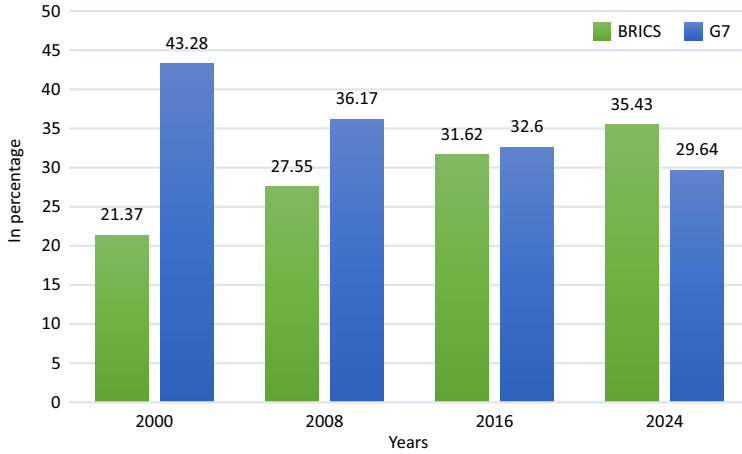

Figure 1. BRICS and G7 global GDP share in purchasing power parity (PPP) from 2000 to 2024 (source: IMF, 2024)

These inflows, irrespective of their scale, play pivotal roles in the comprehensive development and growth trajectories of these countries (Nach & Ncwadi, 2024). The influx of foreign capital not only boosts economic activity but also significantly improves infrastructure, job creation, and overall economic stability (Joshua et al., 2020; Kumari et al., 2023).

This study makes several notable contributions to the existing literature. First, to the best of our knowledge, it is the only study to examine the FDI-TFP nexus in the expanded BRICS group, addressing the unique dynamics and complexities introduced by the new member countries. Second, it explicitly accounts for the heterogeneity among BRICS nations by employing the Method of Moments Quantile Regression (MMQR) with fixed effects, a technique recently introduced by Machado and Silva (2019) that effectively addresses cross-sectional dependence and unobserved heterogeneity. Third, it incorporates wavelet coherence analysis, an innovative approach in the field of economics, to explore short-term and long-term dynamics between FDI inflows and TFP by mapping the patterns of temporal intersections of their relationship.

Further, this research study is organized into six distinct sections. Section 2 provides a comprehensive literature review and establishes the conceptual framework. Section 3 outlines the data and research methodology, describing the data sources and analytical techniques employed in the study. Section 4 presents the results, offering a detailed analysis and discussion of the findings. Finally, Section 5 presents a summary of key insights and offers policy recommendations based on the results, while Section 6 provides the concluding remarks of the study.

2. Literature review

Foreign capital inflows have long been recognised as key drivers of economic growth and development, particularly in emerging economies. One of the primary ways these inflows contribute to growth is through the impact of Total Factor Productivity (TFP), which measures

the efficiency of input utilisation, such as labour and capital (Adnan et al., 2020). These capital transfers facilitate the spread of technology and knowledge from advanced to developing nations, allowing domestic firms in these economies to adopt cutting-edge practices, driving innovation and improving efficiency (Liu et al., 2016). As global interconnectedness intensifies, the flow of capital across borders has accelerated, further enabling these transfers. However, the relationship between international investments and TFP is influenced by several macro determinants, including exchange rate stability, trade openness, and human capital (Kale & Rath, 2018; Tsamadias et al., 2019; Rehman & Islam, 2023). Additionally, factors such as market size, macroeconomic stability, and quality of institutions play a crucial role in attracting capital inflows (Athari & Adaoglu, 2019; Athari, 2023). These factors enhance the absorptive capacity of host nations, shaping the extent to which productivity improvements can drive capital inflows and contribute to sustained economic growth (Athari, 2023; Ngoc et al., 2024).

Advancing this perspective, Baltabaev (2014) explored the relationship between FDI inflows and Total Factor Productivity (TFP) growth across 49 nations from 1975 to 2008, employing the Generalized Method of Moments (GMM) estimation technique. The study demonstrated a significant positive correlation, revealing that increased FDI stock contributed to higher productivity growth**.** This finding is further supported by Maryam and Jehan (2018), who examined 91 developing nations between 1960 and 2015 using two-step GMM, and Adnan et al. (2020), who studied the Pakistani economy from 1970 to 2018 through the Auto-regressive Distributive Lag (ARDL) model. Both studies confirmed the beneficial impact of FDI on TFP. Moreover, similar conclusions were drawn by Yasin and Sari (2022) in their research on the Indonesian manufacturing sector and Essel (2023), who analysed macro-level data for Ghana. These studies collectively highlight the role of FDI in enhancing technological diffusion and operational efficiency (Akinlo & Adejumo, 2016; Liu et al., 2016).

Demir and Su (2016) further emphasised that FDI plays a more crucial role in improving TFP than other forms of investment. Extending this research, Li and Tanna (2019) analysed the correlation between foreign capital inflows and TFP in 51 developing economies from 1984 to 2010, showing that FDI significantly enhances TFP growth, particularly when human capital and institutional factors are considered. On the other hand, Kale and Rath (2018) observed that in India, FDI inflows contribute to productivity growth primarily in the short term. This suggests that while FDI can initially boost productivity, additional factors are required to sustain long-term gains.

Tsamadias et al. (2019) added to the existing literature by investigating the impact of FDI inflows on TFP in OECD countries from 1995 to 2015. Their findings revealed that human capital and research and development (R&D) have strong, positive impacts on TFP. However, FDI's influence was significant only in non-European countries, indicating that regional dynamics may affect the extent to which FDI boosts productivity. Pietrucha and Żelazny (2020) examined the relationship between FDI and TFP across 41 countries, including members of the OECD and the EU, covering the period from 1995 to 2014. Their findings revealed a positive correlation, demonstrating that FDI inflows significantly boost TFP in these economies. The study also highlighted the crucial role of trade direction, asserting that trade with advanced economies leads to more extensive learning and spillover effects. This suggests that engagement with technologically advanced nations enhances productivity by foster-

ing greater knowledge transfer and innovation. More recently, Rehman and Islam (2023) examined the FDI-TFP nexus in 67 upper and middle-income countries between 1990 and 2019 using the cross-sectional autoregressive distributed lag (CS-ARDL) model. Their findings demonstrated a positive influence of FDI inflows on TFP, along with other macro variables such as human capital, trade openness, and technological advancement. Similarly, Sugiharti et al. (2023) underscored the significant impact of trade, market concentration, and FDI inflows on TFP growth in Indonesia.

In the context of Sri Lanka, Kumari and Tang (2024) noted that FDI inflows were a significant driver of TFP growth between 1980 and 2019. Further, Ngoc et al. (2024) highlighted the importance of absorptive capacity in enhancing the productivity of domestic firms in Vietnam through horizontal and vertical linkages. However, not all studies align with these positive outcomes. Using panel cointegration, Herzer and Donaubauer (2018) found a negative long-term relationship between FDI and TFP in 49 developing economies from 1981 to 2018. They concluded that the adverse effects of FDI on productivity were more pronounced in countries with lower levels of human capital, trade openness, and financial development. Similarly, Asongu et al. (2023) highlighted the contrasting effects of FDI in 25 Sub-Saharan African countries from 1980 to 2014. While FDI contributed positively to GDP growth, it simultaneously exhibited a detrimental influence on TFP, indicating that the benefits of foreign investment were more concentrated on economic output than on improving productivity efficiency.

Contrasting these findings, Ashraf et al. (2016) observed no statistically meaningful relationship between greenfield FDI and TFP across 123 countries from 2003 to 2011. Their results suggest that FDI did not significantly contribute to productivity improvements. Similarly, Ali and Akhtar (2024) identified an insignificant correlation between FDI and TFP in Pakistan, attributing this to declining FDI flows in recent years, worsened due to political uncertainty and unfavourable macroeconomic conditions.

Thus, the current literature reflects diverse findings on the relationship between FDI and TFP. Many studies affirm the positive relationship between FDI and productivity, especially when key macroeconomic variables such as GDP, exchange rate, human capital**,** institutional quality**,** and trade openness are present. These factors enhance the absorptive capacity of countries, allowing them to reap the benefits of foreign investment more effectively. However, other research reveals a more limited or even negative association between FDI inflows and TFP. This is particularly true in regions with weaker absorptive capacities or unstable economic conditions**,** where the expected productivity gains from FDI are either marginal or absent. This divergence in findings highlights that the success of productivity growth in driving FDI inflows is often dependent on the broader economic and institutional context of the host nation.

Despite a substantial body of literature exploring the relationship between FDI inflows and total factor productivity (TFP), significant gaps remain unaddressed. One key limitation is the failure to account for the heterogeneity across individual nations. Most existing studies adopt generalized approaches that overlook country-specific differences, such as institutional quality, economic stability, and absorptive capacity, all of which can significantly influence how incoming FDI depends on productivity growth. This gap is particularly pronounced in emerging economies like BRICS nations, where such heterogeneity plays a critical role. Ad-

ditionally, existing studies often focus on advanced economies and rely on homogeneous panel data methods, which fail to capture the diverse characteristics of emerging nations like those in the expanded BRICS group.

Consequently, following a detailed analysis of prior literature, this study aims to address these gaps by posing the following research questions:

1. How does Total Factor Productivity (TFP) influence FDI inflows in the BRICS countries, considering the heterogeneity across member countries?
2. What are the short-term and long-term dynamics between FDI inflows and TFP in the BRICS countries?

To address these research questions, the following conceptual framework in Figure 2 has been developed. This conceptual framework illustrates the interconnected pathways through which FDI, TFP, and sustainable economic development interact, emphasizing the mediating role of TFP in linking FDI to the overall economic development of a nation.

FDI is hypothesized to enhance TFP through technology transfer, knowledge spillovers, and improved managerial practices, which collectively boost production efficiency in host economies. The extent of this impact, however, depends on the absorptive capacities of the recipient countries, shaped by factors such as exchange rate stability, GDP, human capital, institutional quality, and trade openness. TFP, as a measure of the efficiency with which inputs are converted into outputs, serves as a critical driver of sustainable economic development by facilitating long-term performance improvements without proportional increases in labour or capital inputs. Additionally, the bidirectional relationships depicted in the framework highlight that higher productivity (TFP) can attract additional FDI by increasing a country's competitiveness.

This framework provides a holistic representation of the dynamic relationships under investigation, addressing gaps in the existing literature by focusing on the unique characteristics of BRICS economies and offering a comprehensive understanding of the FDI-TFP nexus.

This study employs a novel methodological framework using the Method of Moments Quantile Regression (MMQR) with fixed effects. This technique is specifically designed to account for unobserved heterogeneity across nations, providing more reliable insights by capturing the unique characteristics of each country and differences across the distribution of the dependent variable. By incorporating annual data from 2012–2022 and control variables

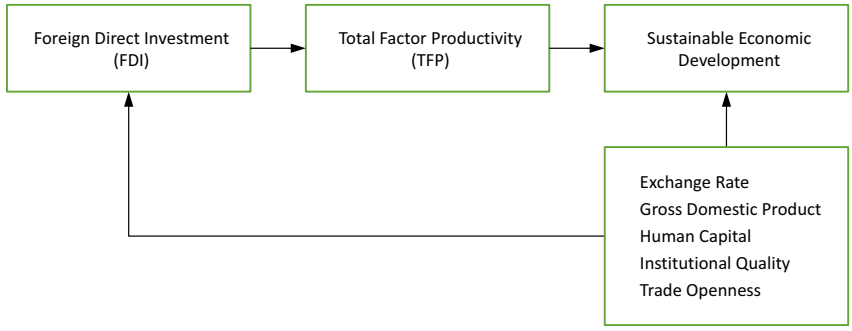

Figure 2. Conceptual framework

such as Exchange Rate (EXR), Gross Domestic Product (GDP), Trade Openness (TO), Human Capital (HC), and Institutional Quality (INSQ), the analysis ensures a comprehensive evaluation of the absorptive capacities of the host nations.

Furthermore, the study introduces novelty by employing wavelet coherence analysis. This dynamic approach examines co-movement and causal relationships between FDI and TFP over time and across varying frequencies, offering a nuanced understanding of their interaction across different time horizons. By mapping the impact of FDI inflows on TFP, the study aims to fill the gaps in the literature and contribute to the broader discourse on economic development in the expanded BRICS group, providing a more detailed and context-specific understanding of the FDI-TFP nexus.

3. Methodological framework

This section provides a detailed explanation of the research methods and analytical tools used to analyse the BRICS nations, which include Brazil, Russia, India, China, and South Africa, along with five additional emerging economies: Egypt, Ethiopia, Iran, Saudi Arabia, and the UAE, all of which are part of the extended BRICS framework.

3.1. Data

The study utilised a balanced panel dataset from 2012 to 2022. The choice of this time frame was driven by the absence of data before 2012 for certain countries, such as Ethiopia. These variables were selected based on existing literature to ensure they effectively capture the key economic, social, and political factors influencing BRICS nations. The data was obtained from reliable secondary sources, including the World Bank, the Organisation for Economic Co-operation and Development (OECD), and the United Nations Conference on Trade and Development (UNCTAD), ensuring consistency and accuracy throughout the analysis. The variables included in the study reflect the distinguished characteristics of the BRICS economies incorporating macroeconomic and structural factors.

Gross Domestic Product (*GDP*) *and Exchange Rate* (*EXR*): These indicators capture economic size and currency stability, both critical for understanding FDI attractiveness in BRICS economies, where financial volatility differs significantly.

Human Capital Index (*HC*): The skill level and education of the workforce determine how effectively FDI-driven technological and managerial knowledge is absorbed.

Institutional Quality Index (*INSQ*): The BRICS group has diverse governance structures and institutional quality (INSQ). Unlike more homogenous economic blocs, BRICS comprises countries with varied political systems, regulatory environments, and levels of institutional development. Institutional quality is particularly relevant because governance strength, policy stability, and regulatory frameworks play a crucial role in shaping FDI inflows.

Trade Openness Index (*TO*): Since BRICS members vary in trade policies, this factor reflects the degree to which external economic engagement influences FDI inflows and economic integration.

Total Factor Productivity (*TFP*): TFP serves as a measure of innovation and efficiency gains, crucial for assessing the long-term impact of FDI inflows in BRICS countries.

All the variables used in the study, and their respective sources, are listed in Table 2. Additionally, the given variables have been transformed into their logarithmic form to normalize the panel dataset and address the issue of heteroscedasticity. This will help in enhancing the reliability and accuracy of the findings, allowing for more accurate comparisons for BRICS nations.

Table 2. List of variables and their definitions

Indicators	Database	Definition
Exchange Rate (EXR)	OECD (n.d.)	Annual average of monthly local currency units relative to the US dollar.
Foreign Direct Investment (FDI)	World Bank (n.d.)	Total volume of FDI inflows received by a country in one year measured in USD millions.
Gross Domestic Product (GDP)	OECD (n.d.)	Sum total of a nation's overall economic output measured at 2015 constant prices in USD millions.
Human Capital Index (HC)	UNCTAD (n.d.)	Measure of skills, education status, and health condition of the population.
Institutional Quality Index (INSQ)	UNCTAD (n.d.)	Measure of institutional efficiency including political stability, government effectiveness, and safeguards against terrorism, corruption, and criminality.
Trade Openness Index (TO)	World Bank (n.d.)	Measure of country's total trade (exports + imports) to its GDP.
Total Factor Productivity (TFP)	World Bank (n.d.)	Measure of technological efficiency within the population.

3.2. Research methodology

3.2.1. Method of Moments Quantile Regression (MM-QR)

The Method of Moments Quantile Regression (MM-QR) with fixed effects combines the robustness of quantile regression with the ability to control for unobserved heterogeneity across panel data. This approach is helpful in capturing the impact of covariates at different points of the conditional distribution of the dependent variable while also accounting for individual-specific effects.

Mathematical model: Consider a panel dataset with $i = 1,...,N$ individuals (here, BRICS countries) and $t = 1,...,T$ time periods. The dependent variable y_{it} represents the log of FDI for country i at time t. The independent variables x_{it} include the logs of Exchange Rate (EXR), Gross Domestic Product (GDP), Human Capital (HC), Institutional Quality (INSQ), Trade Openness (TO), and Total Factor Productivity (TFP).

The quantile regression model with fixed effects can be specified as:

$$Q_{yit}(\tau \mid x_{it}, \alpha_i) = x'_{it}\beta\ (\tau) + \alpha_i, \quad (1)$$

where, y_{it} is the dependent variable for individual i at time t. Q_{yit} $(\tau|x_{it}, \alpha_i)$ represents the conditional τ^{th} quantile of y_{it} given the covariates x_{it} and the fixed effect α_i. x_{it} is a vector of covariates for individual i at time t. β (τ) is a vector of quantile-specific coefficients. α_i is the fixed effect for individual i.

Fixed effects transformation: To eliminate the fixed effects α_i, we use the within-transformation:

$$\tilde{y}_{it} = y_{it} - \overline{y}_{it}; \tag{2}$$

$$\tilde{x}_{it} = x_{it} - \overline{x}_{it}, \tag{3}$$

where $\overline{y}_{it}$ and $\overline{x}_{it}$ are the individual-specific means of y_{it} and x_{it} over time.

The transformed model is:

$$Q_{\tilde{y}it}(\tau \mid \tilde{x}_{it}) = x'_{it}\beta(\tau). \tag{4}$$

The subsequent model for the study is formulated as:

$$Q_{\tilde{y}it}(\tau \mid \tilde{x}_{it}) = \beta_0(\tau) + \beta_1(\tau)\ln(\mathrm{EXR}_{it}) + \beta_2(\tau)\ln(\mathrm{GDP}_{it}) + \beta_3(\tau)\ln(\mathrm{HC}_{it}) + \beta_4(\tau)\ln(\mathrm{INSQ}_{it}) + \beta_5(\tau)\ln(\mathrm{TO}_{it}) + \beta_6(\tau)\ln(\mathrm{TFP}_{it}). \tag{5}$$

Method of Moments: The method of moments approach for quantile regression involves solving moment conditions derived from the quantile regression objective function. For the τ^{th} quantile, the objective function is:

$$\min_{\beta(\tau)} = \sum_{i=1}^{N}\sum_{t=1}^{T}\tau(\tilde{y}_{it} - \overline{x}'_{it}\beta(\tau)), \tag{6}$$

where $\rho_\tau(u) = u(\tau - 1_{\{u<0\}})$ is the check function for quantile τ.

The moment conditions for quantile regression are derived from the first-order conditions of this objective function. Let $z_{it} = \tilde{y}_{it} - \overline{x}'_{it}\beta(\tau)$. The moment conditions are:

$$\mathrm{E}\left[\psi\tau(z_{it})\tilde{x}_{it}\right] = 0, \tag{7}$$

where $\psi\tau(z_{it}) = \tau - 1\{z_{it} < 0\}$.

To apply the given statistical methodology, the study first examines the panel data for BRICS countries from 2012–2022 with the help of various preliminary tests. With the results indicating non-normality, stationarity, and slope heterogeneity, the study proceeds with the Method of Moments Quantile Regression (MM-QR) with fixed effects.

While MMQR is a robust method that effectively accounts for heterogeneity and cross-sectional dependence, the presence of outliers can impact MMQR estimates. Although quantile regression is generally more robust to outliers than the mean-based estimation techniques, extreme values can still exert influence, particularly in the tails of the distribution. Additionally, MMQR is sensitive to the choice of quantiles. The selection of quantiles can significantly influence the results, and different quantiles may yield varying interpretations. To mitigate these limitations, we have presented the results at five different quantiles (e.g., 10th, 25th, 50th, 75th, and 90th percentiles), ensuring a more comprehensive understanding of distributional effects and enhancing the robustness of our findings.

3.2.2. Wavelet coherence analysis

Wavelet coherence analysis is used in this study to examine correlation and causality between variables by decomposing them into time-frequency space. Coherence measures the degree of association or correlation between two variables over time and frequency. Unlike simple correlation, which captures the linear relationship at a specific time point, time-frequency

analysis like wavelet coherence identifies periods of significant association and phase relationships, which can suggest potential causality (Athari et al., 2021). This method is particularly useful for understanding how two variables align or lead each other over varying time scales. This method is particularly effective for identifying periods of significant coherence and phase relationships, providing insights into how two variables interact over time and across different frequency bands. This technique is based on the foundational work of Goupillaud et al. (1984) and has been further refined in the fields of economics and finance by Pal and Mitra (2017), Kalmaz and Kirikkaleli (2019), and Adebayo (2020).

Mathematically, the wavelet coherence between two variables x_t and y_t can be described as follows:

Wavelet Transform: The continuous wavelet transform (CWT) of x_t with respect to a wavelet function $\psi(t)$ is given by:

$$W_x(a,b) = \int_{-\infty}^{\infty} x(t)\psi^*\left(\frac{t-b}{a}\right)dt, \tag{8}$$

where a and b represent the scale and translation parameters, respectively, and ψ^* (t) is the complex conjugate of the mother wavelet ψ (t).

Cross-Wavelet Transform: The cross-wavelet transform of x_t and y_t is defined as:

$$W_{xy}(a, b) = W_x(a, b)\, W_y^*(a, b), \tag{9}$$

where $W_y^*(a, b)$ is the complex conjugate of the wavelet transform of y_t.

Wavelet Coherence: The wavelet coherence measure is then computed as:

$$R_{xy}^2(a,b) = \frac{\left|S\left\{W_{xy}(a,b)\right\}\right|^2}{S\left\{\left|W_x(a,b)\right|^2\right\}\cdot S\left\{\left|W_y(a,b)\right|^2\right\}}, \tag{10}$$

where S{·} denotes a smoothing operator in both time and scale. The wavelet coherence R_{xy}^2 (a, b) ranges between 0 and 1, with values close to 1 indicating a strong local correlation.

Phase Difference: The phase difference between the two-time series at scale a and time b is given by the argument of the cross-wavelet transform:

$$\phi_{xy}(a,b) = \tan^{-1}\left(\frac{\Im\left\{W_{xy}(a,b)\right\}}{\Re\left\{W_{xy}(a,b)\right\}}\right), \tag{11}$$

where $\Im\{\cdot\}$ and $\Re\{\cdot\}$ denote the imaginary and real parts, respectively. The phase difference provides insights into the lead-lag relationship between the series, with arrows pointing right indicating in-phase movement and arrows pointing left indicating anti-phase movement.

4. Empirical analysis and findings

This section presents the empirical analysis and results of the study, focusing on the relationship between FDI inflows and TFP, along with other macro determinants in BRICS nations. The Method of Moments Quantile Regression (MM-QR) with fixed effects has been employed to address the heterogeneity and non-linearity in the data. This method provides robust insights into the determinants of FDI across different distribution quantiles. Following the quantile

regression analysis, wavelet coherence analysis has been conducted to explore the dynamic relationships between the key determinants and FDI over time, offering a detailed examination of how these relationships evolve across different time frequencies. The econometric modelling strategy for empirical investigation is also depicted in Figure 3.

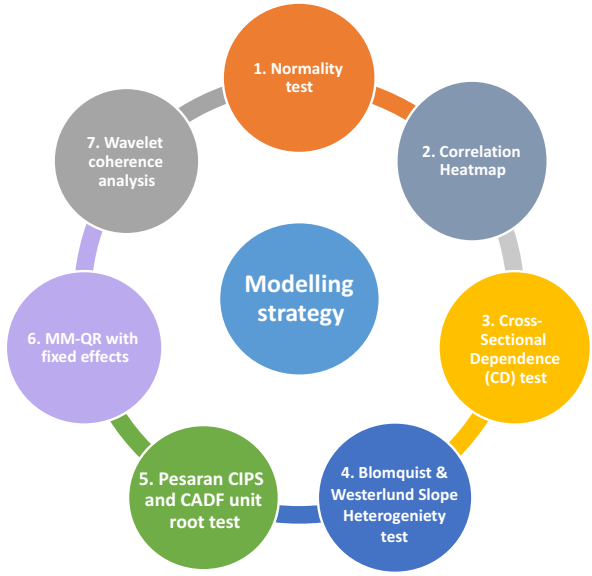

Figure 3. Econometric modelling strategy (source: compiled by the author)

4.1. Summary statistics

The summary statistics for the variables in Table 3 indicate a range of variability. The mean values of the logarithmic transformations of FDI, EXR, GDP, HC, INSQ, TO, and TFP are provided alongside their respective standard deviations, revealing the degree of dispersion.

Table 3. Summary statistics (source: author's computation)

Variables	lnFDI	lnEXR	lnGDP	lnHC	lnINSQ	lnTO	lnTFP
Mean	23.33372	3.254859	27.37423	3.812110	3.831132	3.875630	4.225229
Median	22.97694	2.630069	27.01465	3.859676	3.881805	3.799312	2.587338
Maximum	26.56413	10.64542	30.42372	4.157973	4.268718	5.195718	26.02132
Minimum	19.44515	0.669402	24.59421	3.178054	3.303585	3.110649	0.873333
Observations	110	110	110	110	110	110	110
Std. Dev.	1.533999	2.597861	1.336710	0.242721	0.239333	0.511007	5.619531
Skewness	0.245418	1.913120	0.385529	–1.097126	–0.040095	1.224592	2.727750
Kurtosis	2.320849	5.817023	3.083466	3.533567	2.376722	4.308003	9.147101
Jarqe-Bera	3.218260	103.4721	2.756867	23.37240	1.809987	35.33464	309.6011
Probability	0.200062	0.000000	0.251973	0.000008	0.404545	0.000000	0.000000
Sum	2566.709	358.0345	3011.166	419.3321	421.4245	426.3193	464.7752

Notably, EXR exhibits the highest skewness and kurtosis, indicating significant departures from normality, which is confirmed by the Jarque-Bera test results showing statistical significance for EXR, HC, TO, and TFP at a 5% significance level. This highlights potential non-normal distributions and the presence of outliers in these variables.

4.2. Normality test

The histogram of standardized residuals in Figure 4 illustrates a significant departure from normality, corroborated by the summary statistics in Table 3. The negative skewness and elevated kurtosis indicate a leftward skew and leptokurtic distribution, respectively. The Jarque-Bera test statistic further confirms non-normality with a statistically significant p-value at a 5% significance level, reinforcing the presence of outliers and deviations from a Gaussian distribution in the panel data. These results necessitate the use of quantile regression to robustly estimate the relationships between variables across different points of the conditional distribution.

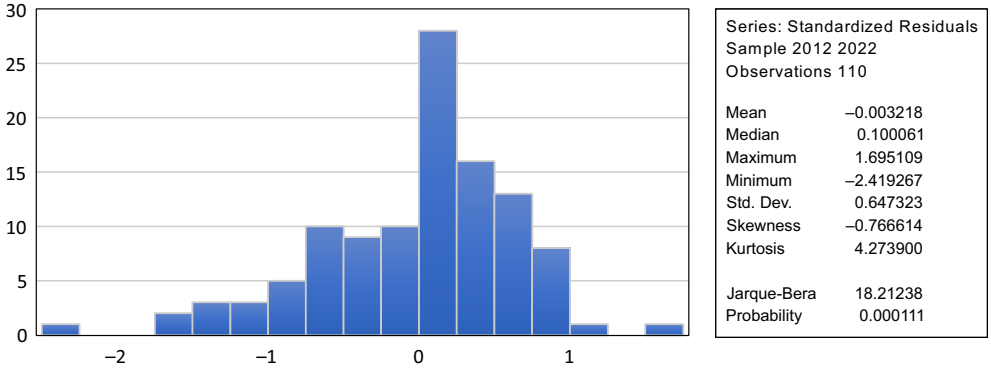

Figure 4. Normality test (source: author's computation)

4.3. Correlation heatmap and Variance Inflation Factor (VIF)

The correlation heatmap in Figure 5 illustrates the pairwise correlations among the given variables. The varying shades of blue represent the strength and direction of the correlations, with darker shades indicating stronger correlations. High positive correlations are observed between FDI and GDP (0.8671), FDI and TFP (0.5948), and GDP and lnHC (0.6518), indicating a strong linear relationship among these variables.

However, the Variance Inflation Factor (VIF) values for the given variables presented in Table 4 are below the critical threshold of 10 (Wooldridge, 2010). This suggests the absence of multicollinearity in the given panel data.

With an average VIF of 2.643889, the predictors exhibit a low degree of linear dependence, affirming that the correlations are not strong enough to affect the reliability of the regression results. The corresponding 1/VIF values further affirm the lack of significant multicollinearity issues.

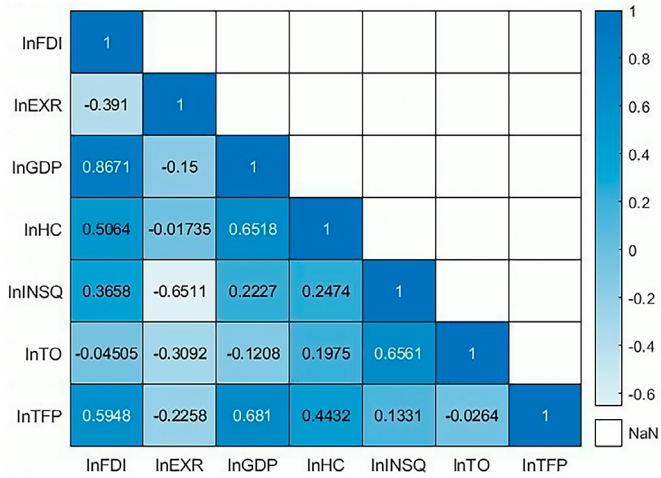

Figure 5. Heatmap of pairwise correlations (source: author's computation)

Table 4. VIF and 1/VIF results (source: author's computation)

Variables	VIF	1/VIF
lnEXR	2.052119	0.487301
lnGDP	3.510414	0.284866
lnHC	2.159644	0.463039
lnINSQ	3.572949	0.279880
lnTO	2.502341	0.399625
lnTFP	2.065872	0.484056
Mean VIF	2.643889	

4.4. Cross-sectional dependency (CD) and slope heterogeneity test

The cross-sectional dependency (CD) test results in Table 5 indicate significant cross-sectional dependence in the given data for BRICS nations. The Breusch-Pagan LM test, suitable for cases where $N < T$, rejects the null hypothesis of no cross-sectional dependence with a p-value of 0.0017. Similarly, the Pesaran scaled LM test also rejects the null hypothesis with a p-value of 0.0005. In contrast, the Pesaran CD test does not find significant evidence of cross-sectional dependence with a p-value of 0.1863. Given the existence of cross-sectional dependence, second-generation panel unit root tests are recommended. Further, the slope heterogeneity test (Blomquist & Westerlund, 2013) evaluates the null hypothesis H_0, that slope coefficients are homogeneous, against the alternative hypothesis H_a, that slope coefficients are heterogeneous. The results in Table 5, with Δ (delta) and adjusted Δ (delta) statistics yielding p-values of 0.000, strongly reject the H_0 at a 5% level of significance. This suggests that there are substantial differences in the slope coefficients across the panels, warranting the use of the method of moments quantile regression (MM-QR) with fixed effects that account for this heterogeneity.

Table 5. Cross sectional dependence (CD) and slope heterogeneity test results (source: author's computation)

Test Type	Test	Statistic	P-value
Cross-sectional dependence (CD)	Breusch-Pagan LM	77.96335	0.0017
	Pesaran scaled LM	3.474642	0.0005
	Pesaran CD	–1.321456	0.1863
Slope heterogeneity	Δ	8.848	0.0000
	$\Delta_{adj.}$	16.942	0.0000

4.5. Second generation panel unit root test

The Pesaran CIPS (Cross-sectional Im, Pesaran and Shin) and CADF (Cross-sectionally Augmented Dickey-Fuller) tests are second-generation panel unit root tests designed to address cross-sectional dependence in panel data. The Pesaran CIPS test extends the Im, Pesaran, and Shin (IPS) test by incorporating cross-sectional dependence into the unit root testing framework. It does this by augmenting the standard ADF regression with the cross-sectional averages of lagged levels and the first differences of the individual series. The CIPS statistic is calculated as the mean of the individual CADF statistics across the panel. The null hypothesis for the CIPS test is that all series in the panel contain a unit root (non-stationary), while the alternative hypothesis is that at least one series is stationary.

The Pesaran CADF test is similar to the CIPS test but focuses on augmenting the Dickey-Fuller regression with cross-sectional averages to handle cross-sectional dependence explicitly. The CADF statistic is derived for each cross-sectional unit by including the cross-sectional averages of lagged levels and first differences in the ADF regression. The null hypothesis for the CIPS test is that all series in the panel contain a unit root (non-stationary), while the alternative hypothesis is that at least one series is stationary. The results from the Pesaran CIPS and CADF tests in Table 6 indicate that all variables (lnFDI, lnEXR, lnGDP, lnHC, lnINSQ, lnTO, and lnTFP) reject the null hypothesis of a unit root at 1% and 5% significance level ($p < 0.01$, $p < 0.05$). This suggests that the variables are stationary at the level, implying that they do not contain a unit root.

Table 6. Pesaran CIPS and CADF test results (source: author's computation)

Variables	Level	
	Pesaran CIPS	Pesaran CADF
lnFDI	–2.637**	–2.421**
lnEXR	–3.797***	–3.102***
lnGDP	–3.385***	–3.004***
lnHC	–2.787***	–2.468**
lnINSQ	–3.603***	–3.160***
lnTO	–3.275***	–2.947***
lnTFP	–4.426***	–3.981***

Note: *** $p < 0.01$, **$p < 0.05$, *$p < 0.1$.

4.6. Method of Moments Quantile Regression (MM-QR)

Table 7 presents the results of the Method of Moments Quantile Regression (MM-QR) with fixed effects analysis, examining the effects of various determinants of FDI across different quantiles (0.10, 0.25, 0.50, 0.75, and 0.90). The coefficient of EXR is negative and significant across all quantiles, indicating a consistent inverse relationship with FDI. The magnitude of the effect decreases as we move from the lower quantiles (0.10, 0.25) to higher quantiles (0.75, 0.90), suggesting that the sensitivity of FDI to exchange rate changes diminishes for higher levels of FDI. This indicates that currency depreciation reduces FDI, with the impact being more pronounced in lower quantiles of FDI distribution for BRICS nations. This finding aligns with previous literature indicating that exchange rate volatility can deter investment by increasing uncertainty (Latief & Lefen, 2018; Morina et al., 2020; Warren et al., 2023). Furthermore, the coefficients for GDP are positive and highly significant across all quantiles, signifying a robust positive relationship between GDP and FDI. The impact of GDP on FDI decreases slightly as we move from lower to higher quantiles, reflecting that GDP is a strong driver of FDI at all levels but slightly less impactful at the higher end of FDI distribution. This indicates that higher economic output is a strong attractor of FDI, particularly at lower quantiles, reflecting the importance of market size and economic potential in attracting foreign investment (Sabir et al., 2019; Abdouli & Omri, 2021; Saidi et al., 2023). Similarly, the coefficients for TO are positive and significant across all quantiles, indicating a positive association between trade openness and FDI. This supports the notion that greater trade openness, which facilitates market access and reduces trade barriers, encourages higher levels of FDI (Cantah et al., 2018; Hao, 2023; Kumari et al., 2023). On the other hand, the coefficients for TFP are negative and highly significant across all quantiles, indicating an inverse relationship with FDI. The effect shows a modest reduction in magnitude at the higher quantiles. This means that as we move to higher levels of FDI, the inverse relationship between TFP and FDI becomes slightly weaker, indicating that the strong negative effect observed at lower and median quantiles is somewhat less pronounced at the upper end of the FDI distribution. Previous studies by Herzer and Donaubauer (2018), Li and Tanna (2019), and, more recently, Abdullah and Chowdhury (2020) have reported similar findings. These results suggest that higher productivity levels reduce the need for foreign capital as efficient economies are often better equipped to utilize domestic resources effectively (Liu et al., 2016; Abdullah & Chowdhury, 2020; Chai et al., 2021). Additionally, foreign investors may view highly productive economies as offering limited opportunities for profit maximization or improvement (Herzer & Donaubauer, 2018). High productivity is also frequently associated with intense domestic competition, which can pose significant challenges for market entry by foreign firms (Asongu et al., 2023). Consequently, FDI tends to gravitate toward less productive economies, where the potential for gains through technology transfer and efficiency improvements is comparatively higher (Han et al., 2024).

In contrast, the coefficients for HC are positive but not statistically significant at any quantile, indicating that human capital does not significantly impact on FDI inflows within the given quantiles. The findings align with earlier research from Cleeve et al. (2015), Kaulihowa and Adjasi (2019), Fagbemi and Osinubi (2020), as well as more recent work of Hammed and Ademosu (2023).

Table 7. MM-QR with fixed effects results (source: author's computation)

Variables	Quantiles				
	0.10	0.25	0.50	0.75	0.90
lnEXR	–0.906713* (0.482896)	–0.844223** (0.358720)	–0.740655*** (0.215106)	–0.665020*** (0.2370041)	–0.604803* (0.325431)
lnGDP	4.009186*** (1.285783)	3.651032*** (0.946795)	3.057437*** (0.569375)	2.623941*** (0.629199)	2.278816*** (0.857393)
lnHC	1.453965 (3.109039)	1.704681 (2.31364)	2.120211 (1.386622)	2.423668 (1.527040)	2.665263 (2.099926)
lnINSQ	–2.094118 (2.237483)	–1.844384 (1.663166)	–1.430481 (0.997039)	–1.128213 (1.098322)	–0.887563 (1.509328)
lnTO	1.389340* (0.759760)	1.329316** (0.565249)	1.229834*** (0.338751)	1.157183*** (0.373052)	1.099342** (0.513093)
lnTFP	–0.240405*** (0.078909)	–0.213650*** (0.057813)	–0.169307*** (0.034766)	–0.136924*** (0.038500)	–0.111142** (0.052552)

Note: Standard errors in brackets. *** p < 0.01, **p < 0.05, *p < 0.1.

Likewise, the coefficients for INSQ are negative across all quantiles but not statistically significant, suggesting that institutional quality does not have a significant impact on FDI within the specified quantiles. Previous studies by Peres et al. (2018) and Hamouda (2023) have also reached similar conclusions. This may be attributed to institutional arbitrage, where firms exploit weaker institutional standards in foreign countries to reduce costs (Tang, 2021; Fani et al., 2023). This is particularly relevant for multinational corporations (MNCs), which may strategically relocate operations to countries with less stringent regulations to benefit from lower operational costs and higher profit margins (Hurst & Sutherland, 2024). Consequently, countries with weaker institutional frameworks may experience increased FDI inflows (Peres et al., 2018). These findings also suggest that while human capital and institutional quality are essential for attracting FDI, their impact may be overshadowed by more immediate economic indicators like GDP and trade openness, which directly reflect market potential and accessibility in BRICS countries (Maryam & Mittal, 2020; Kechagia & Metaxas, 2022).

The graphical representation of the MM-QR results with fixed effects in Figure 6 visually reinforces these findings. The blue lines represent the quantile regression coefficients, and the shaded areas denote the confidence intervals. The descending slope for EXR indicates a consistently negative effect, with more variability at the extremes. GDP and TO show a strong positive influence, which is particularly stable around the median. HC and INSQ exhibit negligible impacts, as suggested by their flat slopes and wide confidence intervals. Lastly, TFP maintains a negative relationship with FDI, with confidence intervals widening at the extreme ends.

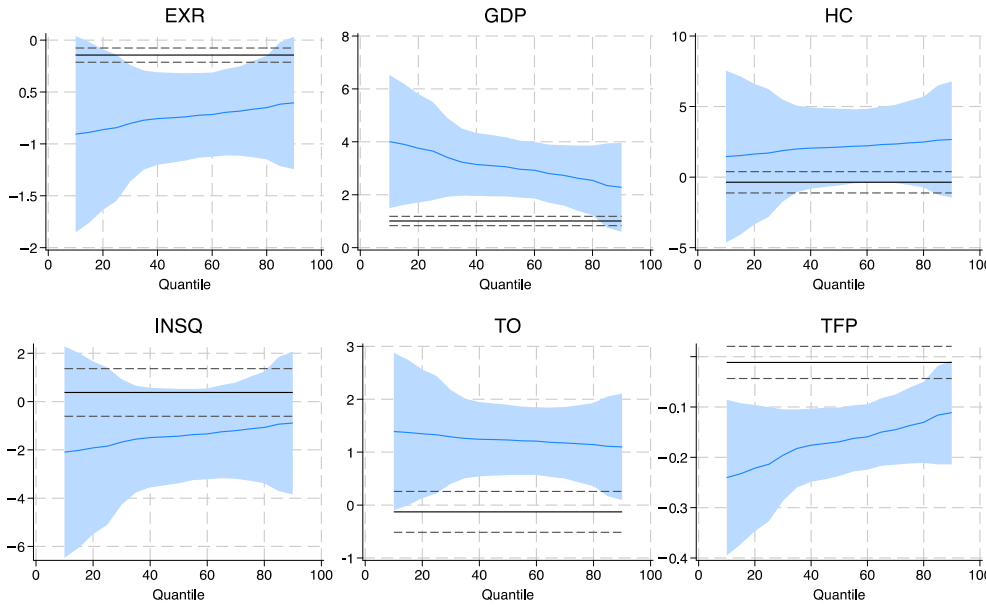

Figure 6. Graphical representation of MM-QR results with fixed effects (source: author's computation)

4.7. Wavelet coherence analysis

Wavelet coherence analysis allows for the examination of the correlation and causality between FDI and its determinants, capturing both the time and frequency dimensions for BRICS nations. The results of WTC are displayed in contour plots in Figure 7, with time (or period) on the x-axis and frequency (or scale) on the y-axis. Each subplot represents the coherence between FDI and one of the economic indicators from 2012 to 2022. The level of significance is denoted by a thick black contour derived through Monte Carlo simulations, ensuring the robustness of the findings. The arrows within the grey area of the plot, known as the cone of influence, indicate the phase relationship between the two variables (Kirikkaleli & Athari, 2020). Rightward arrows show that the variables move in phase (positively correlated), while leftward arrows indicate an anti-phase relationship (negatively correlated). The plot typically uses a colour scale to represent the strength of the correlation, with warm colours (like red) indicating high correlation and cold colours (like blue) indicating low or no correlation (Athari & Hung, 2022).

In the WTC plot for FDI with Exchange rate (EXR), a negative, out-of-phase relationship is observed around 2014–2015, indicated by the leftward and downward arrows in the short-term (4–8 weeks). This suggests that changes in EXR lead to opposite changes in FDI. In the medium term (8–16 weeks), the relationship shifts to a mix of negative and positive associations, with some periods showing a positive influence of EXR on FDI around 2018–2020.

In contrast, the WTC plot for FDI with GDP shows a positive correlation in the short term (4–8 weeks), with rightward arrows indicating an in-phase relationship during 2016–2018, where FDI and GDP moved together. The downward arrows suggest that GDP led FDI during this period. From 2020–2022, rightward and upward arrows in the medium-term (8–16 weeks)

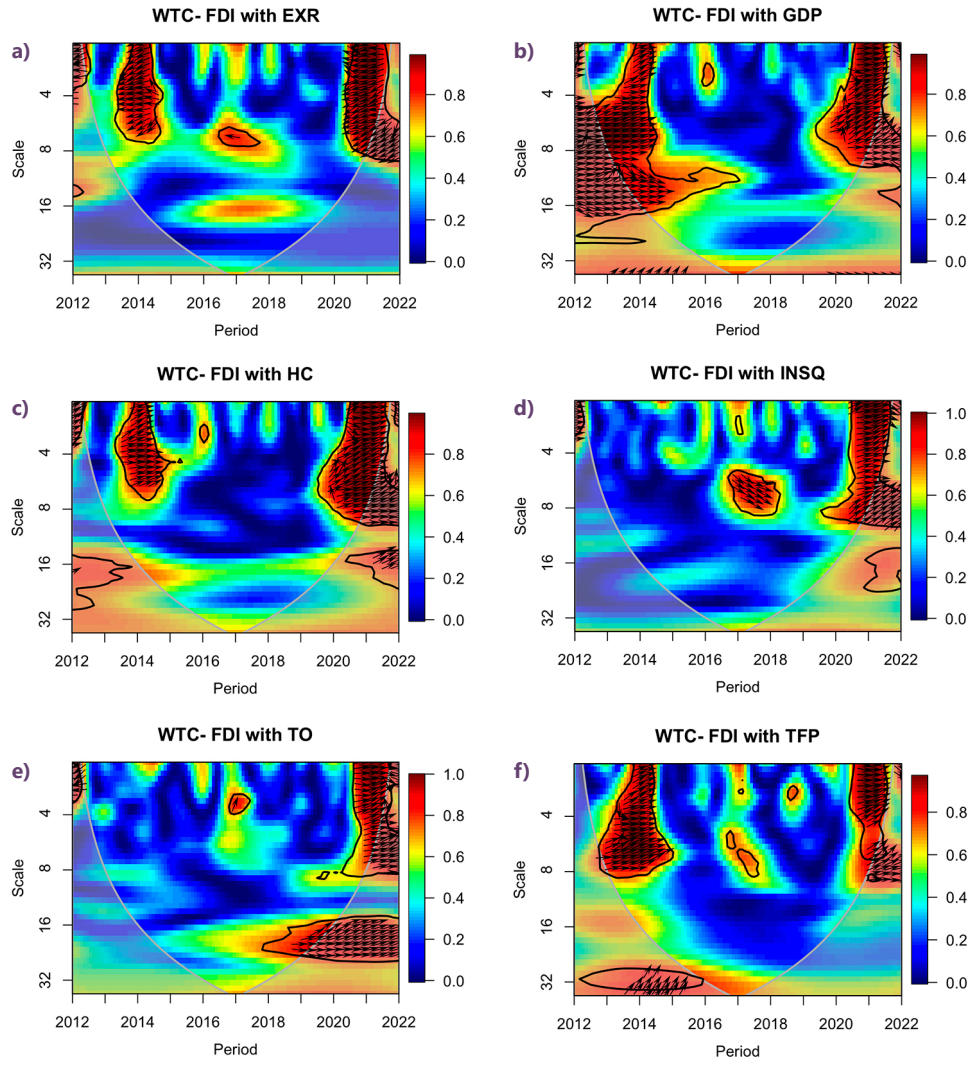

Figure 7. Wavelet transform coherence (WTC) plots (source: author's computation)

frequency band indicate that FDI led GDP, highlighting a shift where changes in FDI influenced GDP. Long-term coherence (16–32 weeks) is weaker for both EXR and GDP, but GDP shows a more stable positive influence compared to the variable and limited impact of EXR.

The WTC plot for FDI with Human Capital (HC) displays significant coherence in the short term (4–8 weeks) around 2014–2016, with rightward arrows indicating a positive, in-phase relationship, suggesting that changes in HC positively influence FDI. This relationship continues in the medium term (8–16 weeks), although less pronounced. Similarly, the WTC plot for FDI with Institutional Quality (INSQ) reveals notable coherence in the short term (4–8 weeks) and medium term during 2015–2017, with rightward arrows indicating a positive relationship. The rightward arrows suggest that INSQ led FDI. Further, the WTC plot for FDI

with Trade Openness (TO) shows strong short-term coherence (4–8 weeks) around 2013–2016, with rightward arrows indicating a positive, in-phase relationship. This suggests that increases in TO are associated with increases in FDI. The medium-term coherence (8–16 weeks) remains positive but less strong. The final plot shows the coherence between FDI and Total Factor Productivity (TFP). Significant coherence regions are evident in the short term (4–8 weeks) around 2013–2015, with down arrows indicating that TFP caused FDI. Overall, long-term coherence (16–32 weeks) is generally weaker across all these variables, with GDP and TFP showing a slightly more stable impact compared to the limited influence of other variables: EXR, HC, INSQ, and TO. These findings highlight the varying impacts of different economic indicators on FDI across different periods.

5. Summary and policy recommendations

The primary objective of this paper is to examine the effects of total factor productivity (TFP) on FDI inflows in BRICS economies. The term BRICS includes the original founding nations, namely Brazil, Russia, India, China, and South Africa, along with the newly added member countries: Egypt, Ethiopia, Iran, Saudi Arabia, and the UAE. The expansion of BRICS has significantly boosted its global influence and economic reach, representing approximately 45% of the world's population and contributing 28% to the global economy. This growth highlights the increasingly significant role of BRICS in global economic dynamics. It stresses the necessity of examining how productivity improvements contribute to FDI inflows in these nations. The study used annual data from 2012 to 2022 to achieve this objective, sourced from multiple secondary databases. Previous research has often overlooked the country-specific differences that can significantly affect how productivity growth influences inward FDI. To address this gap, this study introduced a methodological innovation by applying the Method of Moments Quantile Regression (MM-QR) with fixed effects for BRICS nations. This technique allows for the control of unobserved heterogeneity across individual nations, ensuring that the analysis captures the unique characteristics of each country at different points of distribution. The study added novelty by using wavelet coherence analysis to examine the co-movement and causality between key macroeconomic variables at different frequencies. This approach provides a nuanced understanding of how TFP impacts FDI across varying time periods. The findings revealed a positive and significant relationship between FDI inflows and both GDP and Trade Openness (TO). In contrast, while a negative relationship was observed with the Exchange Rate (EXR) and Total Factor Productivity (TFP). Moreover, FDI inflows showed no significant association with Human Capital (HC) or Institutional Quality (INSQ) across all quantiles. Additionally, the wavelet coherence analysis indicated that long-term coherence (16–32 weeks) was generally weaker for most macroeconomic variables. Among them, GDP and TFP displayed a relatively stable impact. At the same time, the influence of EXR, HC, INSQ, and TO on FDI inflows in BRICS nations remained limited.

The findings of this study offer important theoretical and practical implications for policymakers, investors, and researchers examining the FDI-TFP nexus. The study challenges the conventional assumption that higher productivity automatically attracts FDI inflows, as the results indicate a negative relationship between FDI and total factor productivity. This suggests that foreign investors may not necessarily target highly productive economies but

instead seek markets where they can achieve higher returns due to lower initial productivity levels. This finding highlights the need for a more in-depth understanding of how productivity influences investment decisions. This also calls for further investigation into the role of sector-specific productivity differences in shaping FDI patterns. The positive relationship between FDI and GDP reinforces the idea that larger market size and economic expansion attract foreign investors. At the same time, the strong association with trade openness suggests that economies engaged in global trade networks are more appealing due to reduced trade barriers and enhanced market accessibility. Conversely, the negative link between FDI and exchange rate fluctuations underscores the importance of macroeconomic stability in attracting foreign investment, as currency volatility increases uncertainty and deters long-term capital inflows. Interestingly, the study finds an insignificant relationship between FDI and both human capital and institutional quality, indicating that these factors may not be primary determinants of FDI in BRICS economies, though they remain crucial in the long run for sustainable investment growth.

From a policy standpoint, these findings emphasize the importance of maintaining a stable macroeconomic environment to attract and sustain FDI inflows. Governments should focus on ensuring exchange rate stability through sound monetary policies to minimize uncertainty for investors. Additionally, enhancing trade openness by reducing tariffs, eliminating non-tariff barriers, and actively engaging in global trade agreements can create a more favourable investment climate. As GDP growth is positively linked to FDI, policies promoting industrial expansion, infrastructure development, and economic diversification will indirectly encourage foreign investment. Despite the insignificant impact of human capital and institutional quality in the current analysis, policymakers should not overlook these aspects. Strengthening governance frameworks to improve policy consistency, transparency, and investor confidence can enhance long-term investment attractiveness. Similarly, investing in targeted education and skill development programs aligned with industry demands can create a more competitive workforce that meets the evolving needs of foreign firms.

For investors, the results suggest that market size and trade openness are critical factors when selecting investment destinations. Foreign investors should focus on economies with strong domestic demand and favourable trade policies facilitating cross-border operations. Given the negative impact of exchange rate fluctuations, multinational corporations and institutional investors should incorporate currency risk assessments into their decision-making processes and adopt hedging strategies to mitigate potential losses. While the study finds human capital and institutional quality to be insignificant predictors of FDI, firms operating in knowledge-intensive industries should still consider the long-term benefits of skilled labour and stable regulatory environments when making investment decisions.

These findings also open avenues for future research. Further studies could explore the sectoral variations in the FDI-TFP relationship to determine whether certain industries are more sensitive to productivity levels. Additionally, examining the role of total capital inflows, such as portfolio investments and remittances, could offer a more comprehensive understanding of capital mobility in emerging economies. By integrating these theoretical insights and policy recommendations, BRICS nations can refine their strategies to attract sustainable FDI, while investors can make informed decisions that align with macroeconomic conditions and market dynamics.

6. Conclusions

This study offers new empirical insights into the dynamics of FDI-TFP nexus within the contexts of expanded BRICS group. The results challenge the traditional assumptions in the literature, particularly the expectation that higher productivity levels necessarily attract greater FDI inflows. Instead, the findings suggest that foreign investors may prefer economies with lower productivity where they perceive higher returns on investment. These insights are particularly relevant for emerging economies seeking to balance productivity improvements with strategies to attract sustainable FDI inflows.

Author contributions

AM drafted the manuscript, conducted literature review, collected data, performed analysis and interpreted the results. ANS supervised the project and assisted in the final editing. Both authors have read and agreed to the submitted version of the manuscript.

Disclosure statement

The authors declare no competing interests.

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