Impact of Trade Openness on Selected Macroeconomic Variables: An Empirical Investigation in BRICS Nations

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ABSTRACT

Trade openness is a critical aspect of a country's macroeconomic performance, as it can impact a wide range of economic variables, including output, investment, inflation, and trade balance. While the rising adaptation of trade openness policies led to overall growth in developing countries, the researchers have also raised concerns that it limits a country's ability to pursue more strategic and sustainable forms of economic development. As a result, there has been a growing interest among researchers to study the implications of trade openness for macroeconomic outcomes to promote economic development while ensuring that trade benefits are shared broadly and sustainably especially in developing countries like BRICS. With one-fourth of global growth and one-third of global energy consumption, the BRICS countries are contributing highly toward global growth as well as environmental degradation. Based on the above mentioned, this thesis focuses on analyzing the impact of trade openness on inflation, poverty reduction, economic growth, and carbon emissions in BRICS. The theoretical and empirical scope of these aspects has been provided in four chapters. The analyses are based on the panel data empirical strategies based on the assumption of whether the panels are cross-sectionally independent or dependent. The analysis period for the study is based on the availability of the data

The first empirical chapter is entitled “Trade Openness and Inflation.” Under the umbrella of this chapter, the study examined the impact of trade openness on inflation by considering the indirect effect of the output-inflation trade-off. The study uses the quarterly panel data from 1999Q1 to 2018Q4 for the detailed analysis of trade openness and output gap effects on inflation. The study constructs an output gap estimator using the Hodrick-Prescott filter on the real GDP data to calculate the output gap. The estimate suggested that higher dependence on imports from foreign countries increases the price vulnerability. In contrast, a higher inclination to foreign exports tries to reduce CPI pressures by a higher degree than imports. Justifying with these empirics and the net effect of trade, the estimates reflect that the group may experience 64 percent lower inflationary pressures with the impact of overall trade openness. The results highlighted that with the effect of export openness alone, the foreign output gap is increasing the price sensitivity to 8.55 percent as compared to import and overall trade openness to 5.62 and 5.69 percent. The study found that the domestic output gap has a

meager impact of 0.18 percent and 0.60 percent, with overall trade and export openness, to lower the prices. In addition, the results reveal that expansionary fiscal policy is a boon to prices, whereas expansionary monetary policy is a bane and creates rising inflationary pressures. The study also found that a depreciating exchange rate will increase the economic burden in terms of higher prices. The findings provide an insight that, to control inflationary pressures in BRICS, it is essential to examine trade openness and the output gap between domestic and foreign production. This provides us with significant policy implications to mitigate the adverse economic effects of the foreign output gap and import openness over inflation.

The second empirical chapter is entitled "Trade Openness, Poverty and Institutions." In this chapter, the study tries to examine the impact of trade openness on poverty reduction while taking BRICS' institutional framework into account. In relevance to the presence of CSD (CSD), the study has applied a state-of-art DCCE technique using yearly panel data for 28 years from 1991 to 2019. In addition, to quantitatively measure the institutional framework, the study devised an institutional quality index using principal component analysis (PCA). The results suggested that trade openness increases the per capita household consumption expenditure, which in turn raises the purchasing power of the poor and thus reduces poverty. Along the same line, the results revealed that GDP per capita also acts as poverty reducing agent in BRICS. However, the results demonstrate that the institutional qualities of these countries are not congruent with benefits to the poor, which slows the rate of poverty reduction. In addition, the study found that slower poverty reduction progress is also associated with rising income inequality in BRICS nations. This suggests policy formulation to strengthen the governing institutional quality and reduce income inequality to directly address poverty in these countries.

The third empirical chapter is entitled "Trade Openness, Institutional Quality, and Economic Growth." This chapter contributes to the literature by investigating the long-run and short-run impact of trade openness and institutional quality on economic growth in BRICS. Additionally, it investigates the country-specific effects of how trade openness and institutional quality play an important role in economic growth. The study uses system GMM and PMG techniques to estimate the long-run and short-run coefficients and the FMOLS method for the country-specific analysis from 1991 to 2019. To represent the variability in the exports and imports for BRICS, the study has taken all three measures of trade openness,

i.e., export, import, and overall trade. The study reveals that institutions negatively impact economic growth by 63 percent. The findings on trade openness, however, provided the contrary. All the trade measures (overall trade, export, and import openness) positively contribute towards economic growth (by 11.17, 13.92, and 8.83 percent). The results reveal that higher trade integration improves institutional quality, and their combined effect can accelerate economic growth. When analyzing the short-run and long-run effects, the findings highlight that the impact of trade openness over time changes and is complementary with the long-run economic growth. In contrast, export and import openness complement economic growth in the short run. In addition, exchange rates, capital stock, and financial development only enhance economic growth in the long run. In addition, it found that Brazil and India experienced delayed economic growth due to a stronger predisposition toward specific sectors of the economy. This extends significant policy implications toward overall trade-specific institutional strengthening to boost economic growth.

The fourth empirical chapter is entitled "Trade Openness, Institutional Quality, and Carbon Emissions." The study intends to uncover the impact of trade openness and institutional quality on carbon emissions using different institutional indices and institutional variables separately. Initially, the study investigates institutional quality's impact on carbon emissions by comparing three indices, i.e., an overall institutional quality index, political stability index, and political efficiency index. The study also conducts a separate analysis for each governance indicator to identify the effects of institutions with more transparency. The study applies the DCCE method to overcome the issues of CSD, heterogeneity, and endogeneity using panel data from 1991 to 2019. The results confirm the pollution haven hypothesis, where trade openness posits an environment-degrading effect. Moreover, it found that political stability and efficiency provide a base for effective policy implementation to improve the environmental quality and reduce carbon emissions in BRICS. With respect to the effect of resources, the results disclose that the consumption of non-renewable resources, especially the consumption of fossil fuel, has an overpowering negative impact over the positive effects of renewable energy consumption on carbon emissions. However, when combined with higher political stability and efficiency, the study confirms increased renewable energy consumption among BRICS. Among many institutional quality variables, the study found government stability and bureaucratic control are pro-environment aspects, whereas corruption and weak law and order depict environment-degrading behavior. Thus, it implies that institutions play a vital role in reducing carbon emissions as well, where other

than stability and efficiency, other institutional aspects are to be focused on for the policy implementations that may provide strong institutions promoting the consumption of renewable energy sources to reduce carbon emissions.

As a result, the broader policy implications urge to pay special attention to imports to reduce the susceptibility of domestic prices to the international market and provide a cushion for any unanticipated price fluctuations, especially for the highly-weighted imported products in the basket of which consumption cannot be avoided such as oil and petroleum products. Thus, focus on an offsetting trade element is needed, i.e., exports, which require policy structures encouraging the production of export-based firms by providing subsidies and tax concessions. Moreover, the findings reflect that trade benefits are best received when the institutions are strong to mitigate any uneven distributional effects, economies-to-scale effects, and environment-degrading effects of trade. For this, the study suggests making the government processes more transparent using digital records. Going digital will help provide firsthand information about all the policy-related benefits to the poor and restrict any corruption-related activities, making the resources affordable and accessible to all. In addition, it is crucial to effectively implement policies that may re-orient the resources towards the comparatively advantaged goods and create job opportunities in labor-intensive countries to increase the outreach of trade benefits to the poor, which also depends on the strong institutional framework. Thus, it is vital to fortify the institutions to create an effective policy implementation environment that may help to procure the long-term viability of economic growth and sustainability of the environment.

Keywords: Trade Openness, Inflation, BRICS, CSD, DCCE model, Poverty reduction, Economic Growth, Institutional Quality, PMG estimations, System GMM, CO_2 emissions.

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ABBREVIATIONS

Abbreviation	Meaning
ADF	Augmented Dickey-Fuller
AR	Autoregressive
ARDL	Autoregressive Distributed Lag
BA	Bureaucratic Accountability
BRCS	Brazil, Russia, China, And South Africa
BREXIT	British Exit
BRIC	Brazil, Russia, India, And China
BRICS	Brazil, Russia, India, China, And South Africa
CADF	Cross-Section ADF
CSD	Cross-Sectional Dependence
CIPS	Cross-Section IPS
CO_2	Carbon Emissions
COR	Corruption
CPI	Consumer Price Index
DA	Democratic Accountability
DC	Domestic Credit to the Private Sector as a Percentage Of GDP
DCCE	Dynamic Common Correlated Effects
DFE	Dynamic Fixed Effects
D-H	Dumitrescu and Hurlin
DO	Domestic Output Gap
EC	External Conflict

Abbreviation	Meaning
ECT	Error Correction Term
ET	Ethnic Tension
EG	Engle-Granger
EU	European Union
EXR	Nominal Effective Exchange Rate
FE	Fixed Effect
FMOLS	Fully Modified Ordinary Least Squares
FO	Foreign Output Gap
G7	The International Group of Seven
GCF	Gross Capital Formation as a Percentage Of GDP
GDPC	GDP Per Capita
GEXP	Government Final Consumption Expenditure
GHG	Greenhouse Gases
GINI	Gini Index
GMM	Generalised Method of Moments
GS	Government Stability
HAC	Heteroscedasticity and Autocorrelation Consistent
HEXP	Per Capita Household Consumption Expenditure
IC	Internal Conflict
ICRG	International Country Risk Guide
IEA	International Energy Agency
IMF	International Monetary Fund
IO	Import Openness

Abbreviation	Meaning
IP	Internal Politics
IPEA	Institute of Applied Economic Research
IPS	Im, Pesaran, and Shin
IQ	Institutional Quality
IQI	Institutional Quality Index
IQI	Institutional Quality Index
KMO	Kaiser-Meyer-Olkin
LLC	Levin Lin Chu
LM	Lagrange Multiplier
LNO	Law and Order
MDG	Millennium Development Goals
MENA	Middle East/North Africa
MG	Mean Group
MIP	Military in Politics
MS	Money Supply
NKPC	New Keynesian Phillips Curve
NON	Non-Renewable Energy
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PEI	Political Efficiency Index
PIB	Press Information Bureau
PMG	Pooled Mean Group
PPP	Purchasing Power Parity

Abbreviation	Meaning
PSI	Political Stability Index
RE	Random Effect
REER	Real Effective Exchange Rate
REN	Renewable Energy
RGDP	Real Gross Domestic Product
RT	Religious Tensions
SAARC	South Asian Association for Regional Cooperation
SEC	Socio-Economic Conditions
SWIID	Standardized World Income Inequality Database
TO	Openness To Trade
UN	United Nations
UNCTAD	United Nations Conference on Trade And Development
USD	United States Dollar
WDI	World Development Indicators
WPI	Wholesale Price Index
XO	Export Openness

Chapter-1

Introduction

1.1 Background of the Study

In today's world, trading has become the heart of the global economy. It fosters economic growth and brings development in terms of higher living standards. Since the late 1980s, many emerging and developing economies have pursued trade reforms either in response to perceived deterrents of the import-substitution policies or in response to the directives of international trade organizations. The rationale for such commitment to trade reforms lies in the fact that it serves as an aid in the transition from closed economies to relatively open economies (Zahonogo, 2017), where economic growth is much more pronounced (Grossman & Helpman, 1989). Openness to international trade expands the accessibility and market horizons towards the goods and services that are not available or costly domestically. Moreover, it creates a competitive market which ultimately results in the availability of goods at better prices.

Over the last three decades, the proportional growth in global exports has almost doubled with the prominent contribution of some developing countries. Among these developing economies, BRICS has emerged as one of the significant contributors to global economic growth, with more than 24 percent of the global GDP and 16 percent of the global trade (BRICS, 2021). The BRICS' growing share of global trade from 6.833 percent in 1990 to 7.465 percent in 2000, 12.145 percent in 2005, 16.327 percent in 2015, and 19.833 percent in 2020 has created a worldwide trademark. In terms of exports, BRICS economies alone exported approximately one-third of total

developing countries' export of US$ 3.50 trillion in goods and around US$ 600 billion in Services (UNCTAD, n.d.). However, when accounting for the average Intra-BRICS trade, the imports and exports hovered around US $633.81 million in 2017, with comparative Figures of US$ 89.97 million, US$ 295.61 million, US$ 113.47 million, US$ 100.28 million, and US$ 34.65 million for Brazil, China, India, Russia, and South Africa respectively (PIB, n.d.). However, trade openness has risen as a fundamental part of the economic progress of the nations, but its economic interactions are complex in nature. Over time, trade has generated gains, but its distributional consequences on economic factors, like inflation, poverty, institutions, and carbon emissions, are still questioned by many researchers.

Trade Openness and Inflation

In relevance to inflation, for a long time, when inflation had not seemed to be as much of an issue for modern economies, the sudden emergence of the coronavirus pandemic has put it back on the desks of policymakers. Recent internal and external economic shocks such as hiked oil prices, the outbreak of the coronavirus pandemic, disrupted supply chains, and upsurges in government spending, among others, have disrupted the whole functioning of economies. Such external shocks hit those economies especially hard where a high share of the imported goods basket is used to fill significant domestic gaps. This includes both developed and developing nations, where these recent factors have highly contributed to driving up the prices that are hard to combat. Such inflationary shocks shake the developing economies with a much higher magnitude than developed countries necessitating actions. On the other hand, the ‘good-luck’ hypothesis states that high economic integration helps to reduce inflationary pressures by making external shocks more conducive to economic growth. Rapid trade integration among the lower-cost countries depresses import prices and enhances price competition, resulting in the availability of goods at lower prices. Consistent with this approach, the ‘globalization’

hypothesis enunciates that more openness to the global markets alters the sensitivity of inflation to its chief driving factors, such as the output gap. In the short run, the domestic output gap act as one of the principal economic drivers of inflation. However, with the internationalisation of the domestic markets, the foreign output gap also becomes a crucial factor affecting inflation. This foreign measure of slack generates synchronicity of price shocks across the economies and acts as a common driving force for inflation, such as in the Russia-Ukraine war. The Ukraine war has worldwide influenced oil import prices, increasing inflation in all countries, particularly in developing countries like BRICS. This invokes the question: Is opting for trade liberalisation policies really a good choice to combat inflation? And what roles do the domestic and foreign output gaps play in this process?

Trade Openness, Poverty, and Institutions

In addition to accelerating the transformative process, trade also contributes significantly to global poverty reduction through the distribution of trade gains. The studies have shown that different trade reform policies and the ability of individual economies to combine production techniques based on their abundant factor of production significantly affect the impact of trade openness on poverty reduction. The real income of the abundant factor rises when policies are combined in accordance with it, and this combination aids in poverty reduction. In the context of BRICS, with the collective population of more than one-fourth of the total world population living in Brazil, China, and India, with the increasing trade openness, the latter two countries saw dramatic poverty reductions to 0.1 percent and 10 percent, respectively, the headcount of the population living below US$2.15 in 2019 (PovcalNEt, n.d.). The simultaneous increase in trade and poverty reductions suggest trade is a poverty-reducing element for BRICS. The theoretical evidence in this context also supports this possibility. However, there is no consensus among the empirical studies on the relationship between trade openness and poverty.

According to some studies, globalisation helps to reduce poverty in developing countries such as China (Anetor et al., 2020; Li et al., 2022; Wang et al., 2022). On the other hand, some studies found contrasting results (Onakoya et al., 2019; Singh & Huang, 2011). In addition, some studies have found a negligible impact of trade openness on poverty reductions(Beck et al., 2007; Dollar & Kraay, 2002). Such ambiguities in the evidences necessitate additional research to determine whether poverty can be reduced through international trade and policy regimes, particularly in the BRICS countries that are entitled to be home to the majority world population.

Trade Openness, Institutional Quality, and Economic Growth

However, it has been widely acknowledged that the impact of trade on socioeconomic factors depends on the persisting quality of governance in the country. Lack of good governance, corruption, and less political stability reduce trade benefits due to a weakened trickle-down effect that slows economic growth in developing economies by negatively affecting poverty rates. In the last six decades, the developing economies have undergone significant changes due to shifts in position and power. During the mid-twentieth century's governance phase, national per capita income convergence policies were emphasised to identify the growth-enhancing sectors. The outcome of these strategies, however, was unfavorable. Only Taiwan and South Korea escaped poverty, whereas Pakistan, Brazil, and India, despite higher growth rates, failed to do so due to unsustainable growth in the productivity sector. In the 1980s, the next phase of governance started that focused on promoting structural changes in resolving any persisting governance issues such as rent-seeking and corruption. But after the divergent development paradigm shifts in China and India in the 1980s, when both countries decolonised in the early twentieth century, their capital cities were messy, corrupt, and poor in the 1980s. By the twenty-first century, while Shanghai emerged as a modern developed state, Delhi’s

development was slow and stagnant. This ineffectiveness of structural programs highlighted the significant role of social, economic, and political institutions in the success or failure of a nation. Good quality of institutions and governance is a prerequisite to faster development and poverty reduction. Since high openness to global trade increases the vulnerability to global economic shocks, the existence of strong institutions leads to the sustainability of trade benefits by increasing the odds that an economy can cope with external pressures. In addition, increased institutional investment in physical and human capital improves the economy's adaptability to imported production technologies, leading to faster, more robust expansion. Thus, it would not be wrong to say that trade openness determines economic growth in the short run, while institutional quality determines its sustainability in the long run.

Trade Openness, Institutional Quality, and Carbon Emissions

However, the primary objective of any economy is to achieve sustainable growth instead of economic growth, which highlights the degrading environmental effects of economic growth. Over the last few decades, human activities have led to a drastic increase in the global emissions of greenhouse gases (GHGs), causing unprecedented environmental degradation. The rapid increase in carbon dioxide emissions (CO_2), one of the main GHGs, has piqued the interest of many researchers and experts worldwide. In the last three decades, total global CO_2 emissions have enormously increased by almost 63.91 percent till 2019 (International Energy Agency (IEA), 2022). Besides, the covid-19 crisis has increased carbon emissions even further by forcing power plants to use coal and fossil fuels at full blast to meet the high energy consumption requirements and restore economic growth to its pre-pandemic pace. This has resulted in a strong rebound of carbon emissions, with the largest increase ever seen in global history, of more than 2 billion tonnes (International Energy Agency (IEA), 2022). Trade openness influences carbon emissions through scale, composition, and technology

effects. If the combined technology and composition effects (oriented toward clean goods) outweigh the scale effect, trade openness improves the environmental quality (Fakher, 2019). In contrast, manufacturing goods composition oriented toward polluting products tends to deteriorate environmental quality. Therefore, no theoretical consensus can be achieved. Apart from trade openness, the role of institutions is crucial in mitigating carbon emissions and their economic and social consequences. Through stringent and effective environmental policy choices, higher-quality institutions promote renewable energy that aids in developing green technologies and encourage knowledge spillovers, thereby reducing environmental degradation. However, poor institutional quality obstructs the remodelling of production activities away from renewable resources and creates barriers in achieving sustainable development. Not only does it impact environmental quality, but it also increases economic and environmental costs. Ineffective energy planning and policy-making weaken the institutions and make combating rising carbon emissions difficult. This increases the likelihood of political instabilities and inefficiencies that creates lax environmental regulations. Therefore, it will not be wrong to state that, in association with carbon emissions, the impact of institutional quality remains unclear for developing countries, particularly BRICS. This poses the question of whether trade openness and strong institutions contribute to lower carbon emissions? Is the institutional quality in these countries strong enough to effectively implement environmental policies?

1.2 Significance of the Study

Through the comprehensive exploration, the study presents an elaborated picture for the impact of trade openness on the significant economic factors affecting a nation's economic health over the last three decades. This unravels the effect of openness on inflation, poverty, institutions, economic growth, and carbon emissions.

Since the 1990s, increasing levels of economic integration have caused significant shifts in the global trade landscape. International trade provides a proven route to control inflation, uplift millions out of poverty, and sustainable growth with better environmental quality. When measured as a percentage of GDP, global trade openness-the value of imports plus exports-has risen steadily from 38.39 percent in 1991 to 58.24 percent in 2019 (World Bank, n.d.), with emerging and developing economies leading the way. Among these, BRICS stands out as one of the dominant trade integration groups attributing an average share of approximately 17 percent of the world's trade. BRICS are among the few highest exporting and importing countries representing more than half of the world's total population with a GDP of more than $16.16 trillion. Over the period from 1990 to 2020, its overall trade of goods and services in these countries has immensely increased from US $5.92 trillion to US $46.74 trillion in Brazil, US $8.76 trillion to US $508.04 trillion in China, US $4.98 trillion to US $100.75 trillion in India, US $18.66 trillion to US $68.36 trillion in Russia and US $4.82 trillion to US $17.15 trillion in South Africa. This contributed to building a resilient economy via realized trade benefits, especially in developing economies.

However, along with the corresponding advantages, the disadvantages are also there. With the global recession 2008, the BRICS experienced price fluctuations that highlighted the effects of openness on domestic prices and output gaps created simultaneously. Moreover, the majorly absorbed trade benefits by some sections of society in these economies slowly led to high-income inequality that decelerated the poverty eradication process. Additionally, in 2019, most of the BRICS countries were identified among the top 10 CO_2 emitters in the world (as shown in Figure 1). BRICS accounted for nearly 38.25 percent of global primary energy consumption, with China acing the race with a total primary energy consumption of 24.27 percent. With one-fourth of global growth and one-third of global energy consumption, the BRICS countries are contributing highly toward environmental

degradation. The reason can be many, like leakage phenomenon, use of inexpert environment deteriorating technology, etc. This brought attention to the institutional policies related to trade accelerating economic growth at the cost of environmental quality. Thus, it will not be wrong to say that aspects affected by trade openness should be critical to reducing trade costs. As a result, it is crucial to empirically study the impact of trade openness on inflation, poverty, economic growth, and environmental quality in BRICS. The analysis through this study will provide a new approach and insights to draw the policies by learning the past effects of these indicators. In addition, this will aid in building a new paradigm for future discussions that may lead to more-in depth revelations toward sustainable growth with increased trade benefits.

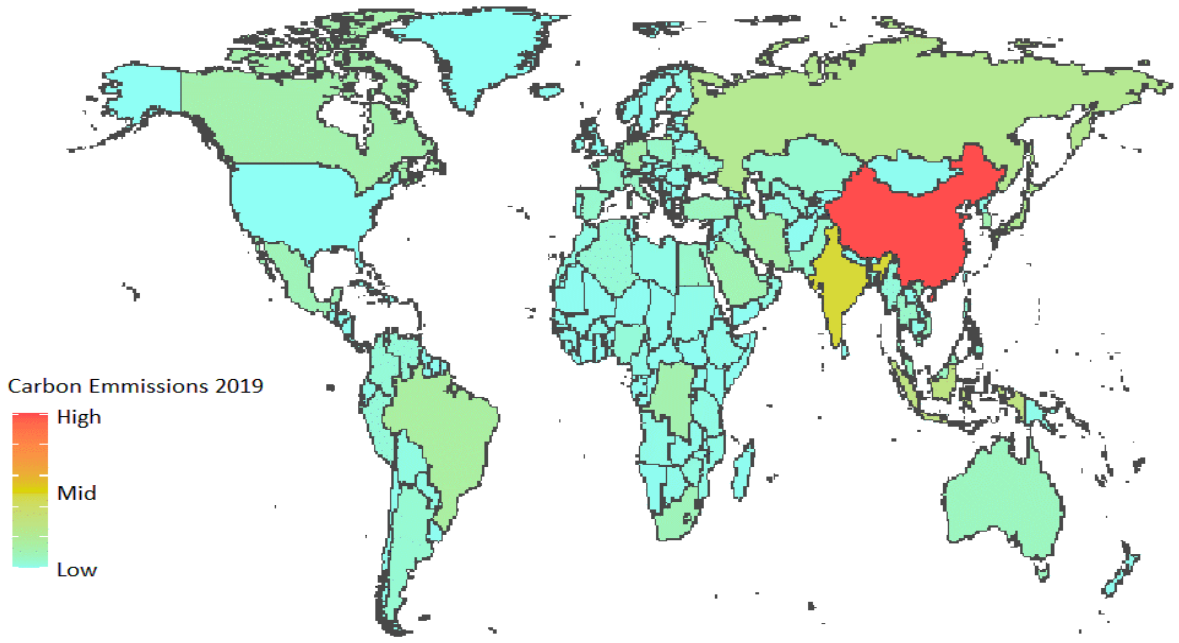

Figure 1.1: Worldwide carbon emissions in 2019. Source: Author's computation.

1.3 Research Gaps

From the above information, the mixed results of the studies highlighted some important knowledge gaps regarding the effects of trade openness on inflation, poverty reduction, economic growth, and carbon emissions (a more detailed overview of related

literature seen in chapters 4, 5, 6, and 7). This study uses the information gap discovered to describe future BRICS research that needs to be addressed.

1. While many studies have solely looked at how trade openness affects prices, the impact of the output gap on trade openness and inflation nexus has been highly ignored. There are few studies, none for the BRICS, that focus on the effect of the output gap on the relationship between trade openness and output gap. The current study fills this void by analysing the nexus while considering the impact of the output gap for the BRICS countries.

2. Most of the previous studies attempting to examine the relationship between trade openness and inflation and between trade openness, institutions, and economic growth have largely disregarded the possibility of a covert effect on exports and imports (Malefane, 2020). The fact that exports and imports are given different weights in the BRICS trading basket emphasises the importance of measuring their effects separately. As a result, this study attempts to fill this gap by investigating the impact of trade openness across all the trade dimensions, i.e., export, import, and overall trade openness, separately for the BRICS nations.

3. Policymaking solely from an overall trade perspective is not a viable option to stimulate economic growth, as the relative importance of exports and imports appears to vary among countries along with economies' institutional features. Therefore, this study deepens the investigation by analysing the interaction effect of export and import openness with institutional quality to analyse its impact on economic growth via trade in BRICS for the varied policy implications.

4. Since the dominance of exports and imports appears to vary with individual countries, policy-making only from an overall trade perspective is not a viable option to boost

economic growth. Therefore, providing country-specific empirical evidence will help to construct better policy frameworks from individual country perspectives.

5. The vast majority of studies on environmental issues in BRICS countries have focused on the potential impact and causal dynamics of energy consumption, economic growth, innovations, and foreign direct investments on the ecological footprints (Danish et al., 2019; Khattak et al., 2020; Sebri & Ben-Salha, 2014; Wang et al., 2021). However, only a handful of studies examined the impact of institutional quality on carbon emissions. As a result, it's essential to delve deeper into the environmental implications of institutional quality in BRICS countries.

6. To the best of the authors' knowledge, very few studies have examined the influence of institutions on environmental degradation. However, these studies either evaluated the impact of institutions using the governance index as a whole or focused on only one element, such as corruption or the legal and regulatory framework. None of the studies investigated the segregated impact of governance indicators, especially for BRICS. Therefore, rather than focusing on just one facet of institution's quality, it's vital to dissect the effect of all the variables separately for a more complete view (Chaudhry et al., 2022; Egbetokun et al., 2020; Haldar & Sethi, 2021). As a result, this study contributes to the literature by conducting a single indicator analysis to examine how various institutional quality measures affect carbon emissions in BRICS nations.

7. To the best of the author's knowledge, very few studies jointly examined the effect of governance and trade openness on poverty for BRICS. Therefore, this study extends the earlier studies and contributes by simultaneously assessing their impact on poverty.

8. The studies done so far assume cross-section independence, which is an unrealistic assumption. Due to rising mutual dependence among the countries, it is impractical in

today's real world to ignore the issues of CSD, heterogeneity, and endogeneity. This makes it essential to consider these issues, as ignoring them may lead to inaccurate and biased results. To overcome this limitation, this study attempts to examine the impact of trade openness on inflation, economic growth, poverty, and carbon emissions in the presence of CSD state-of-the-art technique, providing a more robust analysis.

1.4 Research Questions

Against the above backdrop, it is important to conduct a comprehensive analysis to get a clear picture regarding the impacts of and relationship between trade openness, output gap, inflation, poverty, economic growth, institutions, and carbon emissions. Therefore, this study constructs the following research questions that will help to assess the growing effects, trends, and changes in the patterns of the respective variables.

i. Whether trade openness increase or decrease inflation in the BRICS countries? Does the output gap (domestic and global) affect the price levels in these economies, and if yes, how? Do the trade openness and output gap act as causal factors to inflation or vice versa?
ii. How does trade openness help poverty reduction in the BRICS countries? What role does the quality of institutions play in poverty reduction?
iii. Does trade openness have any significant effect on economic growth in BRICS? Does the quality of institutions significantly affect economic growth in BRICS? Do the quality of institutions and trade openness have any complementarity effect on economic growth in BRICS?
iv. Do trade openness and institutional quality contribute to carbon emissions reduction in BRICS? How do the different institutional factors affect carbon emissions separately?

1.5 Objectives of the Study

Based on the provided research gaps and questions, this study offers an advanced approach in terms of the econometric methodology in analysing some ignored aspects that clearly define the relationship between the various macroeconomic indicators of BRICS. At this end, the followings are the research objectives of this study:

i. To investigate the impact of trade openness and output gap on inflation in BRICS countries.
ii. To investigate the impact of trade openness and institutional quality over poverty reduction in BRICS nations.
iii. To estimate the effect of trade openness and institutional quality on economic growth in BRICS.
iv. To examine the role of trade openness and different indicators of institutional quality on carbon emissions in BRICS.

1.6 Organization of the Study

This study consists of eight chapters. The first chapter highlights the background of the study by introducing and defining the concepts of trade openness, inflation, output gap, institutional quality, poverty, carbon emissions, and economic growth. The chapter also presents the research gaps of the study, research questions, and objectives of the study that this thesis targets onto.

The second chapter is entitled "Trends of Macroeconomic Indicators in BRICS." This chapter examines the trends of all the economic indicators undertaken in the study over the last three decades, from 1991 to 2019, for Brazil, Russia, India, China, and South Africa (BRICS).

The third chapter is entitled "Methodology." The chapter highlights the significance of panel data techniques over time series techniques. Further, it divides the chapter into two sub-sections based

on the techniques that do and do not assume CSD. It highlights the significance, prerequisites, and suitability of the various econometric methods to the objectives of this thesis. In addition, it defines other techniques that the study uses for constructing the index and individual country analysis.

The fourth chapter is entitled "Trade Openness and Inflation." This chapter examines the impact of trade openness on inflation. For this purpose, it first discusses the related theoretical and empirical evidence, followed by the model specification, data sources, and results and analysis.

The fifth chapter is entitled "Trade Openness and Inclusive Growth." This chapter investigates the effect of trade openness on poverty to analyze trade openness impact on inclusive growth. It undertakes the effect of institutional quality on the trade openness and poverty nexus by reviewing the present literature and analyzing it using the econometric techniques that support CSD.

The sixth chapter is entitled "Trade Openness, Institutional Quality, and Economic Growth." This chapter analyses the dynamic impact of various indicators of trade openness and institutional quality on the economic growth of the BRICS countries. In addition, it presents the short-term and long-term effects of these variables on economic growth.

The seventh chapter is entitled "Trade Openness, Institutional Quality, and Environmental Degradation." This chapter examines the impact of trade openness and institutional quality on carbon emissions. It discusses both the panel impact and the country-wise impact of trade openness and the quality of institutions on the respective country's environments. Further, it highlights the separate effect of each institutional indicator separately on the emissions.

Lastly, the final chapter is entitled "Conclusion and Policy Implications of the Study." This chapter highlights the main findings of the study discussed in the earlier chapters of the thesis. Based on these findings, the study further presents the policy suggestions and recommendations, concluded by the limitations and future scope of the study.

Chapter- 2

Trends of Macroeconomic Indicators in BRICS

2.1 Introduction

BRICS brings together the world's five most rapidly developing nations comprising Brazil, Russia, India, China, and South Africa. The acronym was first coined in 2001 by economist Jim O'Neill under the Goldman Sachs banner. He defined BRICS as the five fastest-growing countries that will dominate the global market by 2050. With its emphasis on peace, development, security, and cooperation, BRICS works to make the world a better place for everyone. By contributing nearly a quarter of global GDP and 16 percent of international trade, the BRICS is rapidly gaining prominence as the main driving force behind global economic expansion (World Bank). Thus, it is expected that BRICS will emerge as a sphere of immense energy promoting global economic development with a bright future.

In 2006, Russian President Vladimir Putin proposed the formation of this informal group. The first BRIC ministerial meeting, held in St. Petersburg, Russia, in 2006, was an important step toward the goal of expanding multilateral cooperation among the member countries of the BRIC. After several ministerial meetings, the BRIC held its first summit in Yekaterinburg in 2009, which outlined ways to serve the common interests and address the global financial crisis 2008. In the wake of the economic crisis 2008, the group's investments and trade provided the impetus of a major financial support system. After South Africa was welcomed as a full member at the BRIC ministerial in September 2010, the group changed its name from BRIC to BRICS. To that

end, South Africa attended its first and BRICS' third summit held in China in 2011. With the spirit of "openness, inclusiveness, and win-win cooperation," the BRICS demonstrated its legitimate concerns about global economic order. It created a positive inception on the international systems and is now positioned to take on a higher economic status worldwide. At present, four out of five, Brazil, Russia, India, and China, are amongst the top ten largest countries in the world. With nearly one-third of the world's land area, BRICS is home to 3.14 billion people, i.e., almost 41 percent of the world's population. Among these, Russia has the largest economy in the world, followed by China (in third), Brazil (in fifth), and India (in seventh). It includes China as the most populous country worldwide, followed by India (second most), Brazil (seventh), Russia (ninth), South Africa (twenty-third), and South Africa (twenty-third). All five countries are members of the G20 group, with a combined GDP PPP of almost 32.1 percent of the world. Regarding terms of trade, China is the largest exporter worldwide and contributes nearly 18 percent to the global nominal GDP as of 2021. As the world's fastest-growing economy, it is the world's second-largest importer (Tang and Wang, 2022). Along the same line, India ranked the ninth-largest importer and sixteenth-largest exporter worldwide in 2021 (International Trade Centre). Followed by Russia as the 13th largest importer and twenty-first largest importer worldwide (International Trade Centre). Brazil and South Africa further follow this order in terms of worldwide imports and exports. Given these data, it's easy to see that the BRICS countries' economic growth patterns are quite different from one another. Therefore, an attempt has been made to understand the trends of macroeconomic indicators for effective policymaking as a trade group.

2.2 Trade Openness

Trade openness measures the degree to which a nation engages in global trade. In other words, it shows the dependence of one country on another to fulfill domestic demand. Trade Openness is commonly denoted by the trade-to-GDP ratio, defined as the ratio of total exports

and imports of goods and services divided and total GDP. An increase in openness indicates higher exports and imports with higher revenues and expenditures from and on foreign-based products. From 1991 to 2019, overall trade in BRICS has massively increased from 190 US $ to 3554 US $ billion in 2019 (Figure 2.1). However, as a result of the global recession in 2008, this rising trend experienced a steep decline in the trading market, falling by almost 20%. Even later, in 2016, BRICS experienced similar trade volatility, primarily due to the collapse of the Chinese stock market and BREXIT. A sharp fall in the Chinese stock market sent a global shock that tumbled down the value of the Chinese yuan leading to more competitive exports and expensive investments. On the other hand, Britain's exit from the EU resulted in a sharp rise in USD value, which reduced the value of relative currencies. The high USD value triggered pressure on China to devalue the yuan further, as it was caught between the two largest export markets- the EU and US.

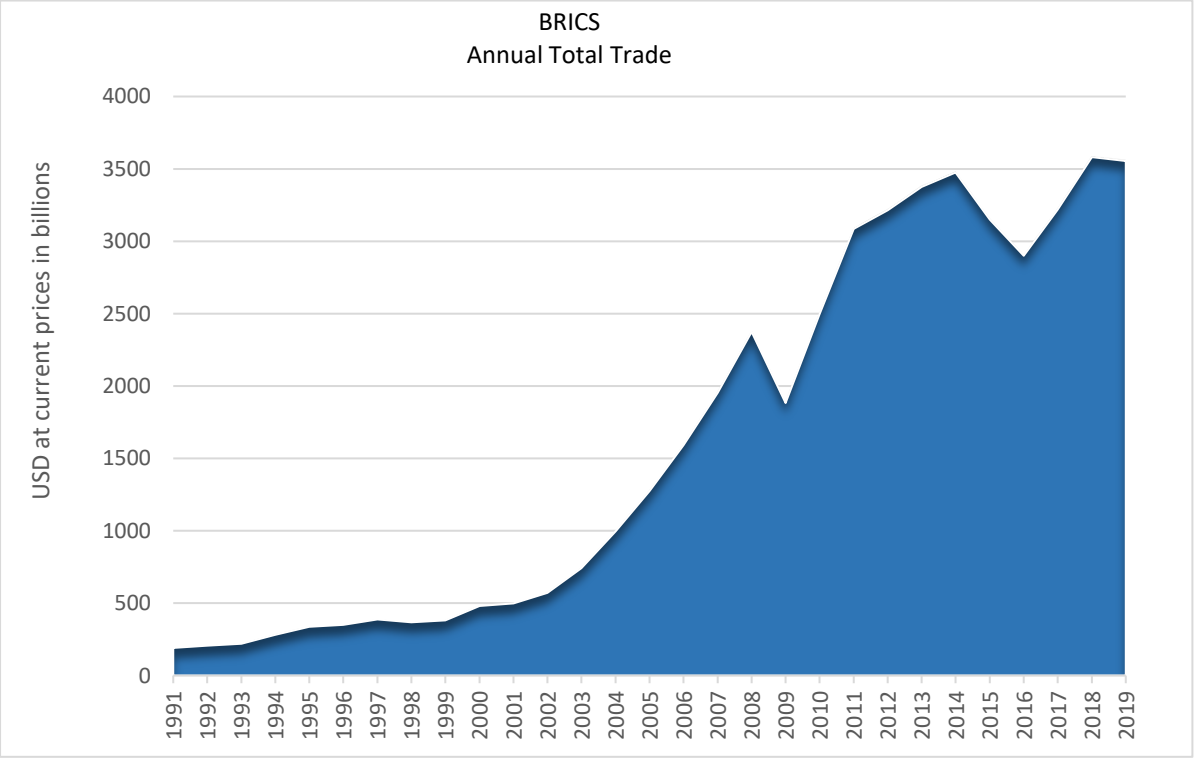

Figure 2.1: Total annual trade of BRICS (1991-2019). Data Source: UNCTAD

On the individual country basis, BRICS has made notable progress in the trade-to-GDP ratio from 1991 to 2019, with Brazil and India increasing their trade shares from 16 percent to 28 and

39 percent, China and Russia increasing their trade shares from 26 percent to 35 and 49 percent, and South Africa increasing its trade share from 38 percent to 59 percent. Compared to other economies that have seen steady but erratic increases in their trade share, China's has steadily decreased over the last decade (as shown in Figure 2.2). China's underperformance primarily impacted India-China trade, which accounted for trade deficits with China. China's efforts to protect the domestic cotton industry by limiting cotton imports have significantly impacted China's international trade, which has been declining in recent years. These are just a few of the reasons why the BRICS countries' trade to GDP ratio fluctuates, but they serve to illustrate the importance of addressing other, more systemic economic factors that play a role in the process.

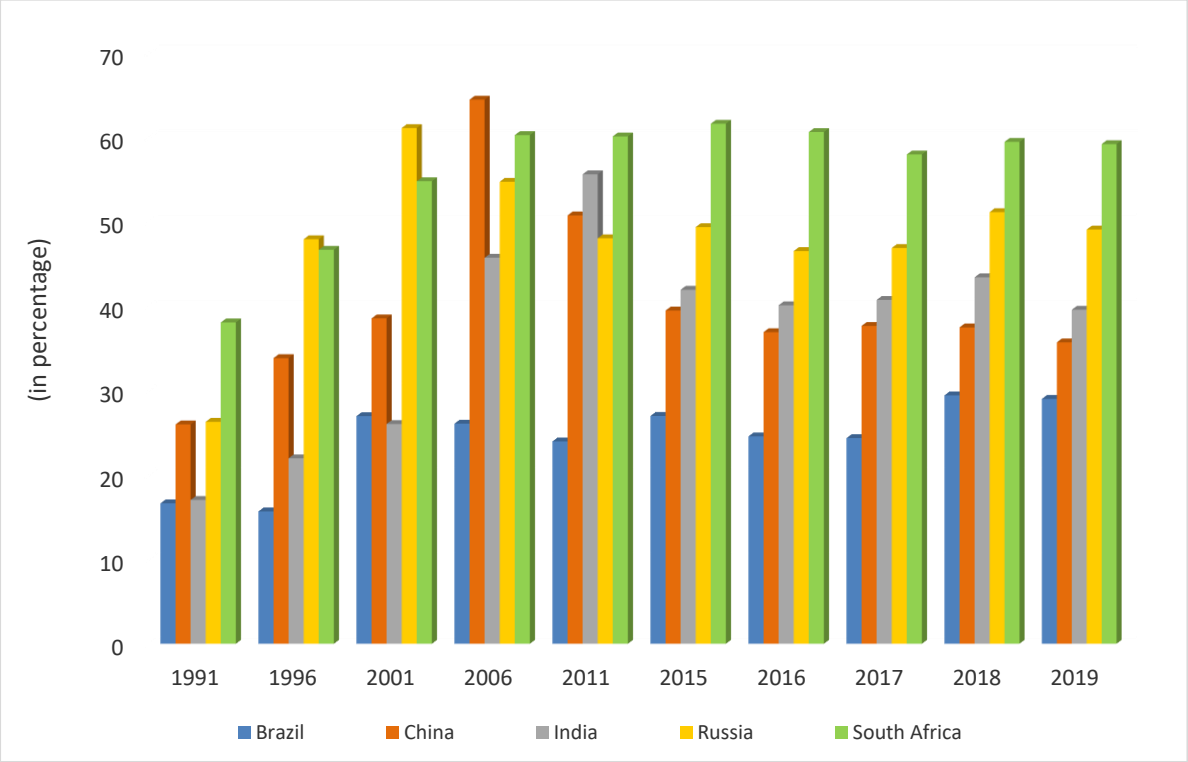

Figure 2.2: Trade openness (trade % of GDP) in BRICS: country wise analysis (1991-2019). Data Source: WDI

2.3 Inflation

Inflation can be defined as a persistent increase in the general price levels. It is a disequilibrium state of an economy where a sustained increase in overall prices occurs instead

of short or sudden price hikes. When the prices of goods increase, it causes a decline in the value of the money that showcases the inflation effect in the economy. In other words, it is a gap between aggregate demand and aggregate supply. The higher the gap between aggregate demand and supply, the higher the speed of rising inflation rates. Inflation can be represented using various indicators such as the wholesale price index (WPI), consumer price index (CPI), and purchasing power parity (PPP). This study measures inflation using CPI because of its advantages over WPI and PPP measures. On the one hand, WPI accounts for the changes in the general price levels for the sale of goods at the wholesale end in the first stage only, and CPI measures the price level changes of both goods and services at the consumer end in the final stage, which ease down the government process of determining the inflation effect on common people. On the other hand, the measurement of PPP is a difficult and resource-intensive activity relative to the CPI. The implementation of PPP is gradual and complex in developing countries due to data gaps, especially in compiling regional PPPs and quality adjustments to make international comparisons. Therefore, CPI is a better approach to measure inflation for BRICS.

The overall CPI picture for BRICS, as depicted in Figure 2.3, shows a continuous upward trend of the price levels for these countries. In contrast, the country-level analysis, as depicted in Figure 2.4, shows fluctuations with both upward and downward price trends. Comparing the individual-country trends, the statistics mark a decline in prices till 2006. However, in 2011, the prices followed an upward trend, for which the reasons can be many. First, the higher prices resulted from the global financial crisis 2008, which rebounded to a sharp 'V'-shaped recovery curve for the global food, commodity, and oil prices.

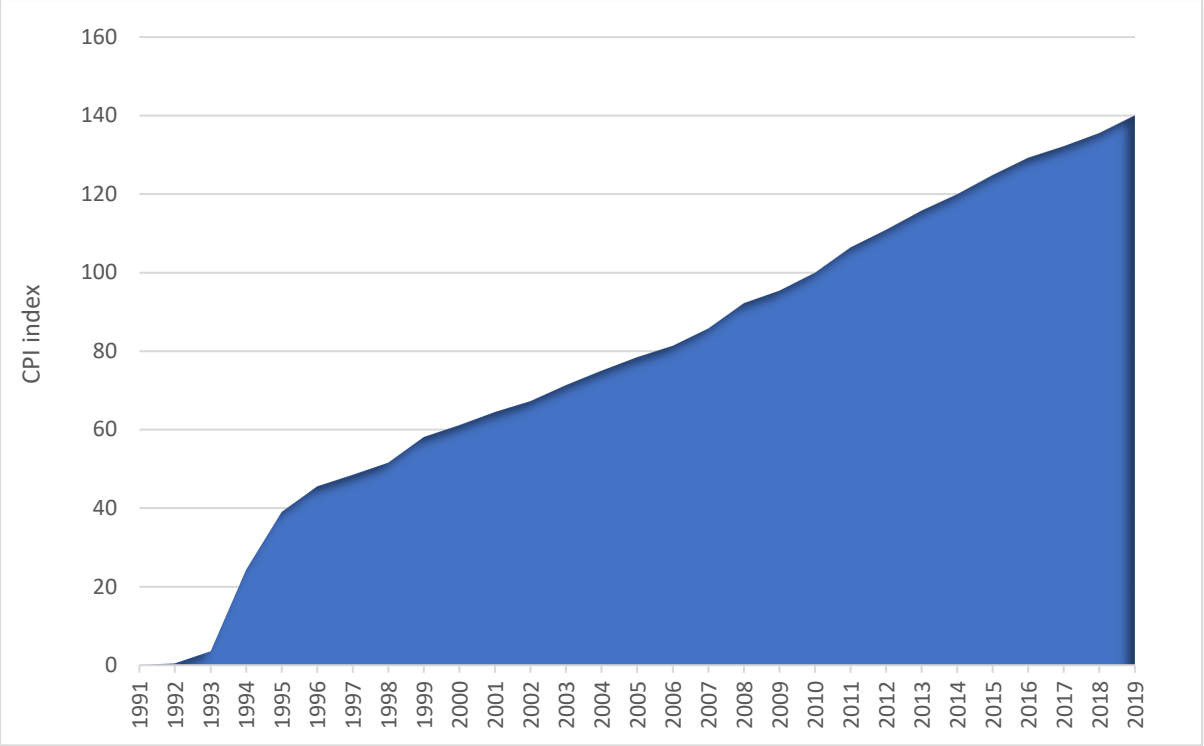

Figure 2.3: Consumer price index for BRICS (base year 2010). Data Source: UNCTAD.

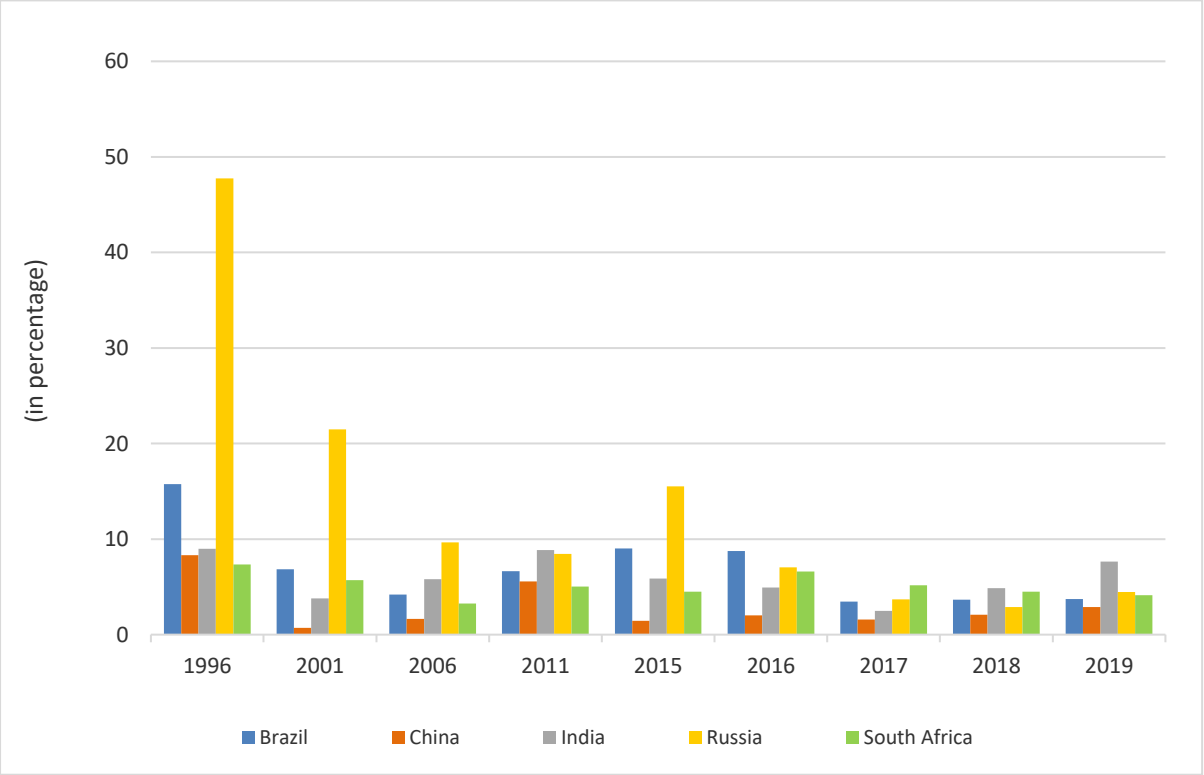

Figure 2.4: Consumer price index (in annual percentage) in BRICS: country wise analysis (1991-2019). Data Source: WDI.

Given that Russia is an oil-importing country, the inflation change was the least among these five countries in 2011. Second, the economic slowdown after 2008 lowered the potential output levels relative to the actual output level, creating a negative output gap. However, a negative output gap implies downward pressure on inflation, the inflation dynamics were against these theories and applied upward pressure on inflation, famously termed as inflation puzzle. On the contrary, when prices were getting relaxed in China, India, and South Africa, Russia experienced an upswing in its prices. The major factor behind rising price levels was a pass-through effect of exchange rate depreciation in late 2014, resulting in food supply shocks. A sharp rise in demand due to currency depreciation and episodic supply reduction of certain commodities due to higher export profitability raised inflation expectations in Russia. With the fluctuating openness to trade, inflation became less of an issue for BRCS countries; however, India reflected a sudden price hike due to food price inflation attributed to poor monsoon. All these facts reveal that rising economic integration is a possible contributing factor towards rising prices via imported inflation and external economic shocks and needs a careful assessment.

2.4 Output Gap

The output gap is the difference between what an economy can produce and what it is producing. In other words, it can be defined as the economic measure of the difference between the economy's potential and actual output. Potential output is the maximum goods and services an economy can produce at its full potential and most efficiently. It can also be termed as the economy's total producer capacity. Actual output is goods and services produced in the economy. With the change in GDP, the output gap can be either positive or negative direction, where neither or zero gaps are unreal or imaginary. A positive output gap happens when the actual output is higher than the potential output. A possibility of a positive output gap can be achieved when excessive demand causes the producers to operate above their full capacity. A negative output gap happens when actual output is less than an economy's full and efficient

output capacity. Weak demand for goods and services may result in slack, hence, a negative output gap. The output gap affects differently in different countries based on their domestic and foreign output gaps, as depicted in Figures 2.5 and 2.6.

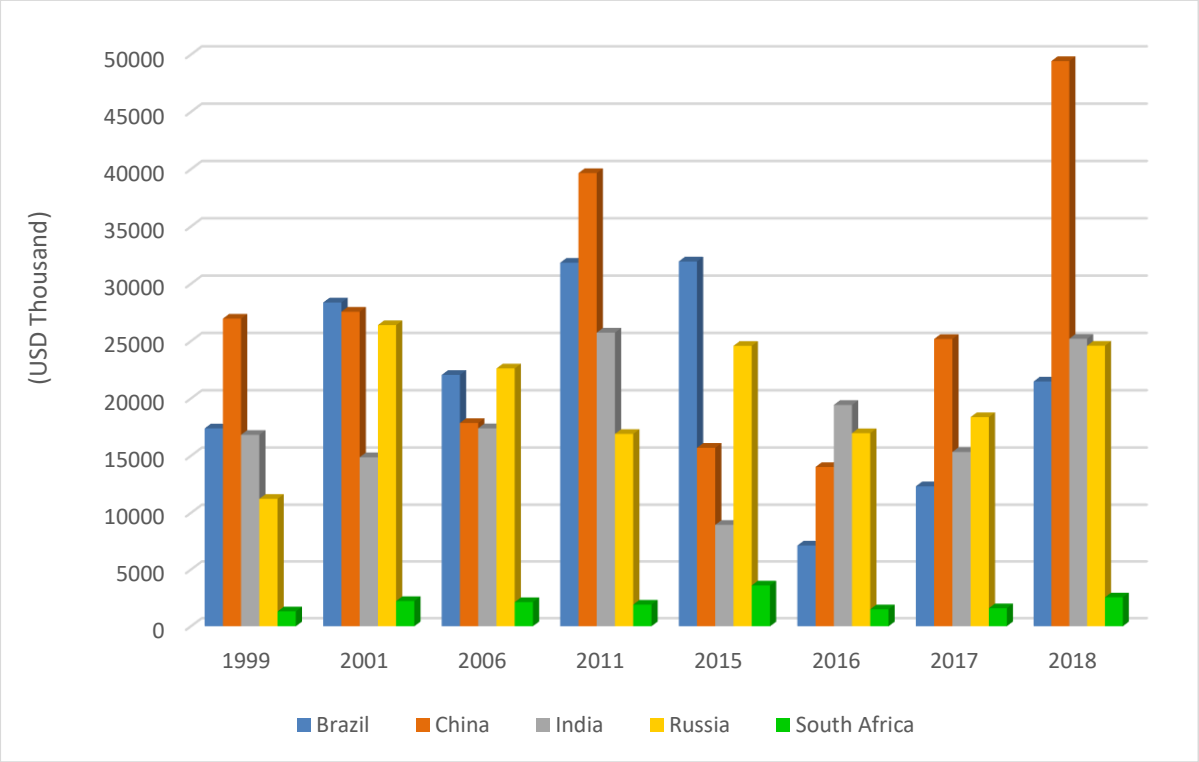

Figure 2.5: Domestic output gap in BRICS (1999-2018). Source: WDI and Author's computation.

Figure 2.5 reveals that, on average, China marks the highest domestic output gap, followed by Brazil and Russia. For the same aspect, South Africa has the lowest domestic output gap in the last two decades till 2018. On the contrary, Figure 2.6 reveals that Brazil shows the highest foreign output gap among BRICS, followed by South Africa and India. For the same, China shows the lowest foreign output gap throughout the data period. Moreover, the Figures infer that global forces massively affect the countries heavily relying on foreign output sources to fulfill the domestic output gaps. As a result, the statistical congruence between the foreign output gap and trade openness in BRICS draws attention to the more profound trade implications of global economic adjustments.

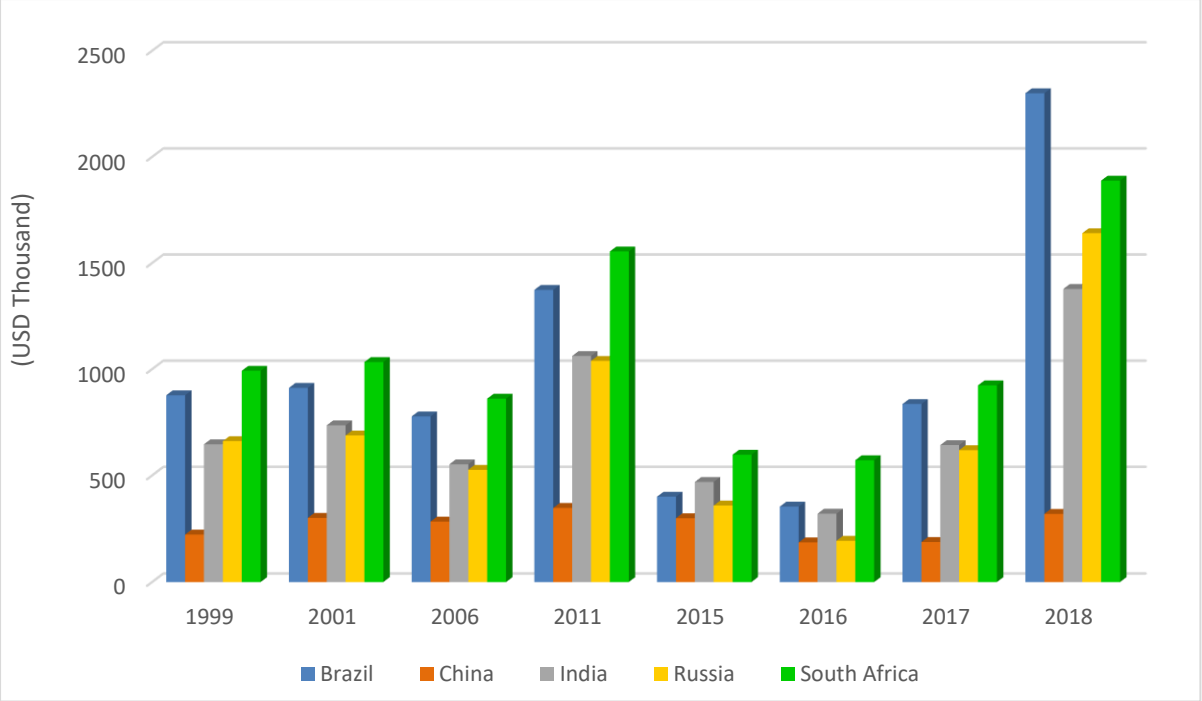

Figure 2.6: Foreign output gap in BRICS (1999-2018). Source: WDI and Author's computation.

2.5 Economic Growth

Economic growth indicates an increase in the overall production of goods and services in an economy over a period of time. Improved economic growth results in higher income levels leading to a better standard of living. While economic growth is easy to define theoretically, its measurement is a difficult task. One of the popular and traditional ways is the income measure to understand economic growth in monetary terms, which is measured by a country's real Gross Domestic Product (GDP). Real GDP is a monetary accounting for the total goods and services produced in an economy over a specific time, adjusted to remove the effect of inflation. An increase in income inspires one to spend more at the consumer end to attain a higher standard of living. Looking at the GDP statistics for BRICS countries in Figure 2.7, China showed continuous steady growth in terms of GDP, marking the highest among BRICS, followed by India, Brazil, Russia, and South Africa. Brazil has experienced a rise in economic growth since 1991, however, the growth slowed down with the de-industrialisation in 2014 to US$ 2337 billion. Although high prices in the early 2000s fuelled

rapid economic growth in Brazil through higher employment and wage rates, they also led to significant structural bottlenecks like lower productivity and fewer investments. Prices, however, fell dramatically after 2010. Despite the tax breaks, subsidies, price controls, and extra credit from public banks, a climate of uncertainty prevailed, discouraging investments. As a result, the process has resulted in slower economic growth in Brazil since 2014. Russia being a former superpower and most resource-rich country has barely grown in terms of its GDP, smaller than one-third of China's GDP at US$ 1762 million in 2019. Since the introduction of economic reforms, economic and political instability, such as a persistent drop in output since 1991, the financial crisis 1998 due to high fiscal deficits, and the fall of the Soviet Union, have contributed highly to Russia's lower economic growth. The economy made real gains when Russia finally exceeded its 1991 GDP. Further, the financial crisis of 2008 and the declining exchange value of the Russian ruble in 2014 shook the investor's confidence and both producers and consumer, hence declining economic growth in the economy. Furthermore, South Africa ranks last among the BRICS with a global GDP of US$430 billion in 2019. The transition of South Africa to democracy has not proved much beneficial to its growth, resulting in a significant portion of people living below the poverty line. The prominent reason behind this is the significantly prevailing one of the globally highest inequality rates, with a Gini coefficient of 62.7 in 2019 (SWIID). Inequality is passed from generation to generation, which is neither pro-poor nor pro-growth. However, India has shown impressive continuous growth and is around one-fourth of China's real GDP, i.e., US$ 2940 billion in 2019. The remarkable growth of India lends credence to its diversified trade baskets that limit the effect of external shocks, increasing the share of exports and investments in response to rising consumer demands and stabilized sectoral growth, particularly post-liberalisation. Similarly, China has risen as the tiger or dragon among BRICS with a staggering rise in economic growth at US$ 11537 billion in 2019. China has

sustained high economic growth for such a long time that it has largely reshaped the distribution of global economic power. Overall, it can be said that adopting relatively liberal trade policies has contributed immensely to faster economic growth in BRICS.

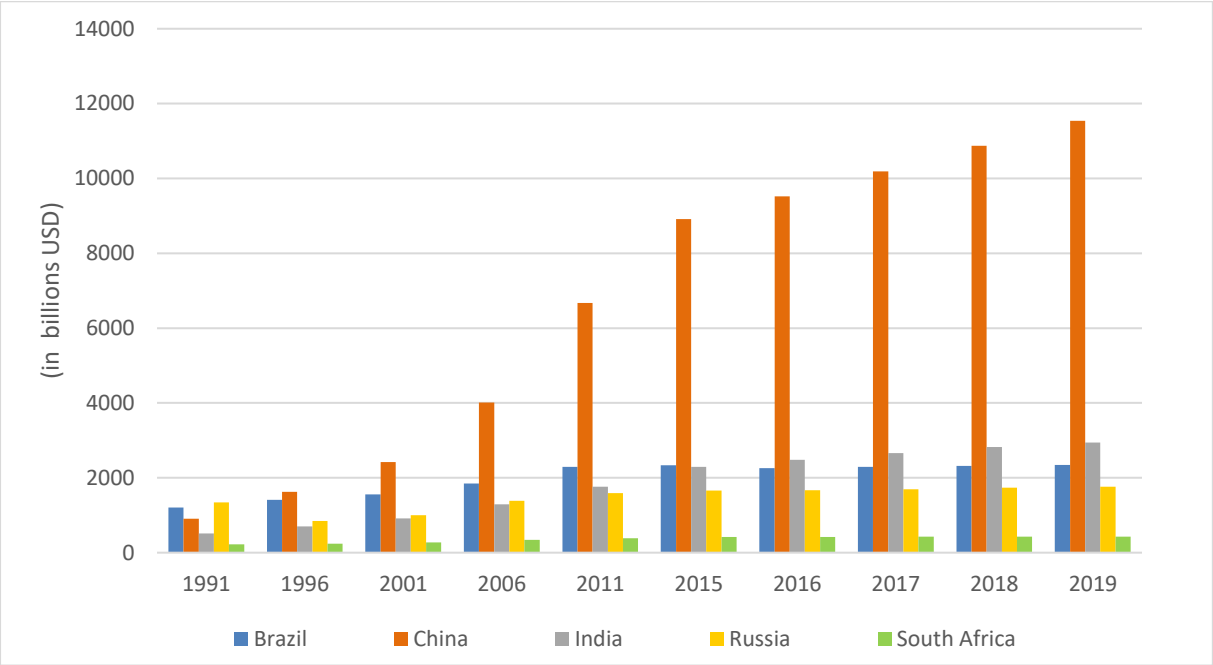

Figure 2.7: Real GDP (at constant 2010 US$) in BRICS (1991-2019). Source: WDI.

2.6 Institutional Quality

The institutional structure of any country represents the long-term development and welfare creation of the nation. It is a broad concept that captures the trajectory of short-term economic gains to determine its sustainability for long-run economic growth. A good quality institution protects property rights, enforces law and order, and maintains government regulation and services. As a result, a better standard of living and higher per capita income is attained in the countries where institutions are relatively strong (Acemoglu et al., 2005). The importance of institutions has been long highlighted by Adam Smith, mentioning that higher institutional quality is a pre-requisite for the economy (Smith, 1776, p.910), and it determines the underlying economic differences of growth, poverty, inequality, etc., between different regions and countries (Smith, 1776, p.405). Institutions serve as the basic requirement for

development consisting of various factors that are difficult to measure. Institutional Quality is usually measured by constructing a composite index based on indicators such as government stability, internal and external conflict, corruption, law and order, and democratic accountability. For this purpose, the study used the ICRG database, where the maximum number indicates very low risk and a score of 0 indicates a very high risk to the potential political risks.

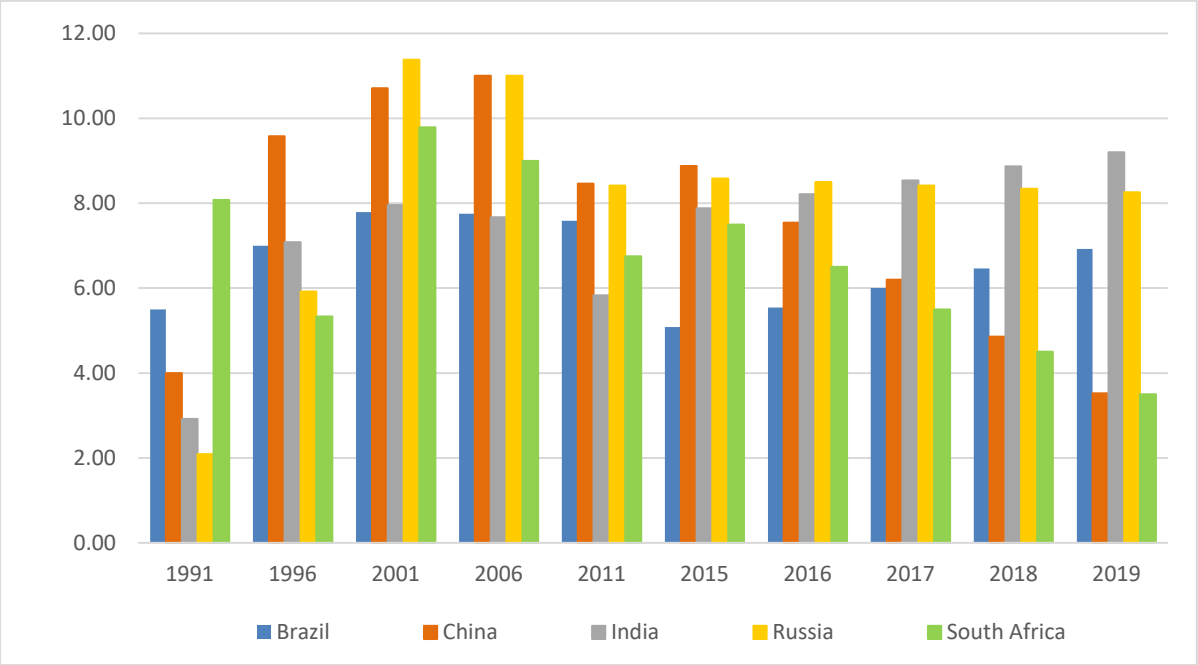

Figure 2.8: Government stability in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

Figure 2.8 shows that since the 1990s, BRICS has successfully maintained a stable institutional environment. Though the trend of stability consists of its ups and downs, especially in the 1990s. A considerable number of events, including the influence-peddling scandal of Brazil's President in 1992, China's strategic concerns regarding the political status of Taiwan's independence in 1995, India's religious politics of Babri Masjid in 1992 in India, continuous coalitions and political support withdrawals by various Indian political parties to form a stable government in 1997, economic sanctions on India for conducting nuclear tests in 1998, the collapse of Soviet Union in Russia where the continued support of Soviet Union to socialist policies lead to

hyperinflation and stumbled macroeconomic indicators in Russia in the early 1990s, the financial crash of 1998 on Russia, and South Africa's worst civil unrest and transitioning to democracy in 1994 have tamed down the political stability time-to-time. However, the political environment became more stable in Brazil, India, and Russia till 2019; on the other hand, the situation worsened in China and South Africa. The structural transition from an export and investment-based economy to a consumer-based economy since 2015-16 and Hong Kong's protest for withdrawing the Extradition Law in 2019 created economic and social unrest in China. The rising political tensions also affected the democratic accountability of the government and disturbed law and order, as indicated in Figures 2.9 and 2.10, wherein the corresponding years, the score of the countries have come closer to 0, demonstrating very high risk or less democratic accountability.

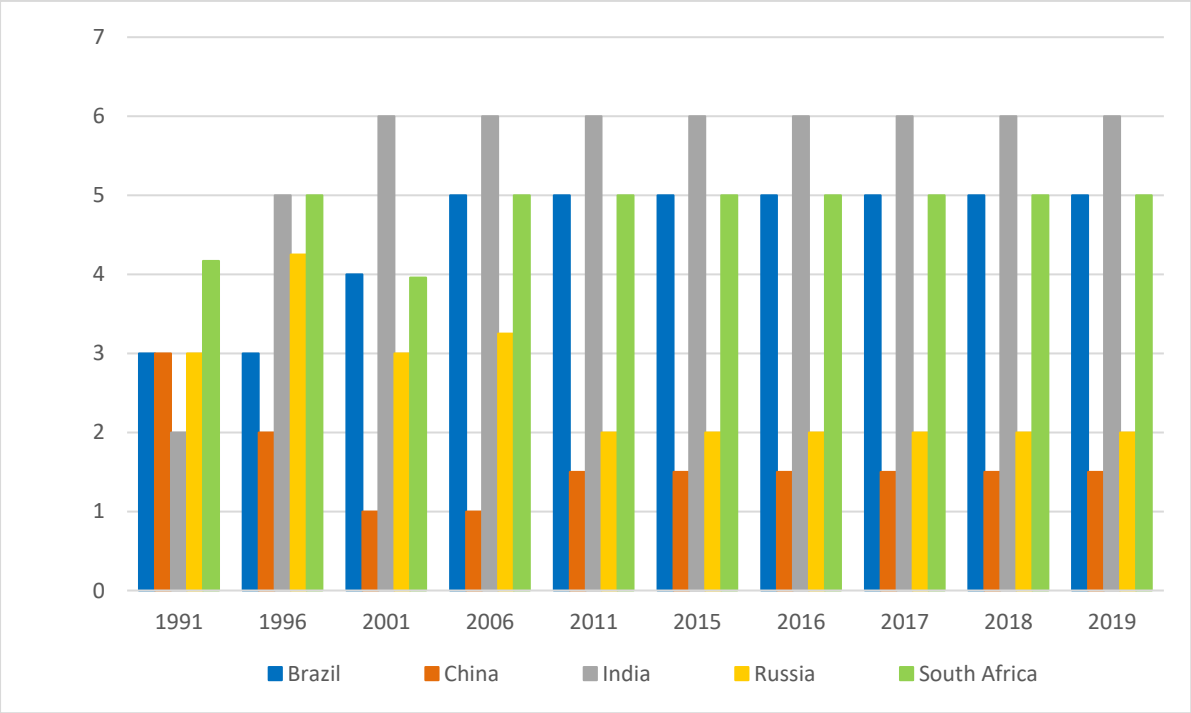

Figure 2.9: Democratic accountability in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

Similarly, Figure 2.11 shows high corruption score contributes negatively to improve the quality of institutions. The bureaucratic corruption activities and scandals like Operation Car

Wash in Brazil, Xi Jinping's corruption case in China, the 2G spectrum scam in India, the Three Whales' corruption scandal in Russia, and the Nkandla homestead scandal in South Africa, to name a few, shook the economies financially and politically. However, with better government stability, the countries have become less prone to the spillovers of any external or internal conflicts and reflect the scores closer to the high values (as shown in Figures 2.12 and 2.13). This demonstrates that while BRICS has significantly benefited from economic integration in terms of GDP, it still struggles to maintain a proper institutional environment.

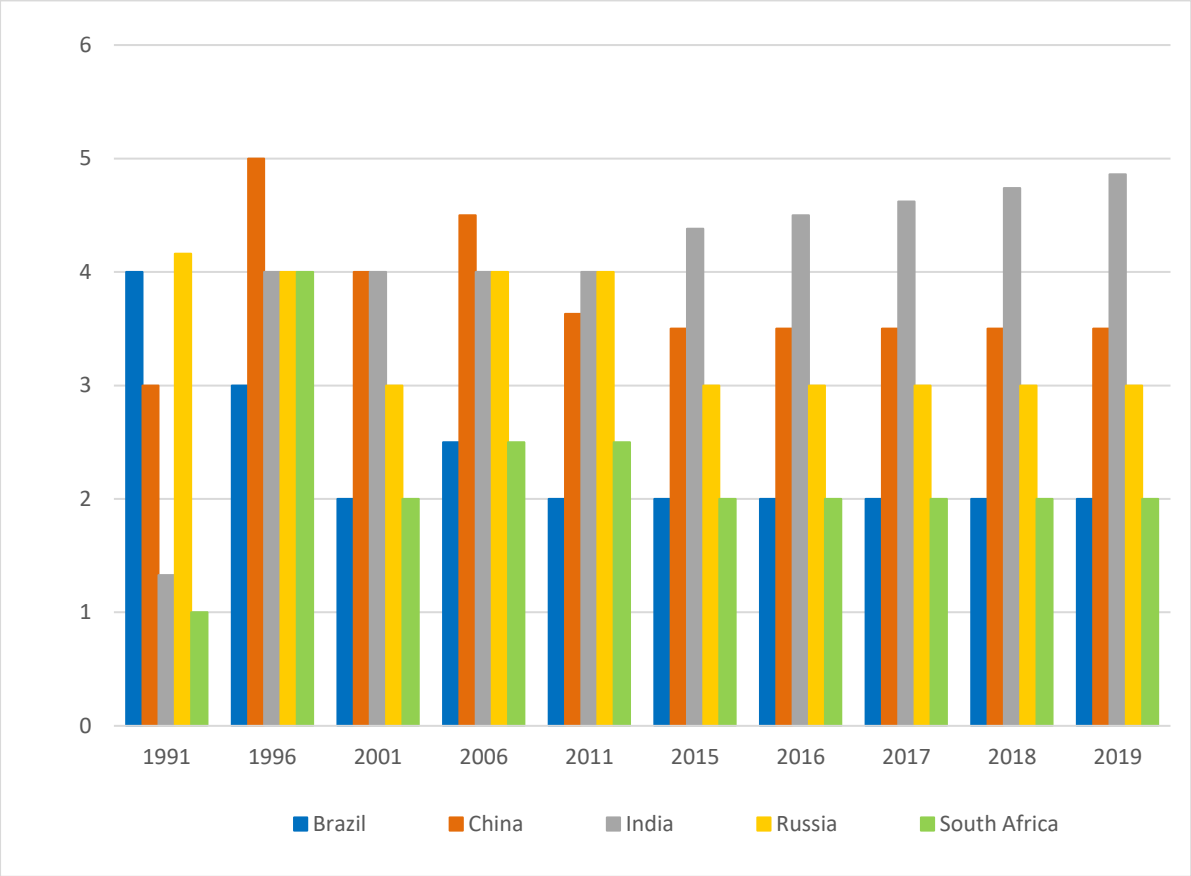

Figure 2.10: Law and order in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

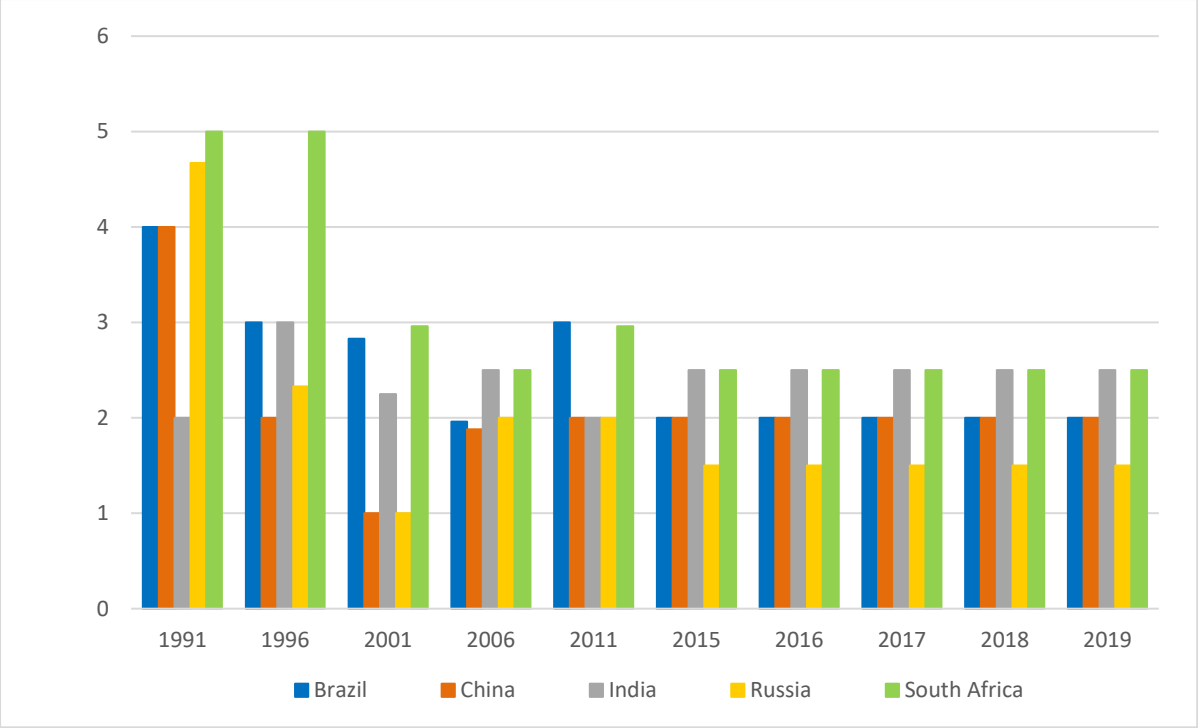

Figure 2.11: Corruption in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

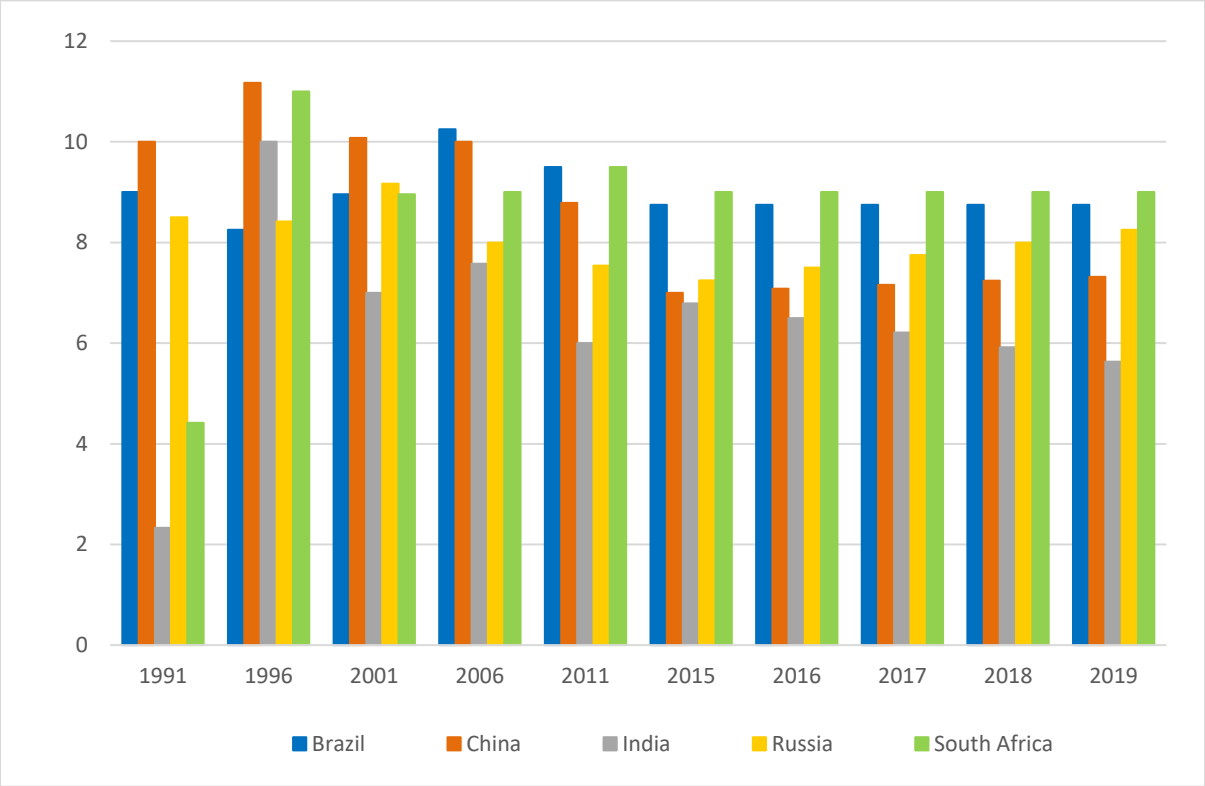

Figure 2.12: Internal conflicts in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

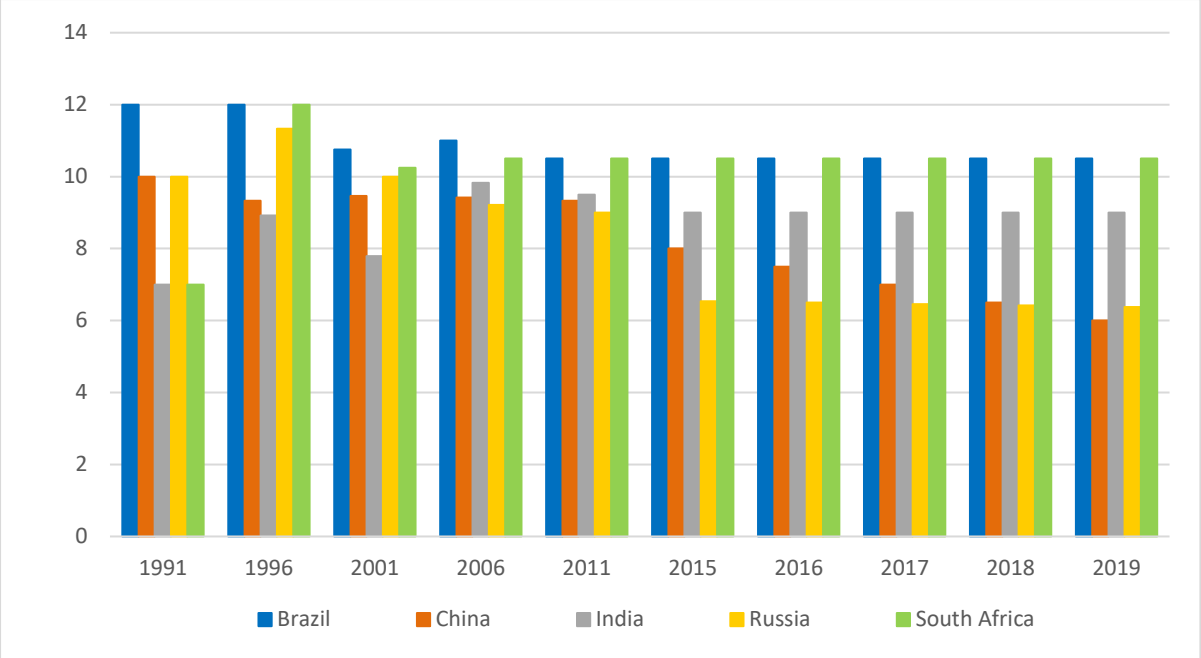

Figure 2.13: External conflicts in BRICS (1991-2019). Source: International Country Risk Guide (ICRG).

2.7 Poverty and Inequality

Poverty is a state where the person lacks to fulfil basic needs like food, clothing, shelter, and education. UN has devised two measures of poverty to classify people below the poverty line- absolute and relative poverty. Under relative poverty, the person receiving less than a specific percentage of the average income is considered poor. At the same time, absolute poverty compares household income with a set minimum level of income or poverty line. If the income of a person is less than the fixed income, then it is considered to be below the poverty line or poor. To compare and measure poverty globally at a common scale, World Bank has fixed the poverty line to $1.90 per day (based on PPP 2011), which has been recently changed to $2.15 per day (based on PPP 2017) in 2022. UN defines it as a phenomenon where the population of an economy lives under the poverty threshold of US$1.5 per day. However, calculating the poverty headcount ratio through this phenomenon is difficult in developing countries like BRICS, where the data is scarce. Therefore, per capita household consumption expenditure has

been used to identify the poverty status in these countries. Higher expenditure shows a rise in income, implying a better standard of living and a poverty reduction.

According to a Noble Prize winner, Nelson Mandela, - "Poverty is not natural; it is manmade." The rising population in developing countries burdens the resources and budgets of countries. The scarcity of financial and economic resources makes it difficult for the policymakers and government to provide basic needs to everyone, raising poverty. Poverty creates a social stigma and high discrimination, leading to reduced social participation, lower political support, and fewer employment opportunities. As a result, it leads to other economic issues such as poor education, unemployment, inequality, etc. Low skills and poor education limit people from getting decent jobs and force them to work at less than the minimum or bare minimum wages, resulting in unequal income distribution or inequality. Inequality is a phenomenon where the distribution of income, resources, and opportunities is unequal or unjust among society members. A typical and traditional measure used to define inequality is the Gini coefficient. The Gini coefficient represents income inequality based on income redistribution through taxes and transfers. Its coefficient varies from 0 to 1, where zero shows perfect equality and one shows perfect inequality.

According to Brazil's Institute of Applied Economic Research (IPEA), Brazil is among the top ten most unequal countries globally, with a Gini index of 48.3 in 2019 (as shown in Figure 2.15). Despite the high growth in Brazil, the disparity has been more visible throughout the last three decades. For Brazil, the 2000s were a period of rising poor growth, while the 2010s experienced a rising income concentration to the top. The fall of the centralist empire magnified the excessive federalism that left education and social policies in the hands of states. As a result, power abuse in favor of the wealthy widened the income gap by limiting only the secondary jobs to the ill-defined and ill-protected people. However, by 2015, Brazil managed to sustain rapid growth, but this was

the turning point in terms of high financial distress and severe recession due to the political turmoil that increased poverty and, consecutively, inequality even more to 48.2 in 2017. Over time, the per capita household consumption expenditure in China has increased almost three times from 1991 to 2017 (as shown in Figure 2.14), which led people successfully uplift out of the poverty line fuelled by the rising growth rates and a series of government plans such as urban subsidies and rural pensions. However, these events have benefitted different people differently, therefore raising inequality. At the beginning of growth, from 1991 to 2006, inequality significantly increased 32.8 to 42.4. China followed the inegalitarian approach of Sir Arthur Lewis that economic development does not start in every part of the country at the same time and manifested only two development attributes, i.e., rising returns to education and rural-urban migration. The approach increased the inequality initially because of the relatively less educated population on the high end of the income distribution but began to reduce inequality with a Gini coefficient of 41.8 in 2019 (as shown in Figure 2.15). India offers a similar pattern of rising standard of living with increasing per capita household consumption expenditure till 2016 with the continuous rise in inequality from 41.1 to 50.19 index value in the last 28 years till 2019. India's rapid economic growth is the main reason for declining poverty rates. The better infrastructure and transportation facilities en route progress faster in urban than rural areas, widening the income gap between rich and poor. Similarly, poverty in Russia is declining, with more than two-fold rise in per capita household consumption expenditure from 1991 to 2015. After 2015, the per capita household consumption expenditure declined, characterizing situational poverty decline due to the economic crisis in Russia. Inequality is still higher in Russia, exacerbated by an inclusive education system, corruption, and low taxes for the rich. Hence poverty is declining, but still a major concern due to rising inequalities. This reflects that over the years, openness to trade has not created any definite positive effect on poverty and inequality in BRICS. However, it is crucial to examine the relationship empirically to confirm this.

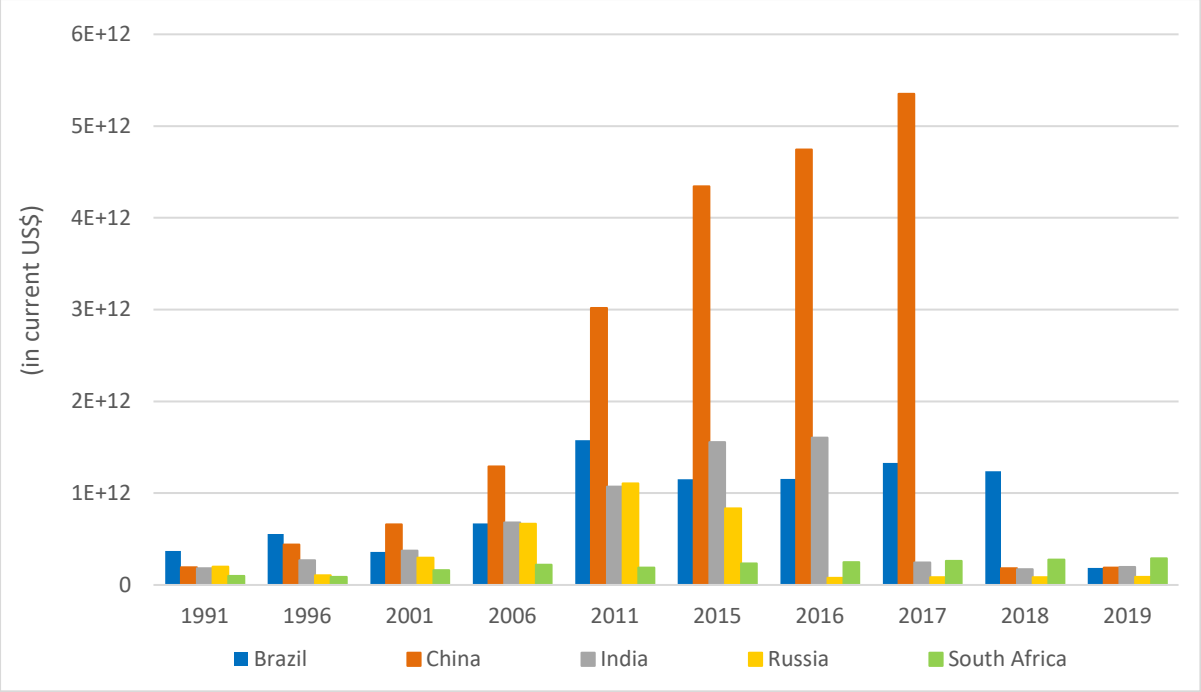

Figure 2.14: Per capita household consumption expenditure (current US$) in BRICS (1991-2019). Source: WDI.

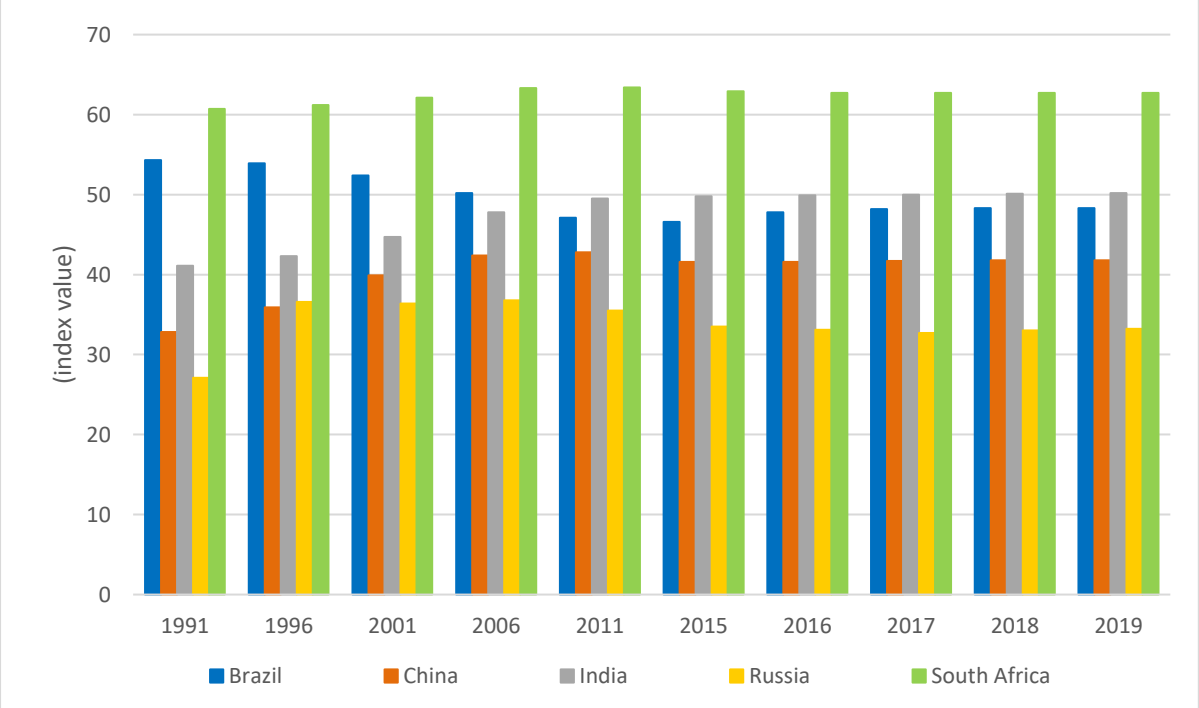

Figure 2.15: Gini index (post-tax) in BRICS (1991-2019). Source: Standardized World Income Inequality Database (SWIID).

2.8 Carbon Emissions

Carbon emissions is a greenhouse gas emitted from natural and human activities, responsible for continuously increasing global warming in the atmosphere. Out of many reasons for high CO_2 emissions, burning fossil fuels is the most significant. In the modern era of the technological and industrial revolution, energy consumption for human activities like electricity generation, transportation, and iron and cement production requires higher combustion of fossil fuels resulting in higher CO_2 emissions, especially in developing countries where alternatives to primary energy sources are scarce. In 2019, most of the BRICS countries were identified among the top 10 CO_2 emitters in the world. BRICS accounted for nearly 38.25 percent of global primary energy consumption, with China acing the race with a total primary energy consumption of 24.27 percent (International Energy Agency). The statistics in Figure 2.16 shows that, on average, China marked the highest carbon emissions in the last three decades among all five countries, followed by India, Russia, Brazil, and South Africa. In 2019, China emitted 10,057 metric tonnes of CO_2, followed by carbon emissions of 2422 metric tonnes in India, 1145 metric tonnes in Russia, 848 metric tonnes in Brazil, and 446.

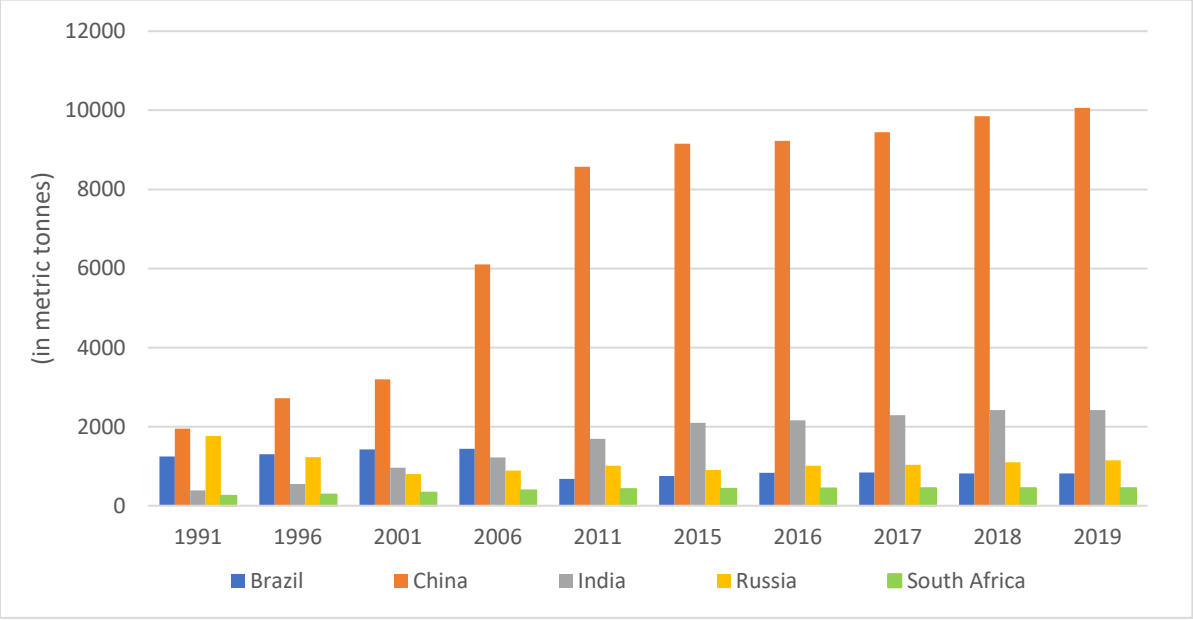

Figure 2.16: CO_2 emissions (in metric tonnes) in BRICS (1991-2019). Source: Climate analysis indicators tool (CAIT).

China is heavily dependent on coal power for its energy consumption which produces twice the amount of CO_2 compared to fossil fuels. It is responsible for almost 27 percent of the world's greenhouse gases in 2019 (Bloomberg, 6 May 2021). Although the Asian superpower is home to the world's largest population, it's per capita emissions remain lower than many developed countries. However, over the last two decades, emissions per person have increased by a factor of three. Most of China's carbon dioxide (CO_2) emissions come from its industrial sector and construction-related activities. Secondly, in India, the rapidly increasing use of dirty energy sources to fulfill the high electricity demand since 2000 has highly contributed to the continuous rise of carbon emissions. Since 2005, India's carbon emissions have doubled till 2019. The three most significant contributors to India's total carbon emissions are rice fields, coal-fired power plants, and livestock. On the other hand, Brazil has shown a declining trend for carbon emissions since 2011 because of a significant decline in deforestation that contributed to its pledged goal to cut carbon emissions by 37 percent by 2025 since 2005. The energy transition in Brazil towards a renewable energy mix turns out as one of the most pro-environment cleanest energy matrices, accounting for approximately 85 percent of power generation from renewable sources. However, non-renewable energy still dominates the total primary energy supply basket, accounting for almost 57.2 percent (Wills & Westin, 2020). In addition, an essential factor in Brazil's success in cutting carbon emissions was the adoption of energy-friendly policies that boosted investment in renewable energy sources to diversify the country's energy mix.

For Russia, carbon emissions fell until about 2015, and then they began to rise again. The primary causes of this are the dissolution of the Soviet Union and the gradual depletion of global carbon sinks. The collapse of the Soviet Union in 1991 transformed the economy from a state-controlled to a market economy, leading to the drastic restructuring of the food industry in Russia. The massive reduction in beef consumption in the 1990s significantly reduced

carbon emissions. However, later, the demand for meat rebounded with the stabilizing Soviet economies. As a result, these Soviet economies became one of the largest beef importers, which resulted in rising carbon emissions yet again. Simultaneously, the collapse of agriculture led to the relocation of the rural population to urban areas. Quickly, these vast areas of untouched agricultural land started to serve as giant carbon sinks. With Russia looking to revive its agricultural sector, it will be increasingly challenging to control associated carbon emissions. In reference to South Africa, however, the economy is the least carbon-emitting among the five but still reports continuously rising carbon emissions. Despite a meager increase in the use of renewable shares in the energy mix, the effects of renewable energy resources are insignificant in reducing overall carbon emissions. Also, with the increasing trade integrations over the year since 1991, carbon emissions have continuously degraded the environmental quality. This prompts to analyse whether higher trade openness triggers carbon emissions in BRICS.

Chapter-3

Methodology

3.1 Introduction

This thesis mainly undertakes panel data techniques to empirically estimate the effects of trade openness on inflation, poverty reduction, economic growth, and carbon emissions, taking institutional quality into account. For this purpose, the study derives four objectives (for a detailed overview of the objectives, see section 1.5 in Chapter 1), empirically analysed using panel data techniques. The panel data combines the cross-section dimensions with time series dimensions and provides an advantage by increasing the number of observations, thereby improving the power of the tested model. However, including the cross-section dimension posits the development of some new issues, namely the contemporaneous presence of cross-sectional dependency and heterogenous cross-section correlation, which can cause bias in results. As a result, the study divides the methodology into two sections. The former section discusses econometrics techniques under the assumption of cross-sectional independence, while the latter concerns the methods under the premise of CSD. In addition, the study incorporates the section on the time series technique for individual country assessment and devising the indices used for analysis.

3.2 Panel Data Techniques (with cross-sectional independence)

This section of panel data techniques takes up the strong assumption of cross-sectional independence across i and the existence of homogenous slopes. The units' heterogeneity is limited to their intercepts, which can be treated as random or fixed. The augmented dickey-fuller (ADF) test by Im, Pesaran, and Shin (IPS) (2003) and the Levin Lin Chu (LLC) tests by Levin and Lin (2002) are widely popular among the panel unit root tests that depend on the cross-sectional independence and are referred to as first generation unit root tests.

3.2.1 First Generation Unit Root Test

The non-stationary data provides inefficient esti0mates unless the panel data are cointegrated. Under the assumption of cross-sectional independence for the first-generation unit root methods, the LLC technique tests the null hypothesis that the panel contains the same autoregressive parameters and unit root with H_0: $\rho=0$ and alternative $H_1= \rho<1$. The rejection of the null hypothesis concludes the existence of a common unit root process. The method obliges to the assumption of strongly balanced data and can be represented as

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{l=1}^{\rho_i} \emptyset_i, l\, \Delta y_{i,t-1} + \alpha_i d_{it} + \varepsilon_{it} \quad (3.1)$$

where $\rho = 0$ denotes the unit root for I, $\rho < 0$ shows the stationarity around the deterministic component d_{it}, and ε_{it} is the error term. Simultaneously, the method assumes the aggressive alternate hypothesis of convergence among all individual units '*i*', which is too strong to be held true empirically. IPS relaxes this assumption $\rho_1= \rho_2= \rho_3= \ldots. =\rho_n$ under the alternate hypothesis. The IPS test assumes the same time (*t*) for all the cross-sectional units. Compared to the LLC test, the IPS test considers the heterogeneity among the autoregressive parameters and combines the evidence from various independent unit root tests on individual units. The

test for IPS unit root without time trend and individual effects are based on the following equation

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{z=1}^{p_i} \beta_{i,z} \Delta y_{i,t-z} + \varepsilon_{i,t} \quad (3.2)$$

The method defines the null hypothesis as $\rho_i = 0$ and the alternative hypothesis as $\rho_i < 0$. IPS test allows heterogeneity among the values, instead of pooled data, it uses separate unit root tests for each cross-sectional unit (N) to check the stationarity. In cases where serial correlation is suspected, the IPS test is recommended. The test is based on t-statistic values of the augmented dickey-fuller (ADF) test. The technique is relevant in analysing the stationarity for the variables in objectives ii, iii, and iv. The test will help to reveal the stationarity properties of the variable assuming cross-section independence.

3.2.2 Pedroni and Kao Cointegration Test

The Pedroni (2004) cointegration test is used to determine whether or not the variables are associated in the long run. This cointegration technique tests the cointegration for two statistics: panel means, and group means test statistics for cointegration. It undertakes the statistics for both between and within dimensions and allows for country-specific fixed effects. The model for the Pedroni cointegration test can be represented as follows:

$$\Delta y_{i,t} = \alpha_i + \delta_t + \sum_{n=1}^{n} \gamma_{ni} x_{ni,t} + \mu_{i,t} \quad (3.3)$$

where y is the endogenous variable, and x is the exogenous variable, assuming both are stationary at first difference. Further, α_i is the intercept term, n represents the number of independent variables, and $\mu_{i,t}$ denotes the residual term. The method estimates the fundamental equations of OLS and utilises its residual estimates to find the model:

$$\mu_{i,t} = \vartheta_i \hat{\mu}_{i,t-1} + \tau_{i,t} \quad (3.4)$$

The method assumes the null hypothesis of no cointegration among the variables and panels. The significant probability value obtained from the estimation implies the rejection of the null hypothesis and concludes the models to be cointegrated in the long run. The further application of Kao (1999) cointegration test checks the robustness of these results. The proposed cointegration test by Kao (1999) checks whether the related variables are cointegrated in the panel. The method is conditional to the ADF test and constrains the number of independent variables included in the cointegration matrix. It assumes a homogeneous slope coefficient for all the cross-sectional units, while heterogeneity is assumed for the intercept in the model. Considering the bivariate model, its specification can be expressed as:

$$y_{it} = \alpha_i + \delta x_{it} + \mu_{it} \tag{3.5}$$

$$y_{it} = y_{it-1} + \gamma_{it} \tag{3.6}$$

$$x_{it} = x_{it-1} + \varepsilon_{it} \tag{3.7}$$

where α_i shows the fixed effect for the cross-sectional units. The estimated residual term for the ADF test can be expressed as

$$\hat{\mu}_{it} = \theta \hat{\mu}_{it-1} + \sum_{j=1}^{p} \rho_j \, \Delta \hat{\mu}_{it-j} + \vartheta_{itp} \tag{3.8}$$

The technique is relevant in analysing the long-run relationship between trade openness, institutional quality, and poverty reduction (assuming cross-section independence) in objective ii for BRICS. The test will pave the way toward a coefficient analysis to confirm the long-run cointegration of the variables.

3.3 Panel Data Techniques (with cross-sectional dependence)

Since the 1990s, strong and increasing economic and financial interdependencies have increased the sensitivity of countries to common shocks and unobserved factors, thereby increasing the heterogeneities and cross-sectional dependencies among panel units. Avoiding the same may diminish the efficiency gains associated with panel data techniques when compared to the single-equation OLS methods. Therefore, this section discusses the econometric tests assuming CSD and heterogeneities among panel units to maintain the estimation efficiency. Thus, checking for these issues is the foremost priority as a prerequisite to the subsequent analysis steps.

3.3.1 Slope Homogeneity Test

To check the heterogeneity among the panels, the study uses two delta test statistics ($\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$) by Pesaran and Yamagata (2008), which is an improved version of Swamy's slope homogeneity test (1970).

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\bar{S}-k}{\sqrt{2k}}\right) \sim X_k^2 \tag{3.9}$$

$$\tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\bar{S}-k}{v(T,k)}\right) \sim N(0,1) \tag{3.10}$$

where N is the number of cross-sectional units, S represents the test statistics by Swamy, and k shows explanatory variables. The method assumes the null hypothesis of homogeneity among slope coefficients. Since $\tilde{\Delta}_{adj}$ symbolizes the mean adjusted version of the standard $\tilde{\Delta}$, the assumption of no autocorrelation is a prerequisite. Relaxing this assumption, Blomquist and Westerlund (2013) developed a more robust homogeneity test, namely Heteroscedasticity and Autocorrelation Consistent (HAC).

$$\Delta_{HAC} = \sqrt{N}\left(\frac{N^{-1}S_{HAC}-k}{\sqrt{2k}}\right) \sim X_k^2 \quad (3.11)$$

$$(\Delta_{HAC})_{adj} = \sqrt{N}\left(\frac{N^{-1}S_{HAC}-k}{v(T,k)}\right) \sim N(0,1) \quad (3.12)$$

The test rejects the null hypothesis slope homogeneity when the probability value arrives at less than 0.05. This method has been proven most relevant for panel data models to be used for this study.

3.2.2 Cross-Sectional Dependence (CSD) Test

The statistical methods used to examine the CSD among panel units include Breusch and Pagan LM test (1980), the Pesaran CD test (2004), and Pesaran scaled LM test (2004). These methods will help to provide a detailed picture of the presence of CSD among BRICS. These diagnostics test the null hypothesis of independent and non-correlated cross-sections among the panel. Since the data of the study attributes small cross-sectional units, the Breusch and Pagan LM test (1980) comes out as an appropriate choice and is given by

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \quad (3.13)$$

where LM represents the Breusch and Pagan LM test and $\hat{\rho}_{ij}$ denotes the sample estimate of the residual's pairwise correlation. On the other hand, the Pesaran scaled LM test (2004) is the best choice for larger panels with larger time dimensions. However, data heterogeneity arises as a prime issue among panel data units in the Pesaran CD test (2004). The test is effective for the panels specifying both smaller units in cross-section and the time dimensions and is given by

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \quad (3.14)$$

This method provides better estimates even if the cross-sectional units and the time dimension are large and bias is less likely. Compared to the Breusch and Pagan LM test, the Pesaran CD statistics assume the mean at exactly zero for both heterogeneous and homogeneous panel-data models. In such a case, the RE and FE produced estimates can be biased but still valid because of the symmetrically distributed disturbances and zero mean value. Therefore, based on the CSD information and following the data attributes, namely the small cross-sectional units with heterogenous data, the study benefits from all the methods.

3.2.3 Second Generation Unit Root test

In case cross-sectional tests reject the null hypothesis, the study applies second-generation unit root tests. Due to the extensive economic and trade interdependencies among the BRICS, the second-generation unit root tests are applicable to all the objectives of this research. However, the specification under the cross-sectional dependencies is not obvious and contains no natural ordering. Therefore, one of the second-generation tests devised for the analysis is the Cross-section ADF (CADF) by Pesaran (2007). The test assumes the null hypothesis of non-stationary data. To check the stationarity among the heterogeneous panels, CADF uses ADF or DF regression by augmenting it with cross-section averages of the first-differenced and lagged values of the individual test series, which eliminates the CSDand provides efficient results for the models showing linear trends and the presence of serial correlation among residuals.

The equation for CADF with serially uncorrelated residuals can be represented as

$$\Delta y_{it} = \alpha_i + \rho_i^* y_{i,t-1} + d_0 \bar{y}_{t-1} + d_1 \Delta \bar{y}_t + \varepsilon_{it} \quad (3.15)$$

where, $\bar{y}_{t-1} = \left(\frac{1}{N}\right) \sum_{i=1}^{N} y_{i,t-1}$, $\Delta \bar{y}_t = \left(\frac{1}{N}\right) \sum_{i=1}^{N} y_{i,t}$, and t_i (N, T) denotes the t-statistic value of ρ_i (OLS Estimate). The method is sensitive to the extreme outcomes arising from small t in the sample data. A truncated version of CADF, i.e., CADF*, is used to avoid such a problem.

The basic idea here is to build the modified t-bar test for IPS (generally represented by CIPS and CIPS* by Pesaran (2007)) based on the averages individually obtained from CADF and CADF* tests.

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} t_i\,(N,T) \tag{3.16}$$

$$CIPS^{*} = \frac{1}{N}\sum_{i=1}^{N} t_i^{*}\,(N,T) \tag{3.17}$$

Compared to the other models proposed for panel unit root with CSD, like Bai and Ng (2004), Phillips and Sul (2003), and Moon and Perron (2007), the methodology by Pesaran is based on proxies for a common factor, and the OLS estimates rather than PCA, which makes its application easier.

Further, the cointegration tests are applied to analyse the long-run relationship among the panel. Pedroni's and Kao's panel cointegration methods are the most widely used methods to examine the existence of a long-run link between the variables. However, the supposition of cross-sectional independence of these methods is highly restricting. Given the presence of CSD, the Westerlund panel cointegration technique (2007) is the perfect fit for the analysis.

3.2.4 Westerlund Panel Cointegration Test

In the next step, the study employed Westerlund (2007) panel cointegration test to analyse the long-run cointegration. Over the conventional Pedroni and Kao cointegration methods, the Westerlund cointegration test allows heterogeneity under short-run and long-run dynamics and permits CSD. It allows heterogeneity among the slopes and trends, individual-specific trends, and fixed effects. This method proposes a bootstrap method for the small sample that enables several cointegration test repetitions and provides better estimates. The results from this technique (for objectives i, ii, and iv) will also help to

conform with the cointegration estimations attained under cross-sectional independent cointegration techniques such as for objective i.

The rationale for the Westerlund cointegration test is to examine the error-correction-based cointegration with the null hypothesis of no cointegration. The rejection of the null hypothesis indicates the presence of a long-run relationship among the variables and that all the panels or only some panels are cointegrated. The method proposes four statistics to check cointegration, consisting of both panel and mean statistics.

$$G_T = \frac{1}{N}\sum_{i=1}^{N}\frac{\epsilon_i}{Se(\widehat{\epsilon_i})} \tag{3.18}$$

$$G_\alpha = \frac{1}{N}\sum_{i=1}^{N}\frac{T\epsilon_i}{\epsilon_i'(1)} \tag{3.19}$$

$$P_T = \frac{\widehat{\epsilon_i}}{Se(\widehat{\epsilon_i})} \tag{3.20}$$

$$P_\alpha = T\hat{\epsilon} \tag{3.21}$$

where ϵ_i represents the error correction speed towards its original equilibrium level, Se is the least square estimate, and T denotes the time dimension. The results from the former two equations confirm whether or not cointegration exists in at least one cross-sectional unit. In contrast, the latter two exhibit whether cointegration exists in the whole panel.

3.2.5 Generalised Method of Moments (GMM)

The Generalised method of moments (GMM) by Blundell and Bond (1998) is a statistical method to estimate the parameters by including the instruments within the lagged differences and lagged levels. This method overcomes the challenges arising in the ordinary least squares (OLS) estimations, such as disregarded individual and time dimensions. This causes bias and misleading outcomes, rendering all random and fixed effect methods inappropriate for panel

analysis (Baltagi & Kao, 2000). In this support, Roodman (2009) and Bond (2002) ascertained system GMM to be an optimal solution, especially when overcoming the issues of the possible presence of unobserved individual effects such as panel autocorrelation, endogeneity, and heterogeneity. The GMM estimator can be represented as

$$\hat{\beta} = arg \min_{\beta} \hat{g}(\beta)' \hat{A} \hat{g}(\beta) \tag{3.22}$$

where, $\hat{g}\beta \stackrel{\text{def}}{=} \sum_{i=1}^{n} g_i(\beta)/n$, i.e., the sample averages, $\hat{A}$ is m*m positive semi-definite matrix, $g_i(\beta) = g(w_i, \beta)$ with m×1 vector of functions of i^{th} data observation w_i and parameter β.

The applicability of the system GMM assumes T > N for the efficient estimations. However, the validity of its outcome for the small sample with T < N is still unknown. The studies ensure that the properties of this estimator are not hindered even when N is so small (Koengkan, 2018; Santos & Barrios, 2011; Sassi & Goaied, 2013; Soto, 2009; Vu, 2017). In this line, Al-Sadoon et al. (2019) found consistency in the Arellano and Bond (1991) estimators for small samples regardless of the severity and nature of the sample selection procedure. As a result, due to its greater reliability and lower bias for the small and finite samples than all other methods based on the studies by Soto (2009) and Hayakawa (2007) and the method is appropriate to analyse the impact of trade openness and institutional quality on economic growth under objective iii.

The diagnostic tests, to examine the autocorrelation and over-identifying restrictions of the model, ensure the reliability and efficiency of results. On the one hand, the autoregressive test AR (2) examines the autocorrelation among differenced error terms, whereas, on the other hand, the Sargan test (1958) and Hansen J test (1982) check the existence of over-identifying restrictions and instrument validity in the model.

3.2.6 Pooled Mean Group (PMG) Method

Pooled mean group (PMG) estimator of ARDL by Pesaran, Shin, and Smith (1999) is a statistical procedure that allows the estimation of short-run and long-run linkages among the heterogenous panels despite the existence of endogeneity. The PMG estimator is advantageous over the mean group (MG) and dynamic fixed effects (DFE) as it allows error variances and short-run slope coefficients to differ freely across the groups while keeping long-run coefficients identical. The method is useful when the long-run relationship between the variables is expected to be identical across economies. This improves the statistical inferences and allows the short-run factors to vary according to country-specific features. In doing so, the method creates the short-run coefficients by averaging the coefficients at the individual country level. The econometric specification for PMG in a dynamic setting can be represented as

$$\Delta Y_{i,t} = \alpha_i + \varphi_i\left(Y_{i,t-1} - \beta_i \Delta X_{i,t}^{'s}\right) + \sum_{j=1}^{p-1} \theta_{ij}\, , j\Delta X_{i,t}^{'s} + \sum_{j=1}^{q-1} \tau_{ij}\, , j\Delta Y_{i,t} + \mu_i + \varepsilon_{i,t} \qquad (3.23)$$

where β_i is the long-term parameter, φ_i is the equilibrium parameter, $Y_{i,t}$ is the dependent variable, X is the independent variables, i shows the countries, and t represents time.

The negative error correction term (ECT) ranging from 0 to 1 and uncorrelated residual terms in the model confirm the validity and efficiency of the results. Thus, the value of φ_i is expected to be less than 0 but not less than 1 for the model to hold and validate that the models are cointegrated. The higher value of φ_i denotes the high speed of convergence toward the original equilibrium level. On the other hand, $\varphi_i = 0$ denotes the non-existence of the model and disturbs its validity. The method assumes uncorrelated error terms with a mean zero and variance greater than zero. The study uses this method to derive the long-run and short-run effects of institutional quality and trade openness on economic growth for BRICS in objective iii.

3.2.7 Driscoll-Kraay Standard Error Method

Driscoll-Kraay standard error method is a non-parametric analysis to examine the long-run relationship among the panel variables. The method provides more rigorous and reliable estimates when dealing with the issues of heterogeneity and CSD. Compared to the other conventional econometric techniques like OLS, fixed effect OLS, Random effect OLS, and GMM, among many others, the Driscoll-Kraay standard errors method estimates the regression results using robust standard errors generated using weighted heteroskedasticity and autocorrelation consistent (HAC). It adjusts the cross-sectional averages by applying the Newey-West-type correction method on the averages of moment conditions. The standard errors generated through this method are well calibrated with the econometric issues like autocorrelation and ensure the estimators are cross-sectional independent. Even in the case of larger time dimensions, this non-parametric method posits no constraints on the feasibility and behavior of the panel. Thus, it provides more precise estimates than other methods like FGLS and PCSE for the small samples, which are lacking in this area. However, the panel data in this study call for the fixed effect with this method, estimated using the Hausman test. The fixed effect under Driscoll-Kraay standard error can be implemented in the two steps. In the first step, using regression, all the variables $z_{it} \in \{y_{it}, x_{it}\}$ will be transformed within.

$$\tilde{z}_{it} = z_{it} - \bar{z}_{it} + \bar{\bar{z}} \tag{3.24}$$

where, $\bar{z}_{it} = T_i^{-1} \sum_{t=t_{i1}}^{T_i} z_{it}$ (3.25)

and, $\bar{\bar{z}} = (\sum T_i)^{-1} \sum_i \sum_t z_{it}$ (3.26)

Since the within-estimator parallels with the OLS estimator:

$$\tilde{y}_{it} = \tilde{x}'_{it}\theta + \tilde{\varepsilon}_{it} \tag{3.27}$$

This regression is further estimated using the OLS estimation along with Driscoll-Kraay standard errors. This approach serves as a robustness check for examining the impact of trade openness and institutional quality on poverty reduction and carbon emissions under objectives ii and iv.

3.2.8 Dynamic Common Correlated Effects (DCCE) Estimate

The panel data techniques like random and fixed effects, FMOLS, and GMM models assume homogeneous cross-section panels and allow variations only among panel unit intercepts, which may produce misleading outcomes. Thus, using the DCCE model developed by Chudik and Pesaran (2015) is viable, which allows the heterogeneity and CSDamong the panel units. The statistical approach of this method is embodied with the features of the MG designed by Pesaran and Smith (1995), Pooled Mean Group (PMG) designed by Pesaran et al. (1999), and CCE designed by Pesaran (2006).

This DCCE approach by Chudik and Pesaran (2015) consists four-fold benefits over other traditional econometric approaches as (1) it resolves the CD issue using average values and lags of cross-sectional units altogether, (2) it controls for heterogeneity, (3) it is appropriate for small sample case, (4) generate reliable outcomes in the condition of structural breaks and unbalanced data (Ditzen, 2016). Considering these benefits of the approach, the study uses the DCCE method to determine the coefficient estimates for the effects of trade openness on inflation, poverty reduction, and environment quality (in objectives i, ii, and iv). The estimated DCCE model can be written as follows:

$$\ln Y_{it} = \alpha_i \ln Y_{it-1} + \beta_i X_{it} + \sum_{p=0}^{Pt} \gamma_{xip}\, \bar{X}_{t-p} + \sum_{p=0}^{Pt} \gamma_{yip}\, \bar{Y}_{t-p} + \mu_{it} \quad (3.28)$$

where, $\ln Y_{it}$ is the log of the dependent variable and $\ln Y_{it-1}$ represents its lag value. X_{it} is the set of exogenous variables in the model. γ_{xip} and γ_{yip} denotes the unobserved common factors

of regression. Lastly, P_t and μ_{it} shows the lag of the cross-sectional average and the error term, respectively. For the small sample, the DCCE approach provides the option for the jackknife and recursive mean adjustment approach, making the inferences equally effective for the small sample size (Chudik & Pesaran, 2015; Ditzen, 2016). This increases the efficiency and reliability of the estimated outcomes.

3.3.9 Dumitrescu and Hurlin (D-H) Panel Causality Test

The traditional techniques to investigate the causality among the variables extend the restrictions of cross-sectional independence. Since the panel data include many countries, the probability of extending the given information from one variable to another is high. Similarly, a causal relationship among the countries is also likely. Therefore, the efficient estimation for causality requires examining the variables with NT observations. However, using cross-sectional data for the estimation implicitly implies considering heterogeneity among the panels and countries. The standard implication for the causality proposes the null hypothesis where x causes y for N countries or individuals under the strong assumption of homogeneity. Therefore, this study employed the conventional methods of the D-H panel causality test to examine the causal relationship among the variables in BRICS for objectives i, ii, and iv. The method produces relatively more consistent results in the presence of CD and heterogeneity. The test considers the heterogeneity of the causality and heterogeneity for the regression test that is used for the causality testing. It's efficiency of results to ascertain the causal relationship for the panels with small N and large T makes it a more appropriate choice for the analysis. The model for the D-H causality test can be expressed as

$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} Y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} X_{i,t-k} + \varepsilon_{it} \quad (3.29)$$

where Y_{it} and X_{it} are the stationary variables. The method assumes the same lag order for each variable with panel stability.

3.4 Time Series technique

3.4.1 Fully Modified Ordinary Least Squares (FMOLS)

The FMOLS technique developed by Philips and Hansen (1990) estimates the long-run relationship between the variables integrated at order 1. The technique produces more reliable and efficient results for small sample analysis than other methods like Engle-Granger (EG) techniques. The additional advantage of FMOLS over the EG estimator includes overcoming the difficulty of the inference issue, which ensures the validity of long-run estimates of the t-test. FMOLS method modifies the least square to the effects of serial correlation and endogeneity resultant from the existence of a cointegrating association between the variables (Kalim & Shahbaz, 2009). The method performs a semi-parametric adjustment to eliminate the issue of long-run correlation among the cointegrating equations and stochastic regressors innovations. The model can be denoted as:

$$\beta_{NT}^{*} - \beta = \left(\sum_{i=1}^{N} L_{22i}^{-2} \sum_{i=1}^{t} (\chi_{it} - \bar{\chi}_{it})^2\right) \sum_{i=1}^{N} L_{11i}^{-1} L_{22i}^{-1} \left(\sum_{i=1}^{T} (\chi_{it} - \bar{\chi}_{it})\, \mu_{it}^{*} - T\hat{\gamma}_i\right) \qquad (3.30)$$

where $\mu_{it}^{*} = \mu_{it} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}} \Delta\chi_{it}$, $\hat{\gamma}_i = \hat{\Gamma}_{21i}\hat{\Omega}_{21i}^{0} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0}\right)$,

and $\hat{L}_i$ is the lower triangulation of $\hat{\Omega}_i$. The study uses this technique to analyse country-specific effects of trade openness and institutional quality on economic growth in BRICS under objective iii. The estimated findings will aid in better understanding the impact of trade openness on individual countries and developing appropriate policy measures.

3.5 Principal Component Analysis

Principal component analysis (PCA) is a method to reduce the dimensionality of large datasets into smaller ones while preserving as much information as possible. Firstly, the method standardises the continuous range of variables to the comparable scale so that each variable equally contributes to the estimation. For this purpose, Bartlett's sphericity test examines the relationship between variables with the null hypothesis that variables are not interrelated. The significant chi-square value indicates rejection of the null hypothesis, implying that using PCA is plausible. Secondly, it identifies if there is any correlation between the variables because high correlations cause information redundance. Thirdly, the method estimates the eigenvalues and eigenvectors to determine the principal components of the matrix. In the final step, the method retains only those components that highly explain the feature and will be used in the final set of information for the index. The formulation of the index is based on the following formula:

$$\delta = \Sigma_{i=1}^{t} h_i \frac{X_{it}}{sd(x_i)} \tag{3.31}$$

Here, δ represents the index formed using PCA, X shows the i_{th} items in t_{th} year, and h_i is the factor loadings procured from the analysis. To evaluate the data sampling adequacy and robustness, Kaiser-Meyer-Olkin (KMO) test is implemented where the results ranging from 0 to 1 and statistical values closer to 1 represent better sampling. The test helps to eliminate the variables that do not meet the criterion, which aids in providing a reliable index. The study uses this approach to construct the institutional quality index for objectives iii and iv and the political stability and political efficiency index for objective iv.

3.6. Summary

Existing studies examine institutional roles by considering only certain characteristics or using an overall index, which fails to capture the impact for political efficiency and stability separately. Furthermore, critical issues such as endogeneity, heterogeneity, and cross-sectional dependence (CSD) are frequently neglected and require attention. Therefore, this thesis aims to address these concerns by employing panel data techniques to empirically estimate the effects of trade openness on selected macroeconomic variables. To achieve this objective, the study constructs two institutional quality indices, such as political stability and political efficiency, obtained through principal component analysis (PCA). As a preliminary step, the study examines common shocks through tests for heterogeneity, autocorrelation, multicollinearity, and CSD. Subsequently, panel data unit root tests are conducted to confirm the stationarity of the variables (see chapter 4, 5, 6, and 7). The existence of long-run cointegration is then examined using Pedroni, Kao, (see chapter 5) and Westerlund cointegration tests (see chapter 4, 5, and 7). Further, the short-run and long-run coefficients for the established panel models are estimated using approaches such as DCCE (see chapter 4, 5, and 7), PMG (see chapter 6), GMM (see chapter 6), and Driscoll-Kraay standard error approach (see chapter 5 and 7). The individual country assessments are conducted using the FMOLS (see chapter 6) method. Finally, the study investigates the causal relationship between the variables using the Dumitrescu-Hurlin causality test (D-H) (see chapter 4, 5, and 7) to ensure conformity.

Chapter-4

Trade Openness and Inflation

4.1 Introduction

The recent economic disturbances, such as the outbreak of coronavirus, the Russia-Ukraine war, and disrupted supply chains, have resulted in high inflationary shocks that are difficult to combat. The most vulnerable to these global shocks are developing open countries where trade is crucial to economic growth. High trade integration creates a significant impact on the domestic as well as foreign output gap. However, the effect of these output gaps depends on the trading basket mix of countries. Since developing countries, like BRICS, rely heavily on imported goods to fulfill the domestic output gap at affordable prices, it is crucial to check the impact of trade openness and output gap on inflation in these economies.

4.2 Review of Literature

4.2.1 Theoretical Literature

The theoretical linkages realising the effect of trade openness and inflation, derived from the time, have marked prominent changes in the view of an open economy since its evolution. The prospect of the link between trade openness and inflation can be elucidated in two ways. On one line, the spill over hypothesis states the negative link and theorizes higher integration of trade with other world economies causes inflation to fall. In support, the studies

(Rogoff, 1985) indicate that the depreciating exchange rate escalates monetary surprise cost resulting in the lower incentive of unanticipated monetary expansion.

Similarly, the new growth theory outlines lower inflation as openness stimulates growth in small open economies. A likely effect on inflation is observed through output when the changes in the composition of domestically acquired inputs increase the efficiency of production (Jin, 2000). The studies also mention that better resource allocation and improved capacity utilisation reduce inflation favorably (Ashra, 2002). The pressure on prices is eased more by an upturn in foreign investment that spurs output growth in the more open economies (Binici et al., 2012). Higher economic integration mitigates the effects of output fluctuation on inflation domestically (Okun, 1963).

Conversely, the cost-push hypothesis proposes that inflation varies positively with the degree of trade integration in the world economy. The argument here holds that more open economies are highly susceptible to imported inflation due to external market shocks like exchange rate fluctuations or sudden policy disagreements with the trading partners (Aron & Muellbauer, 2007). The massive share of imported industrial and manufactured goods in the trading basket and heavy dependence on imported inputs makes developing economies more vulnerable to imported inflation (Lotfalipour et al., 2013). Besides, higher economic integration reduces the effectiveness of fiscal and monetary policies, especially in controlling inflation. However, the output level that causes a price change is ultimately a net result of both policy effectiveness and imported inflation.

In this light, Romer's theory states that more open economies reflect lower inflation rates under discretionary policymaking (Romer, 1993). The theory finds that the absence of any beforehand monetary policy may lead to soaring price levels. The effect of openness on inflation is

channelled through fluctuations in macroeconomic factors like depreciating exchange rates, CPI inflation, domestic inflation, and economic output. Here, CPI inflation comprises the value of the foreign commodities in the consumption basket, while domestic inflation includes the prices of other commodities. However, the changes in the factors are not constrained to the degree of trade openness of the country. However, a higher welfare cost of depreciating exchange rates is endured in highly integrated economies. The exchange rate acts as a disincentive to monetary policy, which leads to import price inflation and, ultimately, higher inflation.

In the case of monetary expansion and sticky prices, the theory finds inflation to be affected through output, where a gradual change in foreign output is assumed to be less than domestic output. The absorption of these increased domestic goods will require a relative fall in domestic prices, leading to a two-way effect on the real exchange rate. First, a depreciating exchange rate affects the price of foreign goods causing higher CPI inflation in the economy. Secondly, the real exchange rate increases domestic firms' production costs, resulting in changed price levels. The effects of monetary expansion may vary with the size of the trading countries. When dealing with a small country, the impact of the home country's price will be relatively less. This is because larger trading nations are less sensitive to even a small change in the exchange rate of a smaller trading nation. Thus, an increase in openness may result in a reduced impact of monetary expansion at home and foreign output. Therefore, the model suggests that a higher degree of openness helps mitigate inflation.

Another way to determine the relationship between trade openness and inflation is via the Phillips curve. The theory of the Phillips curve determines the impact of openness on inflation with the help of the marginal cost, generally proxied by the share of labor in the economy (Ali & Syed, 2012). However, information on the labor structures and their contribution is lacking in the case of many developing countries. Therefore, the output gap is considered the better substitute

established under the New Keynesian Phillips Curve (NKPC) through the marginal cost-output gap relationship.

The framework under New-Keynesian focuses on the two main elements that determine the responsiveness of domestic price levels to the changes in domestic economic activity: inflation elasticity vis-à-vis real marginal cost and responsiveness of the real marginal cost to changes in the output gap. The former factor relies on the frequent adjustment in prices that indicates the degree of rigidness in nominal prices and responsiveness of firms' profit-maximising price to changes in real marginal cost resting upon the degree of real price rigidity (Watson, 2016).

The predictions regarding the relationship between openness and output-inflation tradeoff embody two different sets of models. The first set of models by Romer (1993) and Lane (1997) reveals a steeper Phillips curve when higher trade openness reduces inflation in the economy. Such a smaller tradeoff between output and inflation is backed by the mechanism where the monetary expansion causes real depreciation that triggers terms of trade to turn negative. The benefits of terms of trade reduce more for the large countries (Lane, 1997).

Besides, the second set of models includes the aspects given by Daniels & VanHoose (2006) and Razin & Loungani (2007). The former presumes the existence of monopolistic competition in the economy. Thus, more openness to world economies reduces the pricing power of domestic firms. The contraction of pricing power reduces the output effect of the unexpected price increase through monetary expansion. This results in a larger output-inflation tradeoff. The model also mentions that higher responsiveness of domestic spending to real depreciation reduces the tradeoff but raises the inflation bias. The large countries that invest a smaller share of domestic expenditure on trade produce a lower output effect. It consequently increases the sacrifice ratio and reduces the inflation bias.

In the same line, the later aspect of the second set of the model follows similar implications. It provides two different links that reduce the inflation bias. First, the narrowed relation between output gap fluctuations and consumption in higher open economies, and second, to materialise this effect, both trade openness and financial openness enrich the hypothesis. It deduces the existence of a negative link between openness and inflation and a positive association between openness and output-inflation tradeoff.

4.2.2 Empirical Literature

The study on inflation and trade openness is not new in the discussion. Out of the existing literature, Romer's study is contemplated as one of the pioneering empirical studies directed toward the existence of a negative link between inflation and trade openness for developed countries (Romer, 1993). Although later, Bowdler & Malik (2017) unveiled that the negative association between inflation and trade openness is relatively weak in developed countries compared to emerging and developing countries. Along the same line, one of the earliest studies by Triffin & Grubel (1962) also confirmed the negative association by supporting new growth theory for the set of European countries.

The negative link is furthermore explored and supported by many studies like (Bowdler & Malik, 2017; Gruben & McLeod, 2004; Haq et al., 2014; Jedidia et al., 2019; Kim et al., 2012; Kim & Beladi, 2005; Lane, 1997; Lin et al., 2017; Sachsida et al., 2003, Samimi et al., 2012). Terra (1998) mentions the adverse effect is more pronounced for the countries with severe indebtedness levels and during the crisis time only. However, later Al Nasser et al. (2009) also evidenced the sustenance of the negative link in the pre-crisis period. The relationship is also tested for the small economies open to trade where the surplus in money supply decreases the incentive of monetary policy expansion, restraining inflation (Haq et al., 2014). It helps limit the seignorage, tackle government fiscal deficits, and control inflation (Bowdler & Malik, 2017). At the same, a study conducted for

a sample of Sub-Saharan African countries using the 2SLS approach also found a negative association between inflation and trade openness (Lin et al., 2017). Afzal et al. (2013) investigated the relation for Pakistan using the ARDL approach and found a negative link as well.

The rising competition among the home country producers due to high openness instigates better quality products in the market at lower prices (Salimifar et al., 2015). Trade openness affects inflation through various channels, such as better output growth, lower production cost, and better efficiency, more foreign and domestic investment.

On the contrary, the studies have also evidenced a positive relationship and mentioned the existence of asymmetries between the respective variables (Ajaz et al., 2016). An empirical analysis using the Generalised Method of Moments (GMM) method for Pakistan for almost 60 years detects positive relations (Zakaria, 2010). Besides, an analysis of MENA countries using a two-way fixed effects model also demonstrates a positive link (Lotfalipour et al., 2013). Another study by (Mukhtar, 2012) conducted for Pakistan, given the presence of linear and nonlinear relationships among variables, found soaring inflationary pressures in the short and long run due to high trade openness.

Yet, few empirical studies advocate a non-existent trade openness-inflation tradeoff. Wu & Lin (2006) reveal no clear link between the panel data analysis of G7 countries and 4 Asian countries. Consistent with this, Ghosh (2014) also concluded an insignificant link for the countries with high trade openness.

Although Aliyev & Gasimov (2014) found the results may vary for the different countries in the sample depending on the trade openness indicator. The study also evidenced mixed results, demonstrating an insignificant impact of openness in the sample countries except for Georgia due to increased import openness. Similarly, Kim & Beladi (2005) highlighted the negative

association between developing countries and the positive for developed countries. Jedidia et al. (2019) also show different results for Tunisia's linear and nonlinear analysis. It confirms the positive relationship for the linear model, while openness proved to be an effective tool to control price levels in the case of a nonlinear model. However, Lin et al. (2017) refutes the findings of Aliyev & Gasimov (2014), mentioning that the relationship between inflation and trade openness is not sensitive to using alternative trade openness indicators.

Thus, the preceding theoretical and empirical literature highlights the inconclusiveness of evidence. The unequivocal results toward the direction of the effect of trade openness on inflation create the need to analyse the link for the emerging set of countries empirically. As a result, the study focuses on determining the relationship's direction for emerging market players such as BRICS. Moreover, the existing body of literature shows that only a few studies have focused on assessing the sensitivity of price levels to foreign demand gaps. As trade with global partner's increases, the chances of imported inflation also increase. This motivates us to address the effect of the foreign output gap on the relationship between trade openness and inflation.

4.3 Data

The study utilises a quarterly dataset for Brazil, China, India, Russia, and South Africa (BRICS) from 1999Q1 to 2018Q4 to investigate the impact of trade openness and output gap on inflation. The motivation for the time of this study is entirely based on the quarterly data availability. While data for many variables is extensively available, for a few indicators such as money supply, the quarterly data is only available since 1999Q1. All the variables in the study have been de-seasonalised and are used in the natural log form.

The study utilises the measure of CPI inflation or headline inflation over core inflation as a proxy for inflation. Compared to core inflation, headline inflation includes foreign goods in its

basket of goods. Thus, the Consumer Price Index (CPI) best measures inflation. The data is based on the Federal Reserve's Economic Data Series, with 2015 as the base year.

Further, compared to the other estimates of trade openness, such as export and import intensity indices Sawhney & Kiran (2019), the trade-to-GDP ratio has been used as a measure of trade openness. Trade-to-GDP is the ratio of the total trade of goods and services to GDP. It measures the extent of the economy's dependence on foreign market goods and services, including exports and imports. Since exports and imports impact differently to inflation, this study examines their impact separately on inflation, using export openness and import openness. Here, export openness can be described export of goods and services to the total GDP, whereas import openness refers to the import of goods and services to the total GDP of an economy. The available literature shows that studies use only trade-to-GDP ratio as an openness indicator (Bowdler & Malik, 2005; Farvaque & Sarfaraz, 2009; Hanif & Batool, 2006; Jin, 2006; Kurihara, 2013; Lotfalipour et al., 2013; Yiheyis, 2013; Zakaria, 2010), or only import openness as an indicator (Bowdler & Nunziata, 2006; Jin, 2006; Romer, 1993; Temple, 2002; Terra, 1998). Since all the variables impact inflation differently, the study uses all three proxies to represent the economy's openness. The variable is constructed following the methodology as per definition using the Direction of Trade Statistics (DOTS) dataset by IMF.

Further, the output gap has been constructed to analyse the output-inflation tradeoff and capture the impact of globalisation via the Phillips curve. The output gap is the difference between the potential and the actual output of the economy in terms of potential output. Potential output is typically expressed in terms of the decelerating or non-accelerating price range. This is something that many simple techniques do not provide. While the output affects prices through marginal costs of the firms, i.e., by pushing up the prices of imported raw materials, machinery, and consumer goods, its effect depends upon domestic and foreign output (Borio & Filardo,

2007). A more significant foreign output gap raises demand for domestically produced goods, causing domestic wage levels to rise. This increases the firm's production costs, resulting in high inflation (Engel, 2011). Therefore, the study includes both domestic and foreign output gaps for analysis. Since the required datasets and the size of econometric models used to measure the output gap are impractical and difficult to calculate, the study uses real GDP data series from the Global Economic Monitor data by World Bank for its construction.

The study evaluates the efficacy of monetary policy using the Federal Reserve of Economic Data's M3 money supply indicator expressed in their own currencies. The data has been standardised using the Purchasing Power Parity (PPP) rate by the OECD. The study assumes that the money supply posits a direct proportional relationship with inflation. According to the quantity theory of money and the real balance effect, the holding amount of real cash balance depends on the predicted inflation rate that affects people's purchasing power. According to Fisher, assuming the full employment and speed of money flow, any change in the volume of money is reflected in the price level (Sepehrivand & Azizi, 2016). Thus, the expected relationship between inflation and money supply is positive.

The study uses the WDI measure of government final consumption expenditure to assess the impact of fiscal policy on inflation. Government spending impacts inflation in three ways: the change in the money supply, growth of output, and tax base (Varvarigos, 2010). Increased government spending necessitates increased public revenue, typically generated through high taxation or a monetary base. This results in high prices and reflects a positive relationship between government spending and inflation (Basu, 2001).

Last, the real effective exchange rate (REER) is utilised to analyse the effect of the exchange rate on inflation extracted from the Bruegel database. According to proponents of the cost-push

theory, exchange rate depreciation leads to more expensive imports, resulting in imported inflation (Ajaz et al., 2016; Jedidia et al., 2019; Mukhtar, 2012). Thus, the expected direction of effect is assumed to be positive.

4.4 Model Specification

Following in the footsteps of Jašová et al. (2020), the study directly estimates the domestic output gap by applying the univariate Hodrick-Prescott filter to the quarterly estimates of real GDP. The method estimates the long-run series by discounting any short-run price fluctuations using the smoothing parameter ʎ. For the quarterly data, the ʎ, i.e., smoothing parameter, is set at 1600. For this purpose, the trade-weighted foreign output gap is constructed as

$$Gap_m^G = \sum_{k \in K} \frac{(w_{m.n}^i \, Gap_n^D + w_{m.o}^i \, Gap_o^D + w_{m.p}^i \, Gap_p^D + w_{m.q}^i \, Gap_q^D)}{5} \quad (4.1)$$

here, $w_{m.n}^i$ defines the trade weights, Gap_n^D explains the domestic gap for the trading country n. The weights for the trade-weighted global output gap are assigned by using the following formula

$$w_{m.n} = \frac{imports_{m.n} + exports_{m.n}}{Total\ trade_m} \quad (4.2)$$

Looking at the significance of the foreign output gap effect, the expression uses the exports and imports done by each country within BRICS. The positive output gap indicates that actual output outweighs the potential output resulting in higher inflation due to increased demand, and vice versa for the negative output gap. However, the zero-output gap reflects price stability.

Using the aforementioned, the study lays out the framework for investigating the relationship between trade openness, output gap, and inflation. The main estimating model related to inflation, i.e., measured by the consumer price inflation, for economy '*i*' in the time '*t*' can be expressed as:

$$CPI_{i,t} = \alpha + \beta_1 TO_{i,t} + \beta_2 RGDP_{i,t} + \beta_3 REER_{i,t} + \beta_4 GEXP_{i,t} + \beta_5 MS_{i,t} + \mu_{i,t} \quad (4.3)$$

$$CPI_{i,t} = \alpha + \beta_1 IO_{i,t} + \beta_2 RGDP_{i,t} + \beta_3 REER_{i,t} + \beta_4 GEXP_{i,t} + \beta_5 MS_{i,t} + \mu_{i,t} \quad (4.4)$$

$$CPI_{i,t} = \alpha + \beta_1 XO_{i,t} + \beta_2 RGDP_{i,t} + \beta_3 REER_{i,t} + \beta_4 GEXP_{i,t} + \beta_5 MS_{i,t} + \mu_{i,t} \quad (4.5)$$

where, $CPI_{i,t}$ is the consumer price inflation, $TO_{i,t}$ denotes openness to trade, $RGDP_{i,t}$ shows the real gross domestic product, $REER_{i,t}$ means real exchange rate, $GEXP_{i,t}$ stands for government final consumption expenditure, $MS_{i,t}$ is the money supply, and $\mu_{i,t}$ represents error term. Since the sample countries are a mix of export-oriented and import-oriented countries, the study examines the impact of export openness ($XO_{i,t}$) and import openness ($IO_{i,t}$) separately, as mentioned in (4) and (5). To measure the impact of trade openness on inflation with the output gap, the following equations have been examined for all the openness measures:

$$CPI_{i,t} = \alpha + \beta_1 TO_{i,t} + \beta_2 DO_{i,t} + \beta_3 FO_{i,t} + \beta_4 RGDP_{i,t} + \beta_5 REER_{i,t} + \beta_6 GEXP_{i,t} + \beta_7 MS_{i,t} + \mu_{i,t} \quad (4.6)$$

$$CPI_{i,t} = \alpha + \beta_1 IO_{i,t} + \beta_2 DO_{i,t} + \beta_3 FO_{i,t} + \beta_1 RGDP_{i,t} + \beta_1 REER_{i,t} + \beta_1 GEXP_{i,t} + \beta_1 MS_{i,t} + \mu_{i,t} \quad (4.7)$$

$$CPI_{i,t} = \alpha + \beta_1 XO_{i,t} + \beta_2 DO_{i,t} + \beta_3 FO_{i,t} + \beta_1 RGDP_{i,t} + \beta_1 REER_{i,t} + \beta_1 GEXP_{i,t} + \beta_1 MS_{i,t} + \mu_{i,t} \quad (4.8)$$

where $DO_{i,t}$ means the domestic output gap and $FO_{i,t}$ represents the foreign output gap for economy' *i*' in the time '*t*.'

4.5 Results and Analysis

This section of the paper presents the findings on the relationship between trade openness, output gap, and inflation. In order to avoid any empirical issues, the study examines the correlation statistics among the variables, as presented in table 4.1. The results presented in

the table confirm that no correlation statistic is greater than 0.5649; therefore, the data is suitable for the analysis. The significant delta test values obtained by applying the (Pesaran & Yamagata, 2008) homogeneity test in table 4.2 conclude the rejection of the null hypothesis for homogeneous panels. This lends credence to the notion that panels are not homogeneous.

Table 4.1: Correlation statistics

	CPI	TO	DO	FO	REER	RGDP	GEXP	MS
CPI	1							
TO	0.5477	1						
DO	-0.0059	-0.0912	1					
FO	-0.0133	-0.051	-0.1889	1				
REER	0.3734	0.5649	0.1333	-0.1591	1			
GDPC	0.1747	-0.0643	0.1697	0.2684	-0.2072	1		
GEXP	0.5809	0.3680	0.3680	-0.3867	0.5488	0.1789	1	
MS	0.4463	0.4257	0.4257	-0.3302	0.5353	-0.3056	0.5467	1

Note: Author's construction. The value near zero presents no correlation between the variables, whereas, value near 1 represents perfect correlation.

Table 4.2: Slope homogeneity test results

Delta test	T-statistic
Δ	3.536*
$\Delta_{adj.}$	3.757*

Note: Author's construction. The table here shows the delta test coefficients, checking the BRICS countries' homogeneity. The asterisk signifies the significance level of the t-statistic value: *$p < 0.01$

Since greater trade integrations increase the likelihood of CSD among the countries, the study used the Breusch-Pagan LM test, Pesaran scaled LM test, and Pesaran test to examine the CSD in the panels. The empirical evidence in table 4.3 from all three tests indicates the presence of

CSD in the residuals. As a result, the null hypothesis of no CSDis rejected. This affirms the use of the second-generation unit root approach to test stationarity.

Table 4.3: CSD test results

Tests	Statistics	Results
Breusch-Pagan LM	250.0480	
Pesaran scaled LM	52.5583	Presence of CSD in residuals
Pesaran CD	6.3517	

Note: Author's construction. The table exhibits the estimates of cross-country dependence among the BRICS countries. The asterisk signifies the significance level of the t-statistic value: *p < 0.01

For this purpose, Cross-section ADF (CADF) and CIPS tests (cross-sectionally augmented IPS) have been employed. Both tests assume the null hypothesis of non-stationary data for the cross-dependent panels. The results indicate the combination of stationarity order from both the tests, i.e., at the level or first difference (as shown in table 4.4). None of the variables is found stationary at the second difference. A few variables, such as CPI, TO, DO, FO, REER, and MS, are stationary at the first difference, whereas others are stationary at the level.

After confirming the stationarity, the study employs Westerlund (2007) cointegration approach to examine the long-run relationship among the variables. This approach examines the presence of a long-run relationship assuming the null hypothesis of no cointegration in the panel. The results show that the statistical values for all models with dependent variables trade openness, import openness, and export openness are significant (as shown in table 4.5). This implies the rejection of the null hypothesis for all three dependent variables of the model and confirms the long-run relationship among the variables.

Table 4.4: Unit root test results

Variables		CADF test		CIPS test	
		Constant	Constant and trend	Constant	Constant and trend
CPI	Level	-2.20	-2.25	-2.49	-2.37
TO		-2.70	-3.06*	-3.36	-3.64 *
XO		-3.39*	-3.95*	-3.79*	-4.27*
IO		-3.14*	-3.18*	-4.44*	-4.44*
DO		-2.74*	-2.77	-4.58	-4.64*
FO		-2.76*	-2.95	-3.41	-3.61*
RGDP		-1.62	-2.21*	-1.28	-2.30
REER		-2.76*	-2.73	-2.54	-2.28*
GEXP		-3.24*	-4.62*	-2.28	-2.15
MS		-3.42*	-2.21	-3.52	-2.14
CPI	First Difference	-5.08*	-5.24*	-5.48	-5.65*
TO		-6.07*	-6.42*	-6.19	-6.42*
XO		-6.06*	-6.23*	-6.19*	-6.42 *
IO		-6.19*	-6.42*	-6.19*	-6.42 *
DO		-6.19*	-6.41*	-6.19	-6.42 *
FO		-6.03*	-6.19*	-6.19	-6.42*
RGDP		-4.54*	-5.15*	-5.47*	-6.03*
REER		-5.40*	-5.42*	-6.12	-6.30*
GEXP		-4.66*	-4.79*	-2.22*	-4.66*
MS		-4.46*	-4.53*	-6.19	-6.42*

Note: Author's construction. The table presents the results for checking the presence of stationarity in the variables. Each column shows the calculated t-statistic values for the respective variables. The asterisk signifies the significance level of the t-statistic value: *p < 0.05.

Table 4.5: Westerlund test of cointegration results

Model with varying openness indicator	H_1: Some panels are Cointegrated		H_1: All panels are cointegrated	
	statistics	p-value	statistics	p-value
Trade openness	2.9137	0.0018**	3.3639	0.0004**
Export openness	2.6373	0.0042**	2.6121	0.0045**
Import openness	1.9866	0.0235*	1.7861	0.0370*

Note: Author's construction. The table exhibits the estimates for testing the cointegration in the presence of cross-country dependence, as given by Westerlund (2007). It shows the results for the existence of long-run relationships among the variables taking into account all three different measures of openness as varying independent variables in the models. The asterisk signifies the significance level of the t-statistic value: *p < 0.05, **p < 0.01.

Table 4.6: DCCE mean group test results

Variables	Long Run Coefficients					
	(1)	(2)	(3)	(4)	(5)	(6)
RGDP	0.2363	0.3037	0.3727	0.3150	0.2851	0.5636
	(1.18)	(1.26)	(1.12)	(1.12)	(1.13)	(1.01)
REER	-0.2763**	-0.2386	-0.1964	-0.3823***	-0.3540**	-0.3197*
	(-2.22)	(-1.57)	(-1.10)	(-2.59)	(-2.29)	(-1.95)
GEXP	-0.0284	-0.0336	-0.0513	-0.0306	-0.0184	-0.0738
	(-0.50)	(-0.59)	(-0.60)	(-0.68)	(-0.66)	(-0.89)
MS	0.0968***	0.0908***	0.0901***	0.1049***	0.1051**	0.0983*
	(2.77)	(2.84)	(2.59)	(2.19)	(2.42)	(1.72)
TO	-0.0984	-	-	-0.6442*	-	-
	(-0.40)			(-1.72)		
IO	-	0.6235	-	-	1.3941	-
		(0.80)			(1.37)	
XO	-	-	-1.0620	-	-	-2.2945
			(-1.06)			(-1.21)
DO	-	-	-	-0.0018	0.0060	-0.0076
				(-0.07)	(0.24)	(-0.23)
FO	-	-	-	0.0562**	0.0569***	0.0855*
				(2.85)	(2.58)	(1.91)
R^2	0.50	0.50	0.41	0.43	0.42	0.41

Note: Author's construction. The table indicates the results for the long-run coefficients estimated by the DCCE model for the mean group. The inflation (measured by the CPI) is used as a dependent variable for each column model. The initial three columns estimate the openness effect on price levels without including the impact of the output gap effect. However, the later columns also represent the estimates accounting for the domestic and foreign factors. The Hodrick-Prescott filter has been used to construct the output gap variable. The parenthesis reports the t-statistic values calculated for each column. The asterisk signifies the significance level of the t-statistic value: *p < 0.10, **p < 0.05, ***p < 0.01.

Further, Table 4.6 presents the estimated results for the long-run coefficients using the DCCE test. The empirical evidence demonstrates a significant negative relationship between trade openness and inflation. The findings align with Sahu & Sharma (2018) against the positive relationship obtained by Chhabra & Alam (2020). A percentage change in trade openness causes a 0.64 percent negative change in inflation, resulting in lower CPI.

This implies that as global trade integration increases, domestic prices will fall. In the case of import openness, the findings are consistent with both theoretical and empirical literature (Bhatti et al., 2021; Bianchi & Civelli, 2015; Satti et al., 2013), confirming a positive relationship between import openness and inflation. Increased imports lead to increased trade, which raises the steepness of the Phillips curve, resulting in higher prices and a rise in the quantity demanded. This increases the prices of imported goods such as crude oil, petroleum products, etc., causing inflation at both the consumer and producer ends. In contrast to import openness, export openness posits a negative relationship with the prices and indicates that a percentage increase in exports causes a 2.29 percent decrease in inflation. This implies that global economic integration flattens the Phillips curve for the BRICS countries in terms of export openness. These findings are supported by Dogan and Tansel (2008).

Furthermore, the statistical results for BRICS countries show a positive relationship between the foreign output gap and inflation, with the effect becoming stronger as export openness increases. In contrast, the pattern of the domestic output gap effect differs from that of the foreign output gap. The findings indicate that domestic forces effectively combat inflation and contribute to the flattening of the Phillips curve. However, the prices in these countries are relatively more sensitive to global factors than domestic ones. This indicates that the underpowered effect of the domestic output gap is not sufficient to reduce inflation, which eventually results in a steeper Phillips curve. The results are consistent with the sub-sample of Jašová et al. (2020) and highlight that with the possible increase in trade openness, the prices become more vulnerable to global factors than local or domestic factors.

Similar to the effect of global factors, the results highlight that an increase in money supply creates inflationary pressure in BRICS. The empirical finding of Ashra (2002); Jedidia et al.

(2019); Van (2020) support the result of this study. The results also support monetarists' theoretical arguments and demonstrate that a one percent increase in money supply results in approximately a 0.10 percent hike in prices. This is because the adoption of expansionary monetary policies causes the exchange rate depreciation, resulting in inflated import prices. These price increments are further reflected in the domestic prices in proportion to the economy's sensitivity to global factors and degree of trade openness. As a result, it can be said that the money supply is a significant contributor to rising inflationary pressures.

In contrast, the results show that an expansionary fiscal policy is conducive to reducing prices, where a one percent increase in government final consumption expenditures reduces inflation by approximately 0.03 percent. Consistent with the results of Batool et al. (2022), the results show that the dominance of fiscal policy is vital to attaining price stability. In this instance, the effect of government spending is channelised via interest rates. Increased government spending raises interest rates, which harms private investment and aggregate demand. This generates a crowding-out effect in the economy and brings down the price levels by targeting government spending on lower-income households (Nguyen et al., 2019; Romer, 2012). Further, the results show that the prices are relatively more responsive to the monetary policy tools than fiscal policy. It demonstrates that when used prudently, monetary policy can be a more effective tool to combat inflation in BRICS countries.

The findings also show that the real GDP posits a positive relationship with inflation, where a one percent increase in economic growth causes approximately a 0.30 percent increase in prices. The findings are consistent with those of Sahu & Sharma (2018) for India.

Furthermore, the results highlight a negative relationship between the real effective exchange rate and inflation. A one percent decrease in the real effective exchange rate leads to

approximately a 0.35 percent increase in inflation. The possible rationale behind this can be the heavily weighted import products to the total trading baskets. The heavy reliance of countries on imported products such as crude oil and petroleum products may cause imported inflation in the economy resulting in increased domestic prices in BRICS countries.

Further, the study also uses a causality test developed by Dumitrescu & Hurlin (2012) to investigate the causal relationship among the variables. The test assumes the null hypothesis for the absence of any causal relationship between the variables. For the overall sample, the evidence in table 4.6 shows the existence of a unidirectional relationship from trade openness, import openness, domestic output gap, and the foreign output gap to inflation. This exhibits that the rising trend toward openness and the high weightage of foreign goods has triggered domestic prices. The possible explanation for the unidirectional relationship can be attributed to the increasing firm competitiveness in the global market at the expense of small and local domestic firms. When entering the global market, most domestic firms fail to survive competition against international firms that provide goods at relatively lower prices. Moreover, the overall results highlight a feedback effect between inflation and other variables: export openness, real GDP, real effective exchange rate, government final consumption expenditure, and money supply. The rationale behind this is that high inflation increases the cost of inputs and machinery, which eventually shoots up the production cost and increases the prices of export goods. This reduces domestic economies' global competitiveness, leading to higher current account deficits that cause currency depreciation. Such currency depreciation can also result from expansionary government policies aimed at boosting economic growth. This increases the aggregate demand for both foreign and domestically produced goods. A greater propensity of demand towards foreign goods increases the deficits, resulting in currency depreciation.

Table 4.7: Dumitrescu and Hurlin (2012) granger non-causality test results

Direction of causality	Overall	Brazil	China	India	Russia	South Africa
	z-bar value	Coefficient Values				
CPI → TO	0.0721	0.0048 (1.03)	-0.256 (-1.16)	-0.0043 (-0.62)	0.0048 (0.72)	0.0113 (0.82)
TO → CPI	7.3373***	-0.0342 (-0.97)	0.0421*** (3.90)	0.0811*** (3.44)	0.0092 (0.38)	0.0032 (0.19)
CPI → IO	0.1169	0.0035 (1.06)	0.0003 (0.02)	-0.0001 (-0.03)	0.0101* (1.92)	0.0071 (0.75)
IO → CPI	8.1648***	-0.0098 (0.856)	0.0703*** (3.81)	0.1219*** (3.77)	0.0572 (1.16)	0.0201 (0.82)
CPI → XO	2.4786***	0.0156*** (2.81)	0.0281 (1.12)	0.0001 (0.02)	0.0081 (1.35)	0.0117 (0.179)
XO → CPI	7.2574***	-0.1215* (-1.83)	0.0601*** (3.56)	0.1895*** (3.37)	0.0195 (0.56)	-0.0169 (-0.54)
CPI → DO	-1.2974	0.0584 (-0.48)	0.1355 (0.46)	0.0190 (0.20)	-0.0388 (-0.62)	-0.0099 (-0.17)
DO → CPI	7.1196***	0.0025 (1.43)	0.0038*** (2.60)	-0.0017 (-0.44)	0.0034 (1.11)	0.0125*** (4.15)
CPI → FO	-1.0459	0.269 (0.42)	0.0084 (0.09)	0.141 (0.79)	0.0324 (0.86)	0.0258 (0.37)
FO → CPI	0.0511**	-0.0034 (-1.27)	0.0055** (3.4)	-0.0013* (2.12)	-0.0026 (-0.68)	0.0023 (0.69)
CPI → RGDP	35.2057***	-0.0131 (-0.66)	-0.4864*** (-10.73)	-0.0157 (-0.30)	-0.0023 (-0.10)	-0.0164 (-0.77)
RGDP → CPI	10.2046***	0.0045 (0.62)	0.0107*** (4.47)	0.0271*** (2.42)	0.0036 (0.33)	0.0387*** (3.31)
CPI→ REER	1.8785*	0.0088 (0.44)	0.0904*** (3.10)	0.0065 (0.90)	0.0014 (0.10)	-0.0127 (0.566)
REER → CPI	13.0403***	-0.0138** (-2.05)	-0.0534*** (-4.74)	-0.0212 (-0.58)	-0.0080 (-0.72)	- 0.0343*** (-4.33)
CPI → GEXP	18.0920***	-0.0174 (-0.30)	-1.4331*** (-7.46)	-0.0952* (-1.77)	-0.0818* (-1.83)	0.0010 (0.02)
GEXP → CPI	13.1543***	-0.0025* (-1.75)	0.0139*** (5.34)	0.0151*** (3.41)	-0.0016 (-0.85)	-0.0031 (-1.64)
CPI → MS	11.6255***	-0.0483 (-0.51)	-0.5771*** (-3.08)	- 0.4181*** (-5.09)	-0.0694 (-0.28)	- 0.2044*** (-2.46)
MS → CPI	10.9307***	0.0036 (1.19)	0.0084*** (4.01)	0.0184*** (3.95)	0.0082* (1.71)	0.0044* (1.88)

Note: Author's construction. The table indicates the estimates for the presence of causality among the variables. The results show the coefficient values for all the variables. The parenthesis reports the t-statistic values calculated

for each country separately. The asterisk signifies the significance level of the t-statistic value: *p < 0.10, **p < 0.05, ***p < 0.01.

Looking at the country-specific causal linkages, in the case of Brazil, the results in Table 4.7 show a one-way causal relationship from the real effective exchange rate and government final consumption expenditure to CPI. On the other hand, export openness and inflation posit a two-way causal relationship. This highlights that adopting an expansionary fiscal policy increases the harmful effects of inflation which is detrimental to the economic growth of Brazil. For China, the results are similar to the findings for overall samples. The evidence shows a one-way causal effect from every explanatory variable to CPI. In contrast, the two-way causal link between inflation and export openness, real GDP, real effective exchange rate, government final consumption expenditure, and money supply can be observed. Similarly, for India, one-way causal linkage can be evidenced from every explanatory variable to CPI, except the domestic output gap. This shows that compared to the domestic factors, foreign factors play a more significant role in determining domestic prices for India. Since external factors intensify prices, there is a possibility that, to some extent, the pace of economic growth is dependent on trading activities, making a large consumer share lean towards foreign-based firms in the domestic market. The results also show a two-way relationship between inflation, money supply, and government expenditure. This implies that the prices are susceptible to fiscal and monetary policy, requiring a more cautious policy approach to attain higher growth with controlled inflation. Concerning the causal linkages for Russia, the results show a unidirectional relationship between inflation to import openness and government final consumption expenditure and money supply to inflation. This underlines that the high domestic prices with increased money supply results in chasing more goods than are produced domestically, which attracts the demand for cheaper imported products, eventually increasing inflation. Similarly, for South Africa, the money supply and

inflation show a significant causal relationship but a bidirectional one. On the other hand, the evidence highlights a significant unidirectional causal link from the domestic output gap, real GDP, and real effective exchange rate to inflation. This clarifies that domestic factors are more dominant than foreign factors in determining domestic price levels.

4.6 Summary

Without unequivocal empirical evidence about the direction of effects, the debate over the impact of trade openness and output gap on inflation is far from over. Multiple previous studies in the literature report conflicting results. Moreover, they assume cross-sectional independence among countries, which is unrealistic in this highly globalising era. To address this issue and contribute empirically, this paper undertakes a cross-country analysis to examine the impact of trade openness and output gap on inflation in BRICS countries using the quarterly dataset from 1999 to 2018. This study uses a cutting-edge Dynamic Common Correlated Effect (DCCE) model that accounts for CSD, serial correlation, and heterogeneity across panels for estimating the long-term relationship between variables. Further, Dumitrescu & Hurlin's (2012) causality test has been used to investigate the causal relationship between the variables. The study utilises Consumer Price Index (CPI) as an independent variable and a proxy for inflation. Trade to GDP, export-to-GDP, and import-to-GDP have been used as independent variables and taken as proxies for openness indicators. In addition, the model incorporates the foreign output gap and domestic output gap as control variables. Other control variables such as money supply, real effective exchange rate, and government final consumption expenditure have also been incorporated into the analysis. The empirical evidence demonstrates a significant negative relationship between trade openness and expansionary fiscal policy measures to inflation. On the other hand, the results show a positive relationship between the foreign output gap, high money supply, and real GDP creates inflationary pressure in BRICS.

Chapter-5

Trade Openness, Poverty, and Institutions

5.1 Introduction

Many theorists agree that open economies thrive more than closed ones. However, the effects of trade openness are not limited to inflationary pressures and are feared to be detrimental to the poor as well. While the traditionalists claim that trade creates welfare gains by channeling the abundant factors through specialisation, productivity enhancements, and better resource allocation, the empirical evidence does not converge, especially for developing and emerging countries. It has been widely observed that those who lose from trade liberalisation are usually the poorest in the society. Even the transitory loss to this section of people means a loss of opportunity to obtain better health and education, thus, reducing their chances to escape poverty. However, the distributional outcomes of the trade depend on the institutional quality of an economy. Institutions are critical economic pillars that influence the distributional outcomes via government policies, which in turn affects economic growth, and then affects poverty reduction. High variability in the extent of policy and trade benefits that reach to poor creates significant disparities and makes the role of institutions more pervasive. While the poor quality of institutions hinders problem-solving, the better quality of institutions provides an equitable and just environment. However, improving the institutional environment is a challenge for developing countries because of their ongoing struggles with the fundamental issues of law and order, government stability, conflicts, and corruption, which slows down the process

of trade gains for the poor. This demonstrates that the institutions within a country determine the impact of trade openness on poverty reduction. In the light of preceding, this chapter aims to examine the impact of trade openness on poverty while considering the institutional framework for BRICS.

5.2 Review of Literature

5.2.1 Poverty and Trade Openness

Even though trade liberalisation is promoted as a key to economic development, the effect of trade openness on poverty is still ambiguous. As outlined by Bhagwati & Srinivasan (2002), there are two main lines of argument about the impact of trade openness on poverty, i.e., static and dynamic effects. Under the static effect, the Stolper-Samuelson theory suggests that with the increase in trade openness, the real income of the abundant factors expands, which helps to reduce poverty. In the extension of this theory, (Krueger, 1974) argues that trade reforms should be pro-poor, especially in developing countries where the comparative advantage is most likely to exist in the production of unskilled labor-intensive goods. In reality, the countries impose far too many restrictions on the entry and exit of labor mobility (Topalova, 2007). This results in hampered factor allocation process, and in turn the benefits of trade openness may not be realised. From a dynamic standpoint, poverty reduction can only be sustained if economic growth is accompanied by increased productivity, which can only be achieved through trade liberalisation. Under this, the effects of trade liberalisation on poverty can be observed mainly through four channels: economic growth, labor market, households and market, and government revenues channel, as shown in Figure 1. However, the impact on the poor depends upon the elasticity of substitution from domestic to traded goods.

This theoretical ambiguity can be easily observed in the empirical evidences too, where the negative impact predominates in the developing nations. Looking at the evidence from developing countries, Anetor et al. (2020) confirm this negative impact of trade liberalisation on poverty for upper-middle and lower-middle income countries. Along the same lines, Li et al. (2022) for Asian countries and Wang et al. (2022) for China, found that globalization assists in poverty reduction and reduces the poverty gap between rural and urban areas. Similarly, Gnangnon (2021) concludes that trade openness reduces poverty via its effect on financial development in developing and developed economies. On the other hand, Singh & Huang (2011) suggest that higher trade openness widens the poverty gap. In addition, (Onakoya et al., 2019) find that with the increasing trade openness, the poverty rate also rises over time. In contrast, evidences presented by Kpodar & Singh (2011) found no effect on poverty reduction. Similarly, on the sample of both developing and advanced countries, Beck et al. (2007) and Dollar & Kraay (2004) established either negligible or no impact on poverty reduction. Along the same line, Fambeu (2021), in his study, on sub-Saharan African countries found that trade does not create any impact on poverty. This shows that opting open trade policies is alone not sufficient to reduce the poverty and all the channels and factors require equal attention. Thus, it is clearly proven that the effect of trade openness on poverty is not automatic and depends on various factors including strong institutions.

5.2.2 Poverty and Institutions

The role of institutions in determining economic outcomes is a widely debated subject. The boarder ideas for this can be classified into two schools of thought, one by Douglas C. North, and the other by Commons, Mitchell, and Veblen. Both emphasize on thoughts of neoclassical economics regarding the role of institutions and governance in the economy, only with some methodological differences between these two schools of thought (Rutherford, 1995). In this context, the theoretical

standpoint broadly measures the institutions as an aggregated index of all the aspects related to the institutions. However, some studies contend that stability in property rights and no corruption mark a significant impact on poverty reduction (Acemoglu et al., 2001; Carothers, 2003). Furthermore, the literature suggests that institutions impact poverty via two channels: misallocation of resources and market inefficiencies. When law serves the private interests rather than social interests and uses its power to favor illegitimate or legitimate rewards to the cronies, this results in economic inefficiencies (North, 1990). It also leads to inequitable income distribution, with the rich becoming richer and the poor becoming poorer. This demonstrates that poverty depends on the allocation of political power and how well the institutions cater to the need and their accessibility to their fair share of resources (Sen, 1983, 1999) (shown in fig 5.1).

In this context, the empirical evidences yield mixed results. According to the findings of Anyanwu & Anyanwu (2017), Fabella & I.Oyales (2008), and Fambeu (2021), democracy does not favor poverty reduction and is detrimental to the achievement of millennium development goals (MDGs) on poverty due to its high impact on incidence poverty. This is because, even with fair and transparent elections, the government sometimes under the counter engages in rent-seeking practices which lead to systematized corruption. In support, another study conducted for developing countries found that democracies are not conducive to lower poverty rates (Ross, 2006). The results confirm that democracies spend more on public services like health and education, but the benefits are often confined to upper-income and middle-income groups. In support of this claim, (Ajisafe, 2016) asserts that corruption significantly increases poverty in the short run for Nigeria. In contrast, Aloui (2019) claims that good quality democratic institutions and poverty reduction are positively and significantly more effective in the poorest regions than in richer regions of Sub-Saharan Africa. Similarly, Woldekidan (2015) for Ethiopia and Hassan et al. (2020) for 73 developing countries found that good quality of governance helps to reduce poverty. Coccia (2021)

for 191 countries finds that good quality of institutions helps to alleviate poverty. However, the effect is more crucial to stable economies rather than to fragile and emerging economies. In addition, Sittha (2012) mentioned that pro-poor growth policies alone are not sufficient and require good governance to enhance poverty reduction. This confirms that the role of institutions is crucial to lowering poverty rates and is sensitive to the development level of the economy.

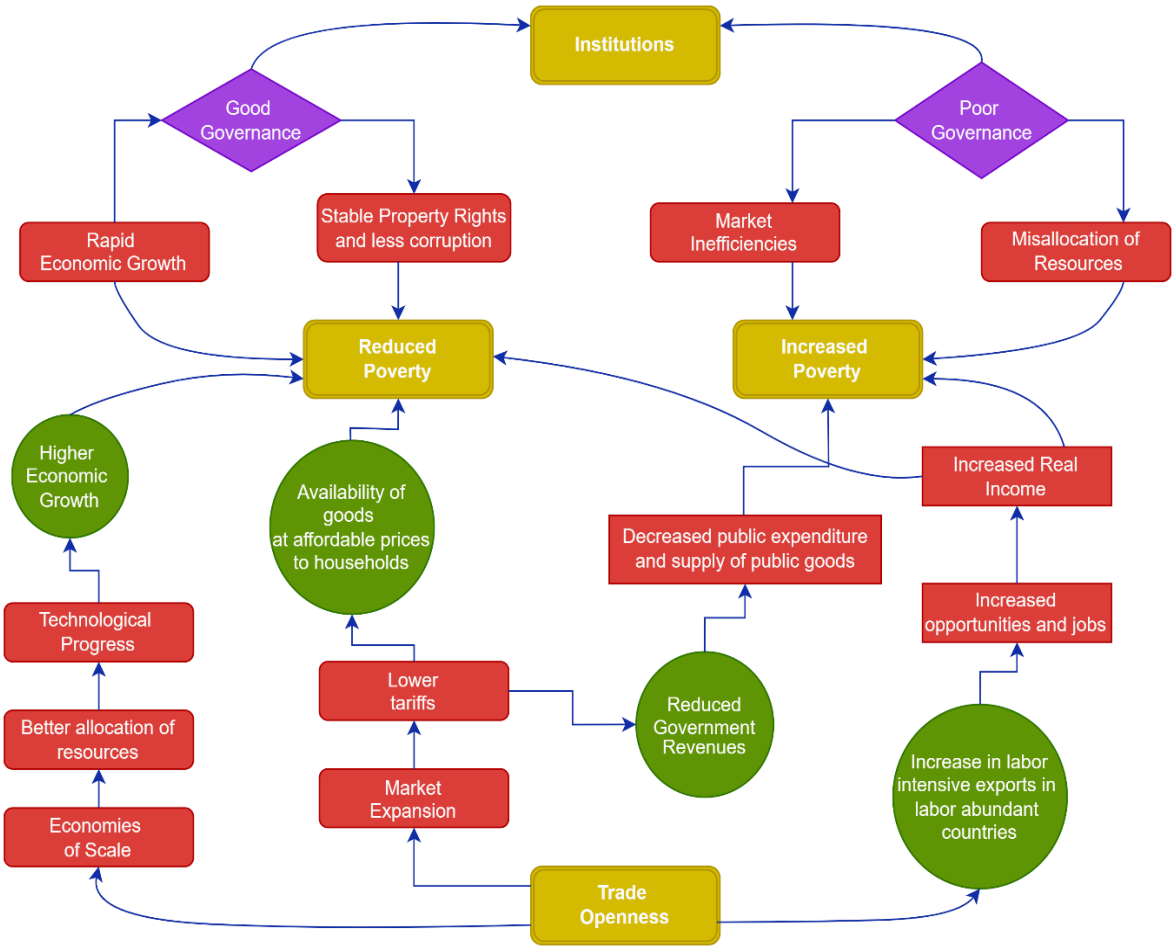

Figure 5.1: Theoretical relationship model between governance, trade openness, and poverty. Source: Author's construction.

5.3 Data

The study uses annual balanced panel dataset from 1991-2019 to investigate the role of institutions and trade openness in poverty reduction for the BRICS countries (Brazil, Russia, India, China, and South Africa). As a proxy for the dependent variable i.e., poverty, the study uses per capita

household consumption expenditure. This measure of poverty is consonant with the definition of poverty defined in terms to fulfil the basic consumption needs by the World Bank which clearly states it as a condition of inability to attain a minimum standard of living (World Bank, 1990). Therefore, the per capita household consumption expenditure is considered to be the more reliable and stable indicator of poverty than income (Datt & Ravallion, 1992; Odhiambo, 2010; Quartey, 2005; Sehrawat & Giri, 2016). To measure the impact of institutional quality, the composite index namely IQI has been concocted using principal component (PCA) analysis. Better institutional quality improves income distribution with an increase in per capita income, thereby reducing income inequality and thus poverty. Further, the percentage of exports and imports to total GDP has been taken as an indicator of trade openness. As stated under the general equilibrium theory, trade openness in developing countries reduces poverty because it allows the countries to engage in the production of comparative advantageous goods that utilise abundant unskilled labor available in such countries (Dollar & Kraay, 2002; Harrison & McMillan, 2007; Sehrawat & Giri, 2016). In addition, to capture the income inequality, the Gini index based on household disposable income after taxes by (Solt, 2019) is taken into account because the taxes and government spending also influence the income distribution. Unlike other measures of income inequality, it maximizes the comparability by standardizing the incomes which makes it a perfect fit for the study. Further, GDP per capita is used to measure economic growth. The study expects the positive impact of all the variables resulting in a rapid poverty reduction.

The estimation data for the variables has been sourced from three secondary sources i.e., World development indicators (WDI), International Country Risk Guide (ICRG), and the standardized World Income Inequality database (SWIID) by Solt (2019). All the variables are used in their natural logarithm which not only helps to control outliers but also establishes the elasticity relationship.

5.4 Model Specification

Based on the theoretical evidence and models adopted by Rewilak (2017), the study aims to examine the role of institutions in poverty reduction with rising trade integration by following a similar approach. Thus, the regression model to be estimated can be represented as:

$$\ln HEXP_{it} = \beta_0 + \beta_1 \ln TO_{it} + \beta_2 \ln GDPC_{it} + \beta_3 \ln IQI_{it} + \beta_4 \ln GINI_{it} + \mu_{it} \quad (5.1)$$

where i shows the country, t shows the time, HEXP denotes per capita household consumption expenditure, TO shows trade openness, GDPC is the GDP per capita, IQI represents the institutional quality index created using principal component analysis, GINI stands for income inequality and μ shows the error term of the model. To estimate this equation, the study uses DCCE method by Chudik & Pesaran (2015) can be written as:

$$\ln HEXP_{it} = \alpha_i \ln HEXP_{it-1} + \beta_i X_{it} + \sum_{p=0}^{Pt} \gamma_{xip} \bar{X}_{t-p} + \sum_{p=0}^{Pt} \gamma_{yip} \bar{Y}_{t-p} + \mu_{it} \quad (5.2)$$

where, $\ln HEXP_{it}$ is the log per capita household consumption expenditure and $\ln HEXP_{it-1}$ represents its lag value. X_{it} is the set of exogenous variables in the model. γ_{xip} and γ_{yip} denotes the unobserved common factors of regression. Lastly, Pt and μ_{it} shows the lag of the cross-sectional average and the error term, respectively.

Further, the study utilizes principal component analysis based on the ICRG database to create IQI that includes government stability (GS), internal conflict (IC), external conflict (EC), corruption (COR), military in politics (MIP), law and order (LNO, ethnic tension (ET), and democratic accountability (DA). The method generates new principal components which consecutively maximize the variance value. Such newly created uncorrelated variables solve the eigenvalue problems as the variables are created using the dataset at hand. The technique aids in reducing the dimensionality of large datasets while preserving as much information as

possible. This makes PCA a more appropriate and adaptable method for the analysis. The index has been developed based on the formula mentioned:

$$IQI = \Sigma_{i=1}^{t} m_i \frac{X_{it}}{sd(x_i)} \quad (5.3)$$

where, IQI shows an institutional quality index, X denotes i_{th} items in t_{th} year and mi shows the factor loadings as attained from PCA. The outcomes from the analysis are shown in table 5.1.

Table 5.1: Summary of principal component analysis (PCA) for IQI

Part A: Eigen analysis of correlation matrix

PCs	Eigen Value	Difference	Proportion Covariance	Cumulative
1	2.4829	0.2914	0.3104	0.3104
2	2.1915	1.1516	0.2739	0.5843
3	1.0398	0.2322	0.1300	0.7143
4	0.8075	0.3255	0.1009	0.8125
5	0.4821	0.0464	0.0603	0.8755
6	0.4355	0.1079	0.0544	0.9299
7	0.3276	0.0948	0.0410	0.9703
8	0.2328		0.0291	1.0000

Part B: Eigen vectors (component loadings)

Variables	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
GS	0.3209	-0.1822	0.6536	0.3565	0.3848	-0.3006	-0.2894	-0.0178
IC	0.3188	0.4682	0.2199	0.0405	-0.1975	-0.3143	0.6445	0.2757
EC	0.0365	0.6010	0.1639	0.1194	-0.2678	0.1136	-0.2595	-0.6666
COR	-0.1686	0.4358	-0.4934	0.2088	0.5314	-0.4274	-0.1553	0.0738
MIP	-0.4688	0.1637	0.3488	0.0070	0.5201	0.4392	0.4020	-0.0817
LNO	0.3755	-0.1418	-0.3458	0.6917	0.0540	0.3980	0.2544	-0.1214
ET	0.4224	0.3635	0.0095	-0.2446	0.1814	0.5077	-0.3551	0.4613
DA	0.4759	0.1319	0.1605	0.5245	-0.3904	0.0789	-0.2387	0.4895
Bartlett Sphericity test			367.323 (Chi-Square)			0.0000 (p-value)		
KMO test			0.638					

Note: Author's construction. The table shows the results of the Eigen analysis generated using PCA to formulate the institutional quality index (IQI).

In addition, Bartlett's sphericity test has been applied to examine the relationship between variables with the null hypothesis that variables are not interrelated. The significant chi-square value of 367.323 indicates rejection of the null hypothesis, implying that using PCA is plausible. Furthermore, the Kaiser-Meyer-Olkin (KMO) test has been used to evaluate data sampling adequacy, where the obtained estimate of 0.638 represents better sampling.

5.5 Results and Analysis

This section of the study reports the results of the empirical analysis of the estimated models. In order to avoid any empirical issues, firstly, the study examines the correlation statistics among the variables, as presented in Figure 5.2. The results presented in the Figure confirm that all correlation statistic is less than 0.5; therefore, the data is suitable for the analysis.

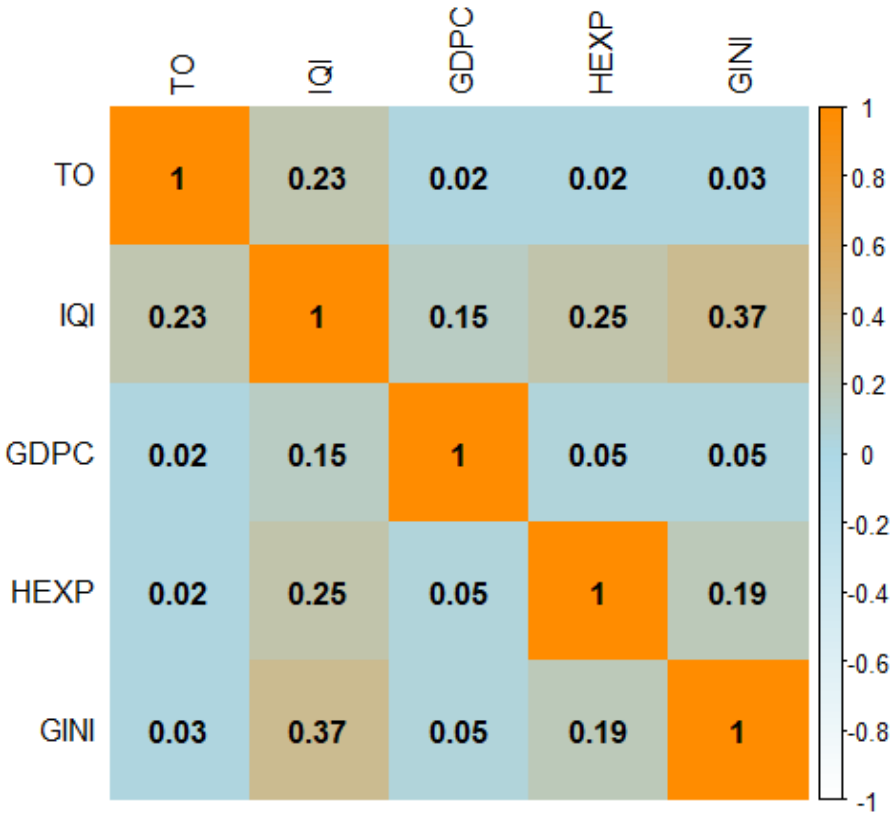

Figure 5.2: Correlation statistics. Source: Author's construction.

To avoid misleading outcomes, the study applies both first-generation and second-generation unit root tests. in table 5.2, the results for the first-generation unit root tests show that the variables are stationary at the first difference with significant p-values for all the respective statistics and none at the second difference. The second-generation unit root estimates confirm these findings and report the stationarity of all the variables at the first difference and none of the variables at the second difference. This, further, corroborates the use of the co-integration technique to examine the long-run relationship.

Table 5.2: Unit root test results

Test Statistic		**First Generation**		**Second generation**	
		LLC	IPS	CADF	CIPS
lnHEXP	I	-2.4315**	-1.9264**	-4.057***	-4.247***
	I&T	-1.5312*	-0.9093	-4.114***	-4.107***
lnTO	I	-0.4733	-5.5534***	-3.741***	-5.291***
	I&T	1.7778	-4.4691***	-3.710***	-5.475***
lnGDPC	I	-1.5244*	-2.4871***	-2.437*	-3.003***
	I&T	-1.8424**	-1.6229*	-2.491	-3.392***
lnIQI	I	-6.3492***	-5.9659***	-4.612***	-4.977***
	I&T	-5.3616***	-4.8722***	-4.502***	-4.968***
lnGINI	I	-3.7652***	-2.6914**	-2.647**	-2.176***
	I&T	-1.7729**	-1.7299**	-3.088**	-2.293

Note: Author's construction. The table presents the results for checking the presence of stationarity in the variables. Each column shows the calculated t-statistic values for the respective variables. The asterisk signifies the significance level of t-statistic value: *p < 0.05, **p < 0.01.

In table 5.3, the results from Pedroni and Kao co-integration tests provide mixed results, but the majority of tests reject the null hypothesis of no co-integration and show strong evidence for the presence of a long-run association between the variables. The table also reports the Westerlund co-integration results which confirm the findings presented by incorporating the phenomenon of CSD to check the robustness. The findings from the Westerlund co-integration

test also confirm that results remain the same in the presence of CSD at a 10% level of significance. As the later method also controls for the issue of serial correlation, heteroskedasticity, and structural breaks, the estimations will be more reliable and ensure the existence of a long-run relationship among the variables.

Table 5.3: Cointegration analysis

Tests	Statistic	Prob.
Pedroni		
Augmented Dickey-Fuller t	1.3447	0.0894
Modified Phillips-Perron t	1.2095	0.1132
Modified Variance ratio	1.3929	0.0818
Phillips-Perron t	1.5236	0.0638
Kao		
Unadjusted Dickey-Fuller t	-2.5953	0.0047
Dickey-Fuller t	-1.2697	0.1021
Modified Dickey-Fuller t	-1.6413	0.0504
Augmented Dickey-Fuller t	-0.0896	0.4643
Westerlund		
Variance Ratio	-1.3898	0.0823

Note: Author's construction. The table exhibits the estimates for testing the cointegration in the presence of cross-country dependence. The results confirm the existence of a long-run relationship among the variables in the panel.

Further, the DCCE estimated findings reported in table 5.4 investigate the long-run variables taking household consumption expenditure (poverty reduction variable) as a dependent variable. According to the findings, increasing trade openness and GDP per capita increases consumption household expenditure and thus reduces poverty in economies. This implies that as economies become more integrated, they generate more income, which facilitates in poverty reduction. The findings are in line with Le Goff & Singh (2014), Pradhan & Mahesh (2014), Sehrawat & Giri (2016), and Wang et al. (2022). However, the benefits to the poor from trade

openness and economic growth diminishes with the inclusion of institutions in the model. The results show that institutional quality indicator negatively impacts the per capita household consumption expenditure by 0.89 percent. This highlights that in developing countries, institutions obstruct efforts to reduce poverty. Ineffective distribution channels are a major contributor to the government's inability to reduce poverty. In developing countries, political systems prioritise the interests of the elites, causing the distribution process to be disrupted, and thus no benefits are passed on to the underprivileged. The results are in line with the findings of Fambeu (2021), Goff & Singh (2014), and Tebaldi & Mohan (2010). Further evidence suggests that the rising income inequality reduces consumption expenditure, increasing the number of people living in poverty. This suggests that, while rising economic integration helps to reduce poverty, rising inequality slows the process.

To check the robustness of these results, the study uses fixed effect regression with the Driscoll-Kraay standard errors test. The results in table 5.4 show that the findings are consistent with the DCCE estimates. The results indicate that the institutions aggravate poverty whereas economic growth in per capita income with rising trade openness squeezes down the poverty rates. This confirms that the results obtained from the DCCE method are reliable and error-free.

In the next step of the analysis, the study employs the Dumitrescu-Hurlin panel causality test as a diagnostic test to examine the short-run causality among the variables. Unlike the Granger Causality test, the Dumitrescu-Hurlin causality method considers the presence of cross- sectional dependence across the panels. This improves its utility for future analysis and makes it more pertinent to the panel's characteristics. Moreover, the technique provides more reliable estimates

Table 5.4: Long run coefficient for DCCE and Driscoll-Kraay standard errors methods

Variables	Dependent Variable: log of per capita household consumption expenditure (HEXP)											
	Dynamic Common Correlated Effect (DCCE) results						Fixed effect Regression with Driscoll Kraay Standard Errors results					
	1		2		3		1		2		3	
	Coefficient	z-stat	Coefficient	z-stat	Coefficient	z-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
lnTO	17.3552*	1.8	10.9098***	0.32	12.0921***	2.92	0.7158**	2.15	0.6313*	1.9	0.5971**	2.28
lnGDPC	81.1629***	5.96	39.9781**	2.01	4.5255**	2.04	0.9228*	1.86	0.8629*	1.74	0.9292*	1.83
lnIQI			-1.2534	-0.41	-0.8904	0.97			-0.5801**	-2.34	-0.7978**	-2.19
lnGINI					-1.2653***	-3.12					-0.1244	-0.97
Constant							16.4253***	5.61	18.1623***	5.76	18.2202***	6.65
R-squared	0.86		0.64		0.63		0.355		0.3661		0.37	
CD Statistic	-3.55		-3.52		-3.19							
P-value	0.0004		0.0004		0.0014							
F stat.							(2,28)		(3,28)		(4,28)	
Prob>f							72.07***		68.97***		67.14***	

Note: Authors construction. The table indicates the results for the long-run coefficients estimated by the DCCE model. To check the robustness of these estimated results, Driscoll-Kraay standard error model has been used. The result confirms that the DCCE estimations are efficient and reliable. The asterisk signifies the significance level of t-statistic value: *p < 0.10, **p < 0.05, ***p < 0.01.

for the small sample data with heterogeneity. The outcome of the test has been extended in table 5.5. One directional relationship can be manifested from institutional quality to all the variables in the models. Whereas bi-directional causal relationship can be evidence between trade openness and economic growth, trade openness and income inequality, and economic growth and income inequality. It implies that higher economic growth significantly impacts the trade integrations and their impact on income inequality. In addition, the results suggest institutions are an important component of the economy in the poverty reduction process.

To elucidate the dynamic characteristics of the variables, the dynamic structure of VAR has been used in conjunction with the impulse response function (IRF) analysis. The method will help to identify the variations in the path of the effect among variables. The IRF results in Figure 5.3 are in agreement with the earlier estimated results and show sensitivity to the VAR estimates. The results from IRF are in the same direction with causality results, thus, prove its robustness.

Table 5.5: Dumitrescu-Hurlin causality results

Dependent Variables	Explanatory Variable				
	lnHEXP	lnTGDP	lnGDPC	lnIQI	lnGINI
lnHEXP	-	0.4937	-0.6071	4.4985	-0.0277
		(0.6215)	(0.5438)	(7.E-06)	(0.9779)
lnTO	-0.0255	-	1.6912	1.9149	2.6845
	(0.9796)		(0.0908)	(0.0555)	(0.0073)
lnGDPC	1.4156	4.1385	-	13.1322	15.6628
	(0.1569)	(3.E-05)		(0.0000)	(0.0000)
lnIQI	-0.2149	0.6065	-0.3855	-	-0.5429
	(0.8298)	(0.5442)	(0.6988)		(0.5872)
lnGINI	-0.3089	2.6984	13.4836	9.2418	-
	(0.7573)	(0.0070)	(0.0000)	(0.0000)	

Note: Author's construction. The table indicates the estimates for the presence of causality among the variables. The results show the coefficient values for all the variables with their p-values in parentheses. The asterisk signifies the significance level of t-statistic value: *p < 0.10, **p < 0.05, ***p < 0.01.

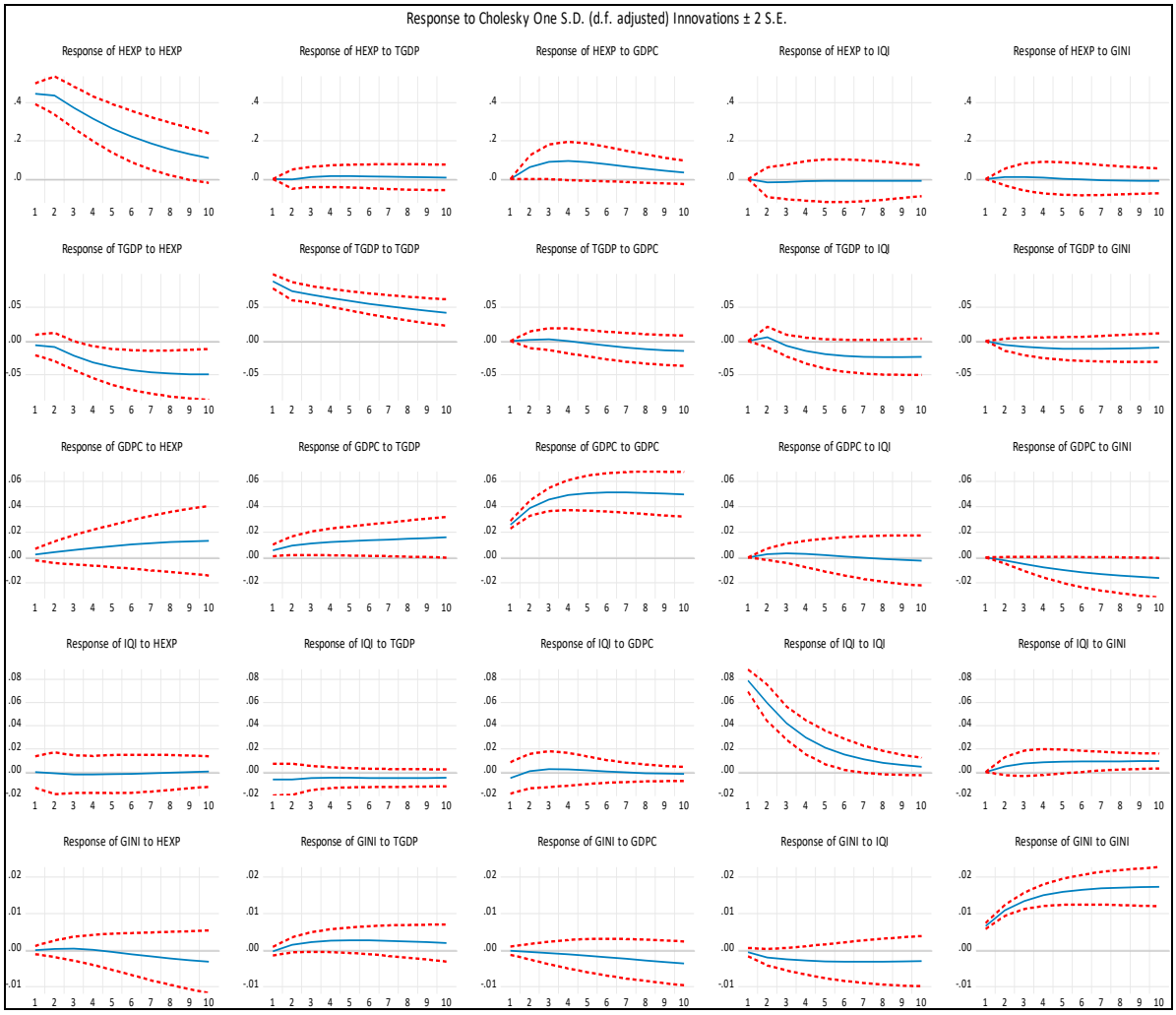

Figure 5.3: The generalized impulse response to one SE shock in ECM. Source: Author's construction

5.6 Summary

Though the impact of trade openness on poverty has been widely discussed in the existing literature, the empirical literature on how the institutions and governance influence this nexus in BRICS still lacks evidence. Moreover, the existing studies analysing the nexus assumes no CSDand homogeneity among the countries, which is highly impractical in the real world. Against this backdrop, the paper investigates the relationship between institutions, trade openness, and poverty in the BRICS countries using dynamic estimation approaches with CSDfrom 1991 to 2019. For this purpose, the study adopts the DCCE approach with a recursive mean adjustment approach that allows for heterogeneity and cross-section dependence,

followed by the Dumitrescu-Hurlin causality test to determine the causal relationship between the variables. The study undertakes per capita household consumption expenditure as a proxy to poverty, where an increase in consumption expenditure infers increased ability to spend and hence poverty reduction. The study uses trade-to-GDP as a proxy to trade openness and constructs an institutional quality index using the PCA approach to proxy the institutional quality. The findings show that trade openness and economic growth benefit the poor by increasing income, which increases consumption expenditure. However, the trade benefits to the poor contracts due to the negative impact of governance indicators and income inequality on poverty reduction. As a result, it is recommended to strengthen the institutions and governance to ensure better regulatory practices that improve the quality of governance and address poverty and structural inequality directly.

Chapter-6

Trade Openness, Institutional Quality, and Economic Growth

6.1 Introduction

Besides the impacts of trade openness on inclusive growth, economists have observed its long-run impact leads to sustained economic growth in developing countries. The theories postulate that openness enhances the growth factors through increased competition (openness forces firms to adopt new cost-cutting and efficient technologies), economies of scale (highly productive firm reciprocates to the global demand and operate at larger scales resulting in lower prices for the products), and innovation (trade increases firm's exposure to develop and adapt innovations and technological standards). However, the mixed results from the empirical evidence posit a question towards the positive impact of trade openness on economic growth. But of course, these trade gains are not only relevant components to economic growth; institutions also play a vital role in the growth process. Institutions determine the framework for economic development via various channels, such as lowering transaction costs, protecting property rights, and determining the limit for expropriating economic resources. The studies show that economies with strong quality institutions can effectively counteract external market disturbances (including openness shocks), which consecutively accelerates long-run economic growth. Thus, it would not be wrong to say trade openness determines economic growth in the

short run, institutional quality is critical to its long-term viability. The empirical evidence also suggests that the effect of trade openness on growth is conditional to the institutional quality factors of an economy (Duodu & Baidoo, 2020; Sakyi et al., 2015; Zahonogo, 2017). Thus, institutions and trade openness are both vital to growth. As a result, this chapter aims to analyse the impact of institutions and trade openness on economic growth for BRICS.

6.2 Review of Literature

6.2.1 Trade Openness and Economic Growth

The classical theories of trade demonstrate trade as a positive-sum game (where all trading countries gain but some gains relatively more) under absolute advantage theory (by Adam Smith) and comparative advantage theory (by David Ricardo). It postulates that trade allows efficient utilization of resources and upgrades for modern innovations and techniques, embarking higher productivity that fuels economic growth. In favour, Heckscher-Ohlin's theory advocates mass production conforming to factor endowment (labor-intensive or capital-intensive) and trade with other economies to enhance economic growth. However, these traditional trade theories assume production factors as exogenous to the models and provide a static perspective.

Therefore, a new set of modern theories of trade began to evolve in the late 1980s to comprehend the dynamic nature of trade openness and economic growth nexus. Some of the pioneering works include Grossman & Helpman (1989), which favor the belief that lowering trade barriers reorients the resources for research and development to produce differentiated labor-intensive goods at higher profit margins. With better quality of human capital, it helps the comparative advantage to evolve and generate spillovers to the domestic economy over time.

According to these models, the contribution of trade openness to economic growth is determined by the direction in which a country's comparative advantage forces move. The relationship is established if these forces converge on activities that generate long-run growth. While trade openness expedites technology diffusion within a country, technology adoption depends on that country's absorption capacity. This leads to promoting economic growth following four channels. First, global integration lays down the path to access foreign markets with better rewarding opportunities. Second, advances in producing goods with comparative advantage redirect the allocation of scant domestic resources. Third, it stipulates consumers with better access to an immense variety of goods and services. Last, it helps to break any existing domestic monopolistic practices and enhance competition within and outside the country (Stensnes, 2006).

Although theories dominantly support the benefits of trade over economic growth, empirical evidence is rather inconclusive. On the empirical front, Das & Paul (2011) and Kabuga & Ismail (2018) found that trade openness stimulates the economic growth of 12 Emerging Asian economies. Haini & Wei Loon (2021, 2022) confirm these findings for ASEAN and OECD economies where trade induces economic growth. Similarly, Malefane & Odhiambo (2018) found a positive impact of trade openness on economic growth in South Africa, but the effect turns insignificant when geography and country size are considered. On the contrary, Zahonogo (2017) found that the impact of trade openness and economic growth is positive only up to a certain threshold, after which the effect is reversed. In accordance, Akpan & Atan (2016) found the negative influence of trade openness on economic growth in Sub-Saharan Africa and Bangladesh. However, these studies use only overall trade as a measure to trade openness and ignore the imports and exports to GDP ratio as a proxy, except studies by Malefane & Odhiambo (2018) and Zahonogo (2017). This shows inconclusiveness and scarcity of evidence for the

impact of trade openness on economic growth, especially considering the imports and exports separately.

6.2.2 Institutions and Economic Growth

The growing body of literature documents the relationship between institutional quality and economic growth for developed and developing countries. The pioneering contribution of North (1990) encouraged a lot of researchers to examine the link further and mentioned three channels to investigate the impact of institutions on economic growth. First, institutions influence the innovations following the mechanism; 'property rights institutions—capital investment productivity per capita output.' Second, it affects the accumulation of technologically well-versed human capital. However, any institutional inefficiency creates investment inadequacies and a lack of innovations which promotes rent-seeking behavior resulting in hampered growth.

North & Thomas (1973) claimed that the impact of institutions on growth is sensitive to incentive structures, property rights, and transaction costs. The poor quality of governance extends the gap for economic agents, causing lingering to lower incentive redistributive activities instead growth promoting productive activities. This promotes rent-seeking behavior, which halts the potential sources of growth, such as the development of skills and technology and better provision of public goods. It increases transportation costs, the unaffordability of which intrudes the application of innovative techniques to attain sustainable growth (North, 1989). In this line, Hall & Jones (1999) have shown that heterogeneity in institutional quality across countries induces variations in educational attainment, capital accumulation, and productivity growth, which causes income disparities across countries.

Conversely, economists suggest that the good quality of institutions helps countries converge toward higher incomes, reducing uncertainty and boosting economic growth via improved

incentive structure (North, 1990). is more likely to adopt foreign-based advanced technologies and innovations in the sight of good institutions (Bernard & Jones, 1996). Further, the studies explain that institutions contribute to reducing the risk of doing business, which helps direct the resources toward innovation instead of protecting property rights or earning predatory rents.

On the empirical front, the recent debates provide mixed results regarding the impact of institutions on economic growth. In the study on developing the Middle East, North African, and Asian countries, Han & Khan (2014) found that better performance of institutional indicators leads to better economic growth prospects. (Bibi et al., 2018) conducted a study on five SAARC countries and revealed that political stability positively impacts economic growth, whereas corruption negatively impacts governance. Li & Kumbhakar (2022) confirm these findings and suggest lesser corruption leads to higher economic growth. Along the same line, Wandeda et al. (2021) find that control of corruption boosts economic performance in African countries. On the other hand, Radulović (2020) and Salawu et al. (2018) found a significant negative impact of governance on economic growth for Nigeria and Southeast European countries. Moreover, the study conducted for Asian countries by Tran et al. (2021) finds that the positive impact of institutions exists upto a certain threshold, exceeding which it may negatively impact economic growth. Thus, the inconclusiveness of results for developing countries calls for further research.

6.2.3 Trade Openness – Institutions – Economic Growth

Generally, openness in the economies is accompanied by increasing exposure to external shocks that can cause domestic conflicts. This creates the need for government intervention with growing openness to adjust any shock impacts to realise more trade benefits resulting in higher economic growth. A positive interaction effect reduces the adverse impacts of trade openness with a strong institutional environment. However, increasing trade openness increases the vulnerability to external economic shocks, which negatively impacts economic

growth in the case of weak governance institutions. Trade openness increases the consumption of cheap imported goods and competition exposure to the producers, which deepens the effect of external shocks on the economy, especially in the case of less diversified developing economies. To combat its adverse effects, strong institutional conflict management is essential to frame strong outward-oriented policy, which fosters economic growth. It prevents rent-seeking behaviour and leads to a fair distribution which means trade benefits all (as shown in Figure 6.1).

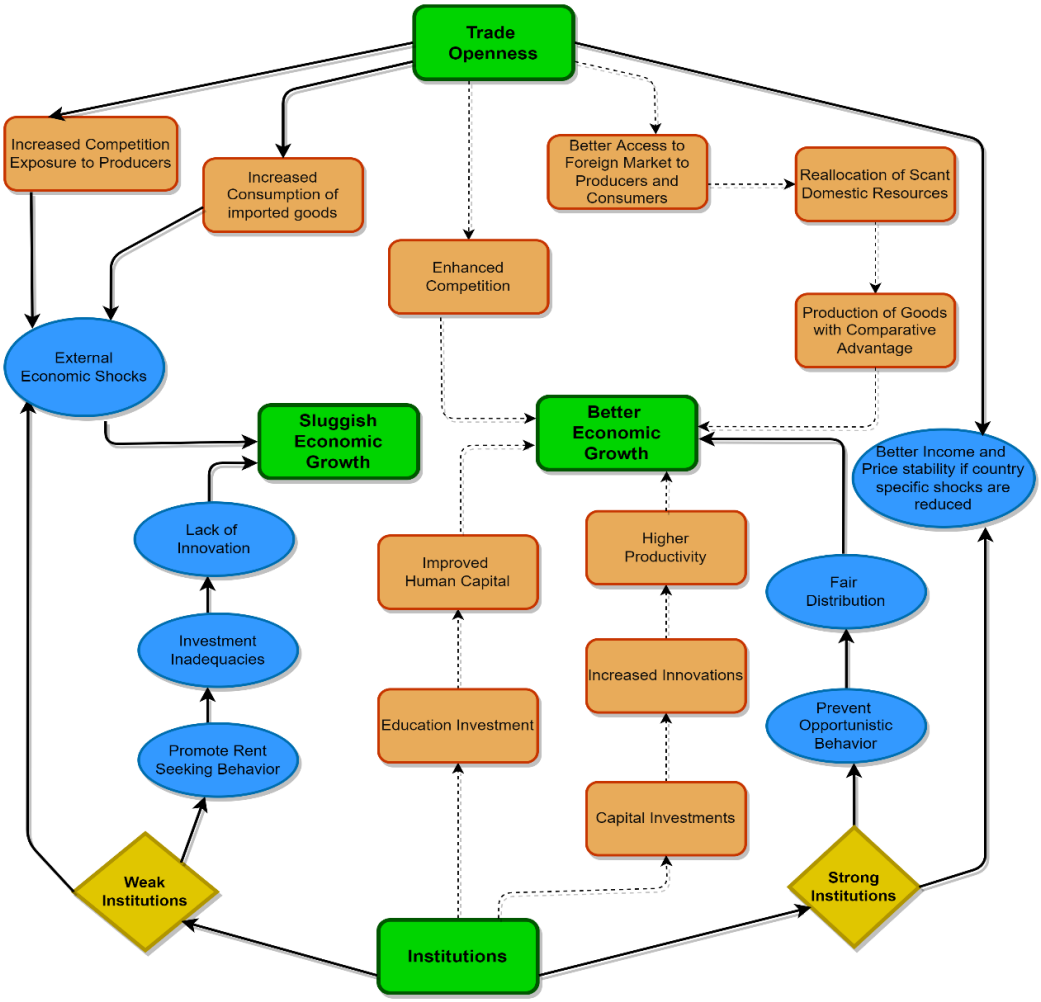

Figure 6.1: Theoretical linkage between Institutions, trade openness, and economic growth. Source: Author's construction.

Given the importance of institutions in economic growth, many recent studies have emphasised the importance of examining the influence of institutions on the relationship between trade

openness and economic growth; however, no consensus has been found (Akpan & Atan, 2016; Doan, 2019; Stensnes, 2006). This captivates policymakers' interest and necessitates additional research to validate the direction of impact procured by previous studies. Therefore, the present study examines the effect of trade openness on economic growth while considering institutional factors for the BRICS.

6.3 Data

This section embodies the rationale for the selected variables with their a priori expectations. The study adopts panel data approaches to identify the trade openness and growth nexus for the BRICS nations from 1991 to 2019. Most developing countries, including BRICS, experienced reforms and trade liberalization policies during the late 1980s or early only, which motivates the starting period of the study. The dataset has been extracted from the International Country Risk Guide (ICRG), World Development Indicators (WDI), and Bruegel. The study includes economic growth as a dependent variable, depicted by the gross domestic product per capita (GDPC). While as an independent variable, trade openness has been represented by exports of goods and services as a sum of GDP (EO), imports of goods and services as a sum of GDP (IO), and a total of exports and imports of goods and services as a sum of GDP (TO). It allows for more efficient use of resources, access to cutting-edge technology, and a broader range of available markets hence fostering economic growth. In addition, to represent institutional quality, the study constructs Institutional Quality Index (IQI) using PCA, where good quality institutional environment complements economic growth (AlShiab et al., 2020; Beyene, 2022). In addition, four control variables have been considered to limit the impact of other extrinsic variables and add more validity to outcomes. First, the study undertakes nominal effective exchange rate (EXR), where currency depreciation makes domestic goods more affordable, promoting more exports, but at the same

time, it reduces domestic production due to high input costs. Second, domestic credit to the private sector as a percentage of GDP (DC) denotes the financial development where a more developed financial sector escalates foreign investments hence, economic growth. Third, the Consumer Price Index annual growth rate (CPI) indicates inflation, where higher production costs cause a reduction in output, therefore, shrunken economic growth. Fourth, gross capital formation as a percentage of GDP (GCF) determines capital stock, where the stock of capital increases, resulting in higher output. The variables have been selected in accordance with Doan (2019), Duodu & Baidoo (2020), and Malefane & Odhiambo (2018). All the data has been used in their natural logarithm. Hence, a positive impact of trade openness, the quality of institutions, financial development, and the capital stock is expected on economic growth. On the other hand, the effect of the exchange rate on economic growth is undetermined.

6.4 Model Specification

Based on the AK endogenous growth model and considering the quality of institutions, the study examines the trade openness and economic growth nexus for the BRICS countries. It follows a theoretical model of the Cobb-Douglas Production function represented as

$$Y = AK^{\alpha}L^{\beta} \tag{6.1}$$

where Y is the economic output or growth, A shows technological progress, K means capital stock, and L is the labor force in the economy. Here, α and β indicate the elasticities of the respective variables. However, dividing the labor force on both sides of the equation provides the output in terms of per capita, as shown in equation 2.

$$Y = AK^{\alpha} \tag{6.2}$$

Taking natural logarithm gives equation 3.

$$lnY = lnA + \alpha lnK \tag{6.3}$$

where y denotes per capita economic output, k is the per capita capital stock, and A captivates growth in total factor productivity caused by economic factors other than capital stock and labor force. Listing the other determinants to the function in the equation form can be depicted as

$$lnY = lnTO + lnIQI + lnEXR + lnDC + lnCPI + \alpha lnK \tag{6.4}$$

where TO is trade openness, IQI is the institutional quality index, EXR is the exchange rate, DC is financial development, and CPI is inflation. For the construction of IQI, the study follows the methodology and index created in chapter 5. Based on the testimonies by Akpan & Atan (2016) and Stensnes (2006), the study extends the model consisting of the interaction term for the quality of institutions and trade openness. The econometric specification of the model can be denoted as

$$lnY_t = \alpha_0 + \beta_1 lnTO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnTO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \tag{6.5}$$

where α_0 is the constant term, β_i (i=1, 2…7) are coefficients of the respective variables, GCF explains K value, i.e., capital stock, $\upsilon_{i,}$ and υ_t are the country-specific effects and time-specific effects, and ε_t represents the error term of the model in time t. Here, TO_t*IQI_t depicts the interaction term that expresses the combined impact of both factors on economic growth. Following Malefane & Odhiambo (2018) and Zahonogo (2017), and considering the growth can be either export-led, import-led, or a balance of both, the disaggregation trade openness aims to investigate the effect of every trade aspect explicitly on economic growth, which can be represented as

$$lnY_t = \alpha_0 + \beta_1 lnEO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnEO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \quad (6.6)$$

$$lnY_t = \alpha_0 + \beta_1 lnIO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnIO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \quad (6.7)$$

where EO_t and IO_t show export openness and import openness in time t. and EO_t*IQI_t and IO_t*IQI_t are the interaction terms for the respective variables with the quality of institutions. Therefore, the study also focuses on examining the direct and indirect effects of the quality of institutions with trade openness on economic growth visualized with the help of a path diagram in Figure 6.2.

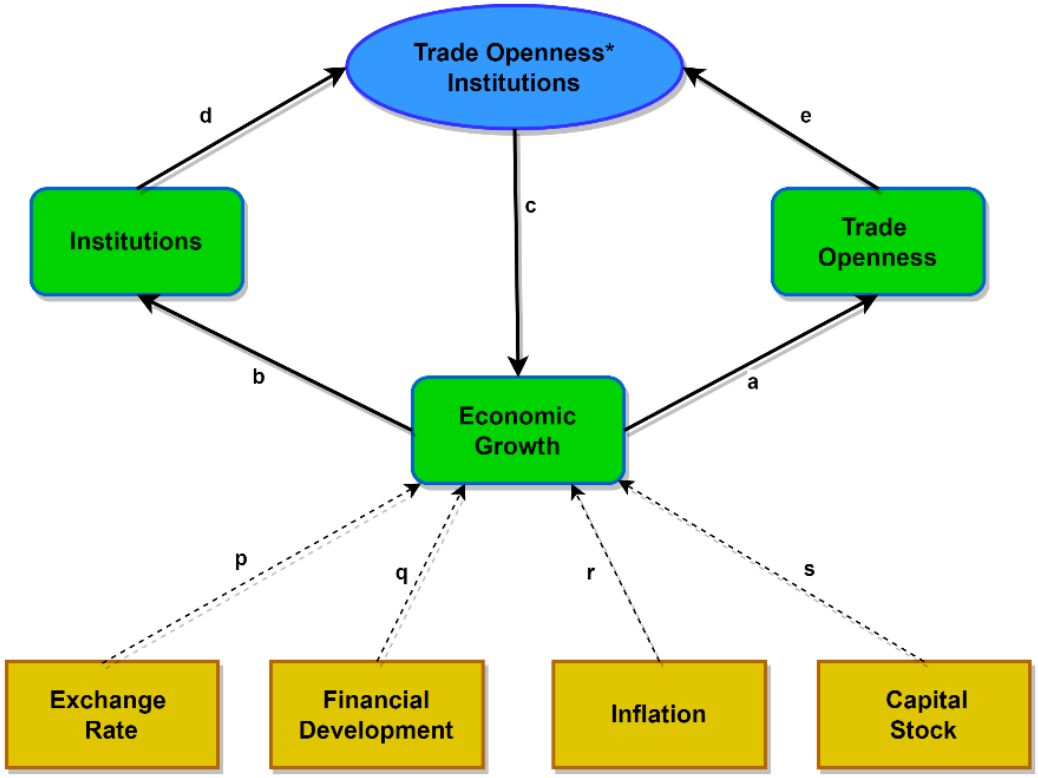

Figure 6.2: Model framework. Source: Author's construction

Figure 6.2 reveals the framework where trade and institutions posit a direct relationship with growth (path a and b, respectively), as do the exchange rate, financial development, inflation, and capital stock (path p, q, r, and s respectively). However, the compound effect of trade and institutions (path d and e, respectively) directed to the growth (path c) posits the indirect impact.

To estimate the direct and indirect effects, the study uses the system GMM method represented as:

$$lnY_t = \alpha_0 + \gamma_1 lnY_{t-1} + \beta_1 lnTO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnTO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \quad (6.8)$$

$$lnY_t = \alpha_0 + \gamma_1 lnY_{t-1} + \beta_1 lnEO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnEO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \quad (6.9)$$

$$lnY_t = \alpha_0 + \gamma_1 lnY_{t-1} + \beta_1 lnIO_t + \beta_2 lnIQI_t + \beta_3 lnEXR_t + \beta_4 lnDC_t + \beta_5 lnCPI_t + \beta_6 lnGCF_t + \beta_7 lnIO_t * lnIQI_t + \vartheta_i + \vartheta_t + \varepsilon_t \quad (6.10)$$

To distinguish the long-run and short-run effects of explanatory variables, the study utilizes the pooled mean group (PMG) method of ARDL by Pesaran et al. (1999). The econometric specification for the same is as follows:

$$\Delta Y_{i,t} = \alpha_i + \varphi_i\left(Y_{i,t-1} - \beta_i \Delta X'^{s}_{i,t}\right) + \sum_{j=1}^{p-1} \theta_{ij}, j\Delta X'^{s}_{i,t} + \sum_{j=1}^{q-1} \tau_{ij}, j\Delta Y_{i,t} + \mu_i + \varepsilon_{i,t} \quad (6.11)$$

where β_i is the long-term parameter, φ_i is the equilibrium parameter, $Y_{i,t}$ is the economic growth, i.e., GDP, X is the macroeconomic variables, I shows the countries, and t represents time.

6.5 Results and Analysis

This section of the study presents the empirical results for the relationship between trade openness, institutional quality, and economic growth. Firstly, the study examines the correlation statistics among the variables, as presented in Figure 6.3. The Figure shows that correlation levels of all the variable are below 0.75 which confirms no high correlation.

Further, the study checks the presence of unit root among the variables using both first-generation and second-generation unit root tests. The results in table 6.1 cofirms the stationarity among variables at the first difference. Thus, it rejects the null hypothesis (i.e., the presence of unit root) and accepts the alternate hypothesis of no unit root. Similarly, the results reported with the second-generation unit root test also ensure the stationarity of variables at integration order (1). Based on these grounds, the study examines the long-run relationship between trade openness and economic growth using the system GMM estimator.

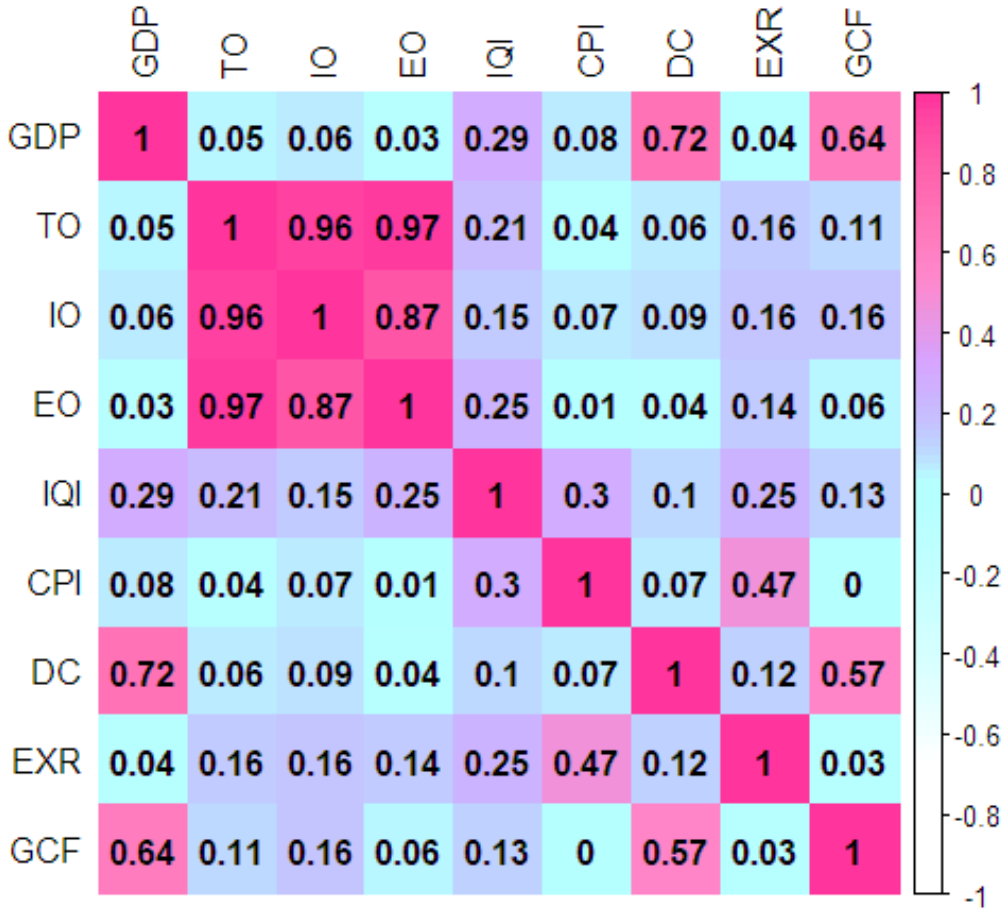

Figure 6.3: Correlation between economic growth, trade openness, institutions, inflation, financial development, exchange rate, and capital stock. Source: Author's construction.

The results for GMM in table 6.2 bestow estimates for direct and indirect effects of the quality of institutions and trade openness on economic growth. In line with Kong et al. (2021) and Nwadike et al. (2020), the results show that a one percent increase in overall trade promotes economic growth by 0.11 percent. On the same line, export openness increases economic growth by 0.13 percent and import openness by 0.08 percent. In contrast, the negative association between the quality of institutions and economic growth signifies poor institutional performance. The present findings are consistent with the theoretical evidence of mercantilist theory, Hecksher-Ohlin theory, and classical theory of trade, as well as empirical evidence by (Khobai et al., 2017; Mireku et al., 2017; Nketiah et al., 2020; Sakyi et al., 2015).

Table 6.1: Unit root test results

Test Statistic		**First Generation**		**Second Generation**	
		LLC	**IPS**	**CADF**	**CIPS**
GDP	I	-1.5244*	-2.4871***	-2.462*	-2.684***
	I&T	-1.8424**	-1.6229*	-2.811	-3.103**
TO	I	-0.4733	-5.5534***	-3.741***	-5.291***
	I&T	1.7778	-4.4691***	-3.170***	-5.475***
EO	I	0.7825	-0.4721***	-3.497***	5.135***
	I&T	2.9375	-3.667***	-3.507***	-5.471***
IO	I	-2.5326***	-2.8933***	-4.081***	-5.328***
	I&T	0.4559	-6.6765***	-4.088***	-5.368***
IQI	I	-6.3492***	-5.9659***	-4.612***	-4.977***
	I&T	-5.3616***	-4.8722***	-4.502***	-4.968***
EXR	I	-6.6428***	-5.5160***	-3.593***	-4.576***
	I&T	-5.9064***	-4.3201***	-3.582***	-4.541***
DC	I	-4.6211***	-5.4965***	-3.002***	-4.159***
	I&T	-4.8420***	5.2714***	-4.199***	-4.309***
GCF	I	-5.9100***	-6.3889***	-4.187***	-4.518***
	I&T	-4.9180***	-5.3417***	-4.448***	-4.651***
CPI	I	-8.1881***	-7.3533***	-4.291***	-4.805***
	I&T	-6.7039***	-5.9404***	-4.201***	-4.899***

Note: Author's construction. The asterisk signifies the significance level of the t-statistic value: *p < 0.10, **p < 0.05, ***p < 0.01.

However, the inclusion of interaction terms significantly increases the impact of overall trade, export, and import on economic growth to 0.17, 0.20, and 0.11 percent. Moreover, the effect for the quality of institutions also turns positive on economic growth in the presence of interaction terms. This implies that trade openness improves the quality of institutions in the countries owing to the two possible changes in preferences of agents, i.e., sensitivity to agents in power and inclination towards the production of comparatively advantaged goods. Trade openness enriches the performance of institutions in the economy, dominant to productive agents rather than rent-seekers. Besides that, it smoothes the way to direct the resources for better institution development where the higher production of comparatively advantaged goods in the dominant sectors necessitates strengthening good institutions. This induces improvement in institutional quality as one of the prominent solutions to attain economic growth.

Further, the results exhibit a significant positive impact of the exchange rate on economic growth, where a one percent increment in the exchange rate enhances economic growth by approximately 0.50 percent. This ascribes to the availability of domestically produced goods at a relatively lower price, escalating the demand for home country goods, resulting in increased exports and enhanced economic growth. The findings are in line with the theoretical premises given by mercantilists and empirical evidence by Khobai et al. (2017). The capital stock also exerts a significant positive impact of approximately 0.75 and 0.72 percent on economic growth. The findings comply with Doan (2019) and Keho (2017). On the other hand, financial development and inflation reveal a significant negative influence on economic growth. The findings for the earlier accord with the evidence by Mireku et al. (2017), whereas for the latter, the results are consistent with Khobai et al. (2017), Mireku et al. (2017), and Nketiah et al. (2020).

Table 6.2: System GMM results (Dependent variable: lnGDP)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
GDP L1	0.7882***	0.6271***	0.7771***	0.6348***	0.8005***	0.6559***
	(0.0266)	(0.0504)	(0.0256)	(0.0399)	(0.283)	(0.0716)
lnEXR	0.5080***	0.4696***	0.5009***	0.5016***	0.5017***	0.4741***
	(0.0227)	(0.0421)	(0.0232)	(0.0389)	(0.0196)	(0.4230)
lnDC	-0.0746**	0.0209	-0.0667*	-0.0122	-0.0869**	0.0067
	(0.0357)	(0.0526)	(0.0388)	(0.0487)	(0.0373)	(0.0832)
lnGCF	0.7465***	0.7215***	0.7492***	0.7153***	0.7563***	0.7353***
	(0.482)	(0.0830)	(0.04498)	(0.0751)	(0.0560)	(0.08190)
lnCPI	-0.1567***	-0.1681***	-0.1589***	-0.1579***	-0.1417***	0.7353***
	(0.0226)	(0.0275)	(0.0246)	(0.0241)	(0.0200)	(0.0819)
lnIQI	-0.6332***	-0.5357***	-0.6058***	-0.5368***	-0.6459***	-
	(0.0574)	(0.1009)	(0.0558)	(0.0895)	(0.0552)	0.1511***
						(0.0284)
lnTO	0.1117***	0.1754***				
	(0.2163)	(0.0361)				
lnTO*IQI		0.0657***				
		(0.0103)				
lnEO			0.1392***	0.2012***		
			(0.0232)	(0.0299)		
lnEO*IQI				0.1011***		
				(0.0116)		
lnIO					0.08831***	0.1194***
					(0.0283)	(0.0449)
lnIO*IQI						0.0752***
						(0.142)
Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Arellano-Bond test (AR2)	0.903	0.838	0.994	0.767	0.807	0.734
Hansen test	0.163	0.573	0.166	0.407	0.253	0.511
No. Obs	116	116	116	116	116	116

Note: Author's construction. The parentheses show standard errors of the coefficients, and the asterisk signifies their significance level: *p < 0.10, **p < 0.05, ***p < 0.01

Comparing the estimates with and without interaction terms, no statistical difference can be observed, and only the intensity of the effect alters. Consistent with the findings by Akpan & Atan (2016). The results show a significant positive impact of interaction term

that reports complementarity of institutional trade to the effect of trade openness on economic growth, hence acceptance of the null hypothesis (iii). Moreover, the significant results from the Sargan and Hansen test and AR (2) test ensure no autocorrelation and no overidentifying restrictions among the panels. Thus, the results are efficient and provide reliable estimates.

In the light that government policies may be effective over time, it is essential to analyze both long-term and short-term effects using pooled mean group (PMG) estimation model. Under direct effects, the results in table 6.3 exhibit a significant negative long-run but a positive short-run impact of overall trade on economic growth. At the same time, the contrary is true for import openness. Nonetheless, exports exert a positive effect on economic growth in the long run as well as in the short run. However, models with indirect effects reveal that the interaction of institutions with trade openness significantly enhance the effect of overall trade and exports, while the impact of imports on economic growth diminishes in the long run. Contrastingly, a significantly negative long-run coefficient value of 2.21 and 4.58 for the interaction term, trade openness, and export openness with the quality of institutions can be observed in models (4) and (5). The results are dissimilar from the findings of Duodu & Baidoo (2020) and Omoke & Opuala–Charles (2021) and manifest the diminishing impact of overall trade and export openness on economic growth with poor institutional quality. In addition, the findings for model (4), (5), and (6) suggests that the positive impact of institutions boosts economic growth in the long run. However, in the long run, institutions do not complement trade to improve long-run economic growth. In contrast, the short-run results highlight complementarity between exports and imports

and economic growth. Moreover, the long-run estimates for the impact of exchange rate and financial development report enhanced economic growth, but its unfavorable effects can be realized in the short term for all the models. It has been evidenced in many countries that financial development and capital stock facilitate trade only in the long run (Kim et al., 2010). On the contrary, inflation exhibits a significant negative impact of rising prices on economic growth in the long run. The negative error correction term signifies the speed of adjustment to reinstate the long-run equilibrium if the economy undergoes shock in the short term. In the next step, the study presents the individual country results for long-run elasticities using the FMOLS in table 6.4. The findings show that trade delays economic growth in both Brazil and India. The stronger predisposition toward exports in agriculture-based countries like Brazil and India fosters sector-specific growth. As a result, the expansion of the economy's other sectors is stunted. This is especially important since it leads the economy's production pattern to adjust in response to global shifts, thereby lowering production efficiency. On the other hand, financial development and gross capital formation act as a booster in Brazil, India, Russia, and South Africa. However, the financial development in Russia did not complement the trade openness in the economy. Regardless, the expansion of openness channels has improved foreign investment and, as a result, economic growth. Based on the low and significant trade outcomes, it can be concluded that trading with countries other than the group members, namely Brazil, India, and South Africa, may be more beneficial to Russia's economic growth. Along with that, inflation has aided Russia's and South Africa's growth. However, the results from China do not support the current hypothesis and do not provide any reliable inferences.

Table 6.3: PMG results: Direct and Indirect effects of Institutional Quality (dependent variable: lnGDP)

Variables	(1)		(2)		(3)		(4)		(5)		(6)	
	Long-term	Short-term	Long-term	Short-term	Long-term	Short-term	Long-term	Short-term	Long-term	Short-term	Long-term	Short-term
lnEXR	-0.3791**	0.0107	-0.4266*	-0.0216	-0.4116*	0.0009	0.4676**	-0.0012	0.3406***	-0.0001	-0.5305*	-0.0141
	(0.4791)	(0.0191)	(0.2550)	(0.0197)	(0.2311)	(0.0189)	(0.2331)	(0.0253)	(0.1233)	(0.0432)	(0.3103)	(0.0071)
lnDC	0.6154**	-0.0164	-0.5713**	-0.0179	0.6538**	-0.0119	0.0263	0.0333	0.4822***	0.0261	0.4564*	0.0144
	(0.2451)	(0.0244)	(0.2378)	(0.0220)	(0.2650)	(0.0293)	(0.1812)	(0.0427)	(0.0384)	(0.0588)	(0.2618)	(0.0288)
lnGCF	0.9432*	0.2145	0.7006**	0.1974***	1.1066	0.2309***	0.2529	0.09219**	0.5831***	0.0667	1.0135	0.2024
	(0.1237)	(0.0391)	(0.1143)	(0.0387)	(0.1431)	(0.0423)	(0.3030)	(0440)	(0.1786)	(0.0599)	(1.0773)	(0.0268)
lnCPI	-0.0087	-0.0023	-0.0241	-0.0028	-0.0524	-0.0018	-0.2577**	-0.0034	-0.4487***	-0.0102	-0.1459	0.0023
	(0.1131)	(0.0035)	(0.1169)	(0.0029)	(0.1198)	(0.0039)	(0.1246)	(0.1007)	(0.0705)	(0.0074)	(0.1390)	(0.0041)
lnIQI	0.1178	-0.0205	-0.1368	0.0203	-0.2101	0.0235	8.1401**	0.8735*	6.6208***	-0.0241	13.3997***	-0.2795***
	(1.6947)	(0.0310)	(0.7138)	(-0.0318)	(0.7512)	(0.0298)	(3.7890)	(0.4286)	(1.7446)	(0.6797)	(4.3870)	(0.0913)
lnTO	-1.0673**	0.0651***					5.4095***	-0.3855*				
	(0.4791)	(-0.0131)					(1.7853)	(0.2217)				
lnTO*IQI							-2.4284**	-0.2279**				
							(0.9786)	(0.1073)				
lnEO			1.0018***	0.0436					5.1171***	-0.0017		
			(0.4657)	(0.0133)					(1.1545)	(0.3767)		
lnEO*IQI									-2.2121***	0.0282		
									(0.5865)	(0.2158)		
lnIO					0.9804*	-0.0633***					8.4515**	-0.2126***
					(0.5587)	(0.0106)					(2.5560)	(0.0534)
lnIO*IQI											-4.5871***	0.9452***
											(1.4218)	(0.0334)
ECT		-0.0594***		-0.0587***		-0.0569***		-0.0322***		-0.0562***		-0.1880***

Note Author's construction. The parentheses show standard errors of the coefficients and asterisk signifies their significance level: *p < 0.10, **p < 0.05, ***p < 0.01.

Table 6.4: FMOLS results

Variables	Brazil		China		India		Russia		South Africa	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lnEXR	-0.6462*** (-6.5337)	-0.6358*** (-6.0004)	513.9689 (-0.4359)	303.6572 (-0.2994)	-1.3698*** (-7.2416)	-1.3339*** (-8.2809)	00.1098** (-2.4929)	0.1005* (-1.7676)	0.1751** (-3.0514)	0.2551*** (-7.7692)
lnDC	0.2449*** (-8.8873)	0.2371*** (-7.8959)	10524.63*** (-11.2742)	11394.90*** (-12.6596)	1.0775*** (-6.2651)	1.0372*** (-7.0846)	0.3902*** (-4.6992)	0.5313*** (-6.7773)	0.0208 (-0.2883)	0.0317 (-0.8266)
lnGCF	0.5796*** (-5.5307)	0.6344*** (-5.3814)	3843.058* (-2.0445)	2401.309 (-1.2322)	0.2771 (-1.0967)	0.306 (-1.4655)	0.4943** (-2.6431)	0.7162*** (-3.8645)	0.2240** (-2.8841)	0.1754*** (-4.2538)
lnCPI	-0.1207*** (-5.1404)	-0.1032*** (-3.7326)	648.0165** (-3.0984)	620.8988** (3.4226)	-0.0385 (-1.2277)	0.6042* (-2.0637)	0.0395 (-0.4927)	0.028 (-0.3391)	0.0256 (-1.4839)	0.0668*** (-5.7146)
lnIQI		-0.0652 (-1.3885)		316.3346*** (-15.6667)		-1.1786** (-2.1969)		-0.0481 (-0.8328)		-0.0849*** (-0.6264)
lnTO	-0.5784*** (-4.0020)	-0.6084*** (-3.8975)	-940.9285 (-1.6635)	-564.1882 (-1.0575)	-0.7758*** (-3.6322)	-0.7366*** (-4.0537)	0.181 (-1.2676)	0.079 -0.5176	0.2501** -2.868	0.2097*** -4.4526
R squared	0.8512	0.8634	0.9123	0.9131	0.9713	0.9816	0.9123	0.928	0.9702	0.9801

Note: Author's construction. The parentheses show t-statistics of the coefficients and asterisk signifies their significance level: *p < 0.10, **p < 0.05, ***p < 0.01.

6.6 Summary

The importance of trade openness and institutional quality in economic growth has been explicitly recognized in the literature. While theoretically, these studies highlight that outward-oriented policies are far more superior to attaining long-run economic growth, there is a lack of empirical evidence, especially when the quality of institutions comes into play. In response to this lack, this paper adds up to evidence and investigates the relationship between trade openness and economic growth by incorporating the role of institutional quality for BRICS countries using a panel of data from 1991 to 2019. To estimate the results, the study employs System GMM and Pooled Mean Group (PMG) methods to estimate the panel's long-run and short-run elasticities in the models. Additionally, the fully modified ordinary least squares (FMOLS) model has also been used to identify the country-specific results for BRICS. According to the findings, inflation and institutions negatively impact economic growth. On the other hand, trade openness, financial development, trade openness, export openness, and import openness boost economic growth. However, trade openness and institutions only act as short-run complements to economic growth, as a lack of good governance limits the positive impact of trade openness. In addition, the results reveal that Brazil and India experience delayed trade benefits due to their inclination of economic activity toward specific sectors only.

Chapter-7

Trade Openness, Institutional Quality, and Carbon Emissions

7.1 Introduction

The benefits of trade over the past 30 years have not only helped the economy grow quickly but also led to an unprecedented rise in carbon emissions. Indiscriminate use of fossil fuels like natural gas, oil, and coal emits massive amounts of CO_2, along with human activities such as deforestation, which have been a major contributor to environmental degradation. Knowledge spillovers from increasing trade activities and effective environmental regulations are suggested as viable ways to control these rising emissions. Trade openness improves environmental quality if combining technology and composition effects (oriented toward clean goods) outweigh the scale effect (Fakher, 2019). On the other hand, higher trade of dirty goods from developing countries due to the leakage phenomenon brings along environmental issues. Thus, the impact of trade openness is not certain on carbon emissions. However, from time to time, institutions design environmental laws and strategies that directly or indirectly mitigate CO_2 emissions. A stable institutional environment provides a corruption free society and frames regulations that result in the effective implementation of the environmental laws. Advanced institutions promote environment-friendly technology and innovations that improve the environmental performance of economic growth. However, in contrast to these theories, empirical evidences do not provide a clear picture of whether trade openness and institutions

affect positively or negatively to carbon emissions, especially in developing countries like BRICS. Therefore, this chapter intends to uncover the impact of trade openness and institutions on the carbon emissions in BRICS, the home of a few of the largest CO_2 emitters.

7.2 Review of Literature

7.2.1 Trade openness and CO_2 Emissions

The ever-debated relationship between trade and environment has allured the attention of many scholars over a long period. The disaggregated impact of trade openness on the environment can be hypothesised through three key channels- scale, technology, and composition. The scale effect exhibits that an upsurge in energy consumption with trade for higher production causes higher CO_2 emissions. The technological effect improves production techniques and innovations via trade that induces energy efficiency and a cleaner environment. The composition effect mentions the re-assignment of resources and traded commodities either towards pollution-intensive or environment-friendly goods. In addition, it is essential to reserve special attention for the leakage phenomenon while assessing the impact of trade on the environment. The leakage phenomenon is a process where GHG emissions are reduced by shifting the pollution-intensive production activities from developed to developing countries (Dogan & Seker, 2016; Ertugrul et al., 2016; Kuik & Gerlagh, 2003). Due to the strict environmental regulations, the pollution-intensive industries refuge their location that upsurges the pollution and gives rise to the pollution haven hypothesis. In this context, Cai et al. (2018) highlighted that China is a host to the pollution of almost 22 developed countries, while it has transformed nearly 19 underdeveloped countries into pollution havens. Le et al. (2016) emphasised that the trade may degrade the quality of the environment, but its effect may vary in different regions. Moreover, Ertugrul et al. (2016) found that trade openness and energy consumption are one of the main determinants of carbon emissions that result in an upsurged pollution in the top ten developing countries. Similarly, Zhang et al. (2017) examined the link

in ten countries and found that trade openness negatively influences carbon emissions. In support, a recent study by Dou et al. (2021) for China-Japan- ROK FTA countries found that trade surges the GHGs in these countries, where the signing of the FTA agreement may reduce this upsurging effect. Moreover, Omri (2013) studied the trade openness and carbon emission nexus in 14 North American and Middle East countries and highlighted an inverse impact of trade openness on GHG. In recent evidence by Dauda et al. (2021) and Khan et al. (2022), and Appiah et al. (2022), the studies found a significant negative impact of trade on environmental sustainability. On the other hand, Yu et al. (2019) indicated that while trade openness increases emissions overall, it has a double-edged effect by decreasing them indirectly in CIS countries. While in Belt and Road countries, Sun et al. (2019) found both positive and negative impacts of trade on emission conditional to the varying country samples. As a result, no consensus can be drawn on the effects of trade openness on carbon emissions.

7.2.2 Institutions and CO_2 Emissions

With the increasing economic growth, the impact of the quality of institutions on environmental quality has become mainstream (North, 1990). No matter the GDP level of the country, the quality of environment depends on the institutions within. Less effective institutions cause lax environmental regulations leading to increased pollution. On the other hand, strong and effective institutions promote a cleaner environment. Institutions are connected to the environment via possible legal rules and procedures. The linkage between these two is partially based on the 'Porter Hypothesis' which states that strict regulatory policies motivate to innovate of pollution-reducing technology to attain a competitive advantage, which will eventually compensate for the negative externalities to the environment and lead to better efficiency in growth (H. Zhang et al., 2018). Moreover, the studies argue that a stronger negative association between the rule of law and environmental pollution demonstrates an EKC turning point at a much lower country income level, thus lowering carbon

emissions (Castiglione et al., 2012). Regulations affect the environmental quality via four channels, i.e., by reducing the use of non-renewables, increasing the barriers to entry for pollution-intensive industries, encouraging the development of energy-saving products, and investing in pollution-reducing technology (H. Zhang et al., 2018). Meanwhile, corruption creates a direct as well as indirect impact on the environment, where direct impact refers to the impact on pollution through environmental rules, and indirect impact refers to the impact on pollution through the effect of corruption on per capita income levels, thus effecting environment (Welsch, 2004). It affects three bottom lines of sustainability (i.e., social, economic, and environmental), creating a roadblock to adopting green solutions and cleaner resources (Silvestre et al., 2018). On the other hand, political and bureaucratic inefficiencies come up as distorting channels that weaken environmental governance (Welsch, 2004).

When it comes to empirical evidence, their impact is still up for debate. Phuc Canh et al. (2019), Salman et al. (2019), and Shahbaz et al. (2019) highlighted in their study of G-7 economies that effective environmental policies improve environmental sustainability. Salman et al. (2019) examined the effect of institutions on CO_2 emissions in Indonesia, South Korea, and Thailand and found that institutional quality facilitates the reduction of CO_2 emissions. Further, Khan and Rana (2021) researched the link for 41 Asian economies and found that institutions are conducive to the mitigation of CO_2 emissions. Similarly, Ali et al. (2019), Haldar and Sethi (2021), and Wawrzyniak and Doryń (2020) documented that greater efficiency of institutions reduces GHGs emissions in emerging and developing economies. On the other hand, some studies mention that a weak institutional environment creates loops for economic inefficiencies, resulting in degraded environmental quality. A recent study by Azam et al. (2021) documented that institutional quality impacts CO_2 emissions positively in developing countries. Similarly, Teng et al. (2021) highlighted a significant increase in carbon emissions due to institutional quality. Analysing the components of institutional quality separately, Abid

(2016) found that control of corruption, political efficiency and stability, democracy, and governance efficiency mitigates carbon emissions, whereas law and regulatory quality induces a boost in carbon emissions. Later, Akhbari and Nejati (2019) highlighted that corruption might create an insignificant impact on environmental quality in both developed and developing countries. As a result, a strong institutional environment is an optimum choice to tackle increasing GHG emissions, yet no empirical unanimity exists for its impact on emissions, particularly in BRICS.

7.2.3 Economic Growth and CO_2 Emissions

The relationship between economic growth and pollution has been widely acknowledged via the Environmental Kuznets Curve (EKC) hypothesis by Panayotou (1994). The hypothesis posits that in the early stages of development, countries are more concerned about higher income and economic growth than any environmental issues, which results in degraded environmental quality. While in the later stage, when the income rises to a certain level, the countries shift their concern toward a cleaner environment and increase the awareness for using renewable energy resources and less polluting goods, resulting in better environmental quality. A modified version of EKC consists of more than two variables that include institutional quality and globalisation. However, the studies have mentioned that local pollutants decline with higher per capita income, but the emissions of pollutants still increase (D. Stern, 2018). The studies also confirm that emissions rise with per capita income when other factors are kept constant (D. Stern, 2018). The statement is supported by many empirical evidence over time. In a study by Le and Ozturk (2020), the results confirmed the existence of EKC in emerging countries utilising institutional quality, globalisation, and government expenditures. Egbetokun et al. (2020) also revealed the presence of EKC in Nigeria but further suggested strengthening the institutional structure to reduce carbon emissions with higher economic growth. Similarly, Lawson (2020) and Hassan et al. (2020) analysed the economic

growth-emissions nexus for Sub-Saharan African countries and confirmed that the effect of economic growth significantly mitigates carbon emissions. Danish et al. (2019) examined the economic growth-emissions nexus and found that EKC holds in BRICS countries. Further, Chhabra et al. (2022) highlighted the existence of EKC in selected high and low middle-income countries. On the other hand, Asongu et al. (2020), in their study on African countries, found that EKC does not hold and higher economic growth does not ensure lower pollution levels. Wawrzyniak and Doryń (2020) investigated the nexus with institutional quality and indicated that the effectiveness of government institutions alters the impact of economic growth on carbon emissions in developing countries. In addition, Aust et al. (2020) found that higher economic growth due to modern industrialisation, infrastructural activities, and population growth increases the consumption of non-renewable resources and causes a rise in carbon emissions in developing countries. Osadume (2021) found that economic growth creates a positive impact on carbon emissions in West African countries in the long-run as well as in the short-run. Similarly, Ostic et al. (2022) indicated a positive and significant relationship between economic growth and carbon emissions in OPEC countries. Hence, no consensus can be made for the effects of economic growth on pollution.

7.2.4 Renewable energy resources, Non-renewable resources, and CO_2 Emissions

The stifling stress of global warming on the climatic conditions necessitates to take a leap toward modulating the anomalies emitting enormous greenhouse gases. One possible way to harmonize such anomalies is a shift toward renewable resources. It is a widely believed fact that the consumption of non-renewable resources, such as fossil fuels, exacerbates carbon emissions, causing severe environmental issues (Li and Haneklaus, 2022). Thus, De La Peña et al. (2022) highlight that using solar, wind, geothermal, and other renewable resources is crucial in reducing the consumption dependence on fossil fuels and promoting a cleaner environment. Moreover, the studies highlight that keeping the increase in global temperatures

below 1.5° C and lowering carbon emittances to net zero is essential to halt any damages from global warming (Kenner & Heede, 2021; Obobisa, 2022). Subsequently, Acheampong et al. (2019) revealed that higher use of renewable resources reduces carbon emissions in Sub-Saharan Africa. In a study for South Africa, Sarkodie and Adams (2018) conclude that diversification in the energy usage portfolio to include renewable resources reduces carbon emissions. Bilan et al. (2019) assessed the impact of renewable resources on CO_2 emissions and found that adopting renewable resources enhances the quality of environment by lowering CO_2 emissions in EU states. Similarly, Awosusi et al. (2022) investigated the association between renewable resources, globalisation, and CO_2 emissions and found that renewable energy sources reduce carbon emissions in Columbia. Further, Fatima et al. (2021) found that economic growth moderates the effect of renewable energy on carbon emissions. Further, Szetela et al. (2022) indicated that the shift to renewable energy consumption helps in a faster reduction in CO_2 emissions.

To sum up, very few studies have examined the trade openness-emissions nexus with a special focus on the role of institutional quality. Most such studies also fail to consider the effect of renewable and non-renewable resources on the nexus for BRICS countries. As a result, this paper adds to the existing literature by incorporating the role of institutional quality, renewable resources, and non-renewable resources in the openness-emissions nexus in BRICS.

7.3 Data

This study analyses the relationship between trade openness and carbon emissions with institutional quality for BRICS countries from 1991 to 2019. The selection for the study period is purely based on the availability of data for all the variables used in the study. For the dependent variable, the study used CO_2 emissions in metric tons (CO_2) as a proxy for carbon emissions in compliance with previous studies by (Stern 2004; Shahbaz and Sinha 2019;

Chhabra et al. 2022). For independent variables, the study uses trade-to-GDP (TO) to represent trade openness. The inclusion of the variable is significant due to the persisting leakage phenomenon in developing countries. Further, three institutional indices are constructed using PCA to represent the quality of institutions in compliance with Khan et al. (2022). The construction of these indices will help us to identify whether transparency and democracy electorate exert policy pressure on the government. Secondly, it will check whether democratic countries are more likely to provide public goods, such as environmental protection (Hughes & Lipscy, 2013). In addition, the study conducts a single indicator analysis for each governance indicator. It will provide a better picture of the individual effects of institutional quality variables. The other explanatory variables for the analysis include GDP per capita (GDPC) constant (2010 US$) indicating economic growth, fossil fuel consumption per capita (in kwh) denoting non-renewable energy, and renewable resource consumption per capita (in kwh) representing renewable energy. Since fossil fuels play a crucial role in high carbon emissions and are a major source of energy consumption in these countries, it is vital to analyse the role of non-renewable energy and its modulators (renewable energy) on carbon emissions. In line with the existing empirical evidence, the study expects a negative sign for trade openness (Zhang et al. 2017; Yu et al. 2019; Dauda et al. 2021), renewable energy (Awosusi et al., 2022; Fatima et al., 2021; Szetela et al., 2022), and economic growth (Danish et al., 2019; Lawson, 2020) on carbon emissions whereas, a positive sign is expected from non-renewable energy on carbon emissions in BRICS countries (Fatima et al., 2021). The data for the variables has been sourced from WDI, ICRG, CAIT, and Our World Data.

7.4 Model Specification

The study aims to examine the impact of trade openness and institutional quality on carbon emissions for BRICS countries. For this purpose, the model also includes other explanatory variables, such as economic growth, renewable resources, and non-renewable resources. The

model proposed to analyse the impact of these respective variables on carbon emissions can be expressed as

$$CO_2 = f(TO, IQ, GDPC, REN, NON) \quad (7.1)$$

where CO_2 shows carbon emissions, TO denotes trade openness, IQ represents institutional quality, GDPC refers to GDP per capita, REN signifies renewable energy, and NON is non-renewable energy.

All the variables have been converted into natural logarithms to reduce the sharpness of data and control heterogeneity. As a result, the converted model can be presented as

$$lnCO_2 = \beta_0 + \beta_1 lnTO_{it} + \beta_2 lnIQ_{it} + \beta_3 lnGDPC_{it} + \beta_4 lnREN_{it} + \beta_5 lnNON_{it} + \varepsilon_{it} \quad (7.2)$$

where $\beta_1, \beta_2, \ldots, \beta_5$ denotes the elasticities of trade openness (TO), institutional quality (IQ), economic growth (GDPC), renewable energy (REN), and non-renewable energy (NON) to carbon emissions (CO_2). In function, 'i' represents the country and 't' means the time. To investigate the impact of institutional quality on environmental quality, the study utilises different measures following Khan et al. (2022). Based on existing evidence, the study uses numerous institutional indicators from International Country Risk Guide (ICRG) database. The effect of all the variables can be observed in Figure 7.1, which shows the directions and magnitude of the impact of all these variables under PCA divided into the four quadrants.

Firstly, the study constructs an Institutional Quality index (IQI) using government stability, law and order, democratic accountability, bureaucratic accountability, corruption, ethnic tension, internal conflict, external conflict, and religious tensions in model 2a. Secondly, the political stability index (PSI) has been constructed using ethnic tensions, religious tensions, government stability, internal conflicts, and external conflicts in model 2b. Thirdly, the political efficiency index (PEI) has been devised using law and order,

democratic accountability, bureaucratic accountability, and corruption in model 2c. As a result, the study uses three proxy indices to represent institutional quality and investigate its impact on environmental sustainability more profoundly. All the three indices have been constructed by applying PCA technique. Following Boateng et al. (2021), the study also conducts a KMO test to check the validity of IQI, PSI, and PEI. The KMO results provide statistical values of 0.638, 0.600, and 0.7872 for IQI, PSI, and PEI, with eigenvalues of 2.48, 2.61, and 1.88 explaining the total variation of 71, 73, and 75 percent, respectively (as shown in table 7.1).

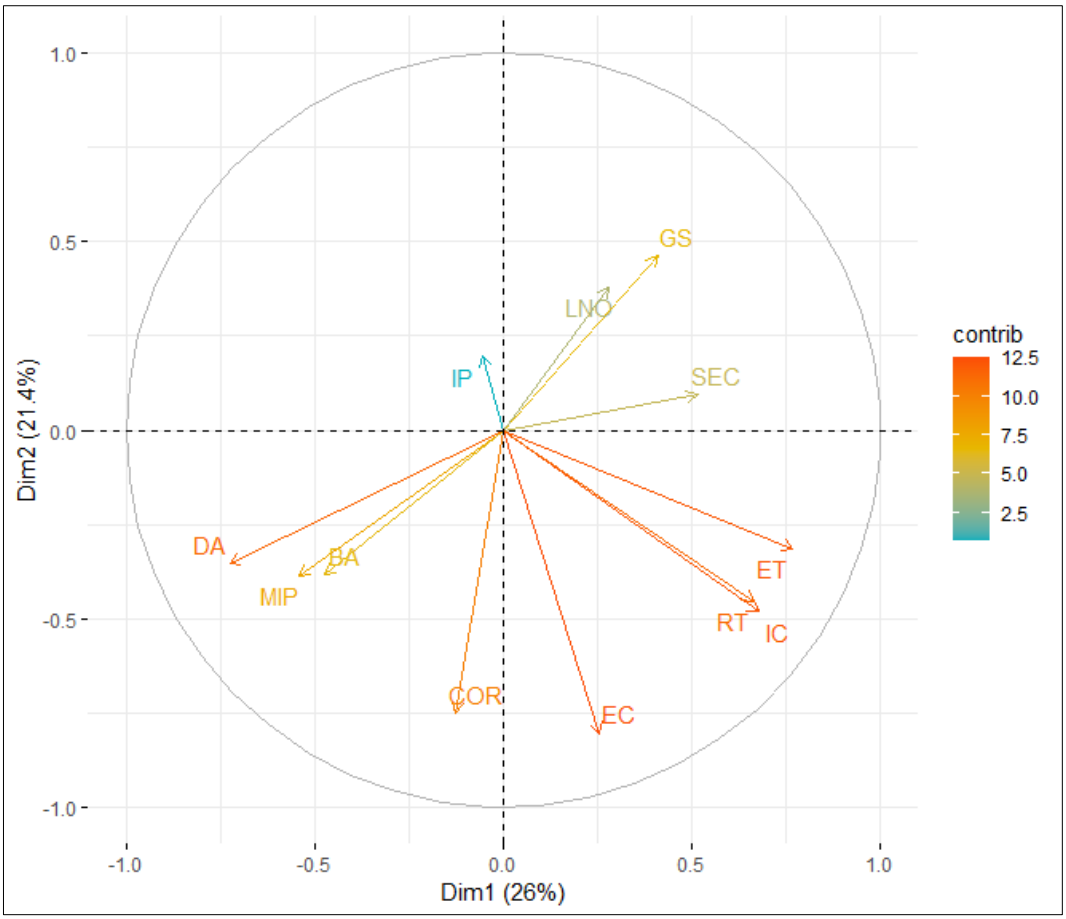

Figure 7.1: Effect of institutional quality variables under PCA.

Source: Author's computation. Note: Here, IP- Internal Politics, LNO- Law and Order, GS- Government Stability, SEC- Socio-Economic Conditions, ET- ethnic Tension, IC- Internal Conflict, EC- External Conflict, RT- Religious Tensions, COR- Corruption, BA- Bureaucratic Accountability, DA- Democratic Accountability, MIP- Military in Politics.

Table 7.1: Summary of PCA results for political stability index (PSI) and political efficiency index (PEI)

Part A: Eigen analysis of correlation matrix						
PCs	**Political Stability Index (PSI)**			**Political Efficiency Index (PEI)**		
	Eigen Value	**Proportion Covariance**	**Cumulative**	**Eigen Value**	**Proportion Covariance**	**Cumulative**
1	2.6052	0.5211	0.5211	1.8808	0.4702	0.4702
2	1.0601	0.2120	0.7331	1.1451	0.2863	0.7565
3	0.5487	0.1098	08428	0.6879	0.1720	0.9285
4	0.4692	0.0939	0.9367	0.2860	0.0715	1.0000
5	0.3166	0.0633	1.0000	-	-	-

Part B: Eigen vectors (component loadings) for Political Stability Index (PSI)					
Variables	PC1	PC2	PC3	PC4	PC5
IC	0.5375	0.0652	0.2537	0.1656	-0.7843
EC	0.4693	-0.3358	0.6411	0.0209	0.5055
GS	0.0868	0.9363	0.2433	0.0604	0.2291
ET	0.4925	0.0794	-0.3446	-0.7925	0.0653
RT	0.4907	0.0044	-0.5884	0.5834	0.2695
Bartlett Sphericity test			163.336 (Chi-Square)	0.0000 (p-value)	
KMO test			0.6		

Part B: Eigen vectors (component loadings) for Political Efficiency Index (PEI)				
Variables	PC1	PC2	PC3	PC4
LNO	-0.1313	0.8538	0.3868	0.3226
DA	0.5159	-0.3720	0.6515	0.4134
BA	0.6271	0.3060	0.1257	-0.7052
COR	0.5687	0.1973	-0.6404	0.4771
Bartlett Sphericity test		196.363 (Chi-Square)	0.0000 (p-value)	
KMO test		0.7872		

Note: Author's construction. The table shows the results for the Eigen analysis generated using PCA to formulate the political quality index (PQI) and political efficiency index (PEI) for BRICS.

Thus, the PCA is appropriate and creates valid indices. The econometric models for this can be presented as

$$lnCO_2 = \beta_0 + \beta_1 lnTO_{it} + \beta_2 lnIQI_{it} + \beta_3 lnGDPC_{it} + \beta_4 lnREN_{it} + \beta_5 lnNON_{it} + \varepsilon_{it} \quad (7.2a)$$

$$lnCO_2 = \beta_0 + \beta_1 lnTO_{it} + \beta_2 lnPSI_{it} + \beta_3 lnGDPC_{it} + \beta_4 lnREN_{it} + \beta_5 lnNON_{it} + \varepsilon_{it} \quad (7.2b)$$

$$lnCO_2 = \beta_0 + \beta_1 lnTO_{it} + \beta_2 lnPEI_{it} + \beta_3 lnGDPC_{it} + \beta_4 lnREN_{it} + \beta_5 lnNON_{it} + \varepsilon_{it} \quad (7.2c)$$

where CO_2 shows carbon emissions, TO denotes trade openness, GDPC refers to GDP per capita, REN signifies renewable resources, NON is non-renewable resources, IQI is an institutional quality index, PSI represents the political stability index, and PEI denotes the political efficiency index for 'i' cross-section over time 't.' In order to get a clearer picture, the study performs a single indicator analysis, in which the impact of each governance indicator has been examined separately.

7.5 Results and Analysis

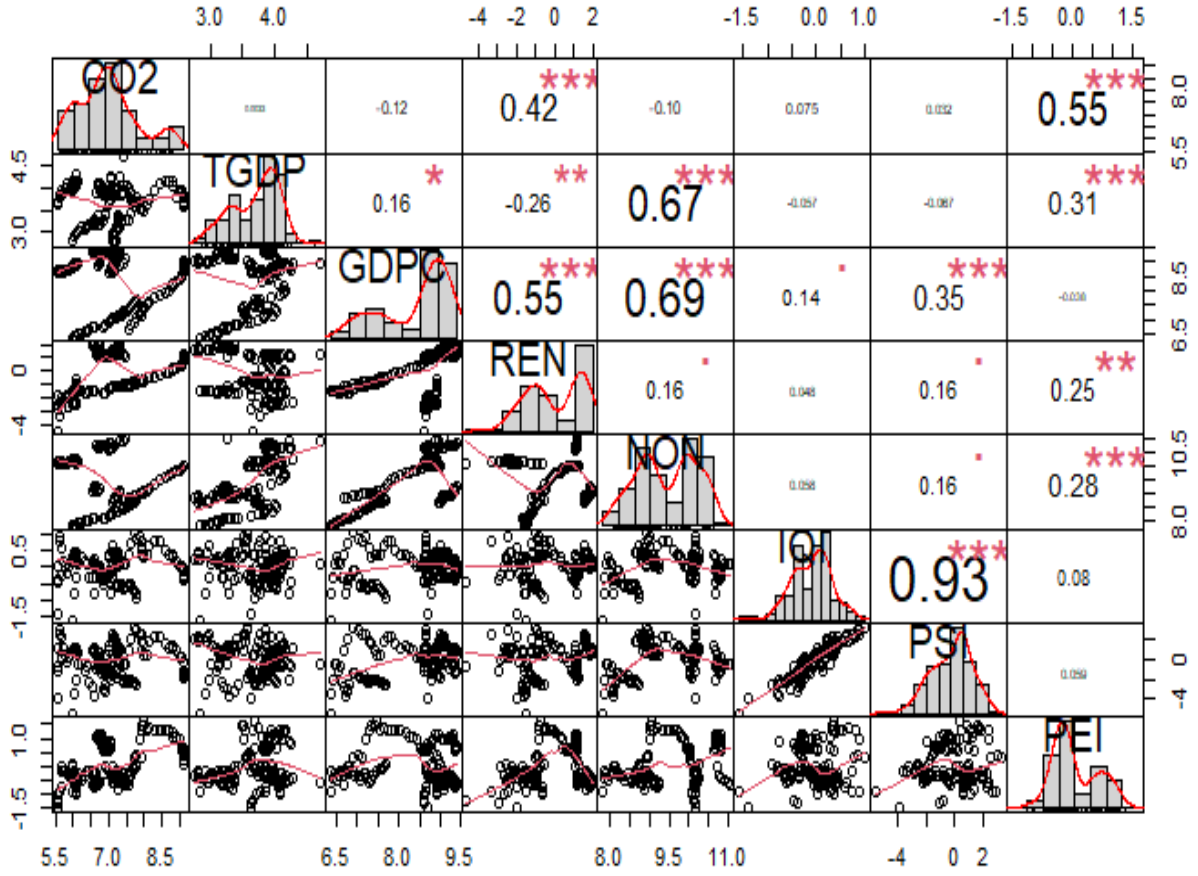

Figure 7.2: Correlation statistics between carbon emissions, trade openness, GDP per capita, renewable energy, non-renewable energy, institutional quality index, Political stability index, and political efficiency index. * means <10%, ** means <5% *** means <1%. Source: Author's construction.

For the empirical analysis, the study initially checked the correlation statistics for the variables, as shown in Figure 7.2. The diagonal in Figure 7.2 shows the distribution of each variable, where bottom of diagonal displays bivariate scatter plot with the fitted lines, and top of diagonal shows the correlation values with their significance values. The findings from the correlation statistics confirm that there is no multi collinearity issue in the data. Further, the study examines presence of unit root stationarity using second-generation unit root tests, namely, CADF and CIPS. The results from both CADF and CIPS tests in table 7.2 reveal that the variables are stationary at mixed order. All variables are stationary at the first difference, while trade openness, economic growth, non-renewable resources, and institutional quality proxies are stationary at the level as well. Further, the first-generation unit root tests, namely IPS and LLC tests, reject the null hypothesis and confirm that all the variables are stationary at first difference. As a result, the robustness check validates the findings of second-generation unit root tests.

Table 7.2: Unit root test results

Variables	First-generation unit root				Second-generation unit root			
	LLC		IPS		CADF		CIPS	
	At level	At 1st diff	At level	At 1st diff	At level	At 1st diff	At level	At 1st diff
CO_2	-2.4386**	-3.7491***	-0.3969	-4.4001***	-2.157	-3.396***	-2.202	-4.172***
TO	-1.6732**	-8.6918***	-1.7155**	-4.5149***	-2.836**	-3.741***	-3.259***	-5.291***
GDP	-0.8824	-1.5245*	1.4291	-2.4871**	-2.462*	-2.078	-2.614***	-2.684***
REN	1.3013	-6.0138***	1.7693	-7.4465***	-1.484	-3.714***	-1.451	-5.269***
NON	-0.5052	-1.9849**	0.1813	-3.1084***	-2.632**	-2.433*	-2.570**	-3.588***
IQI	-0.8012	-5.5923***	-2.0031**	-6.0762***	-2.423*	-4.846***	-2.649***	-4.647***
PSI	8.2205	-4.5331***	-2.1682**	-6.2205***	-2.347*	-3.871***	-2.788***	-4.687***
PEI	-1.6998**	-2.8822***	-1.1598	-4.1746***	-2.149	-4.163***	-2.831***	-5.165***

Note: Author's construction. The table shows t-statistics and t-bar values. * means <10%, ** means <5% *** means <1%. The results reject the null hypothesis and confirm the stationarity at the first order

The results in table 7.3 present three separate models, one for each institutional quality proxy variable, IQI, PSI, and PEI. The cointegration results reject the null hypothesis of no cointegration for all the models. As a result, the findings support the existence of a long-run relationship between carbon emissions, trade openness, institutional quality, renewable resources, and non-renewable resources.

Table 7.3: Westerlund cointegration results

Models	Gt	Ga	Pt	Pa
CO_2 = f (TO, IQI, GDPC, REN, NON)	-1.910***	-4.803***	-3.962	-6.926***
CO_2 = f (TO, PSI, GDPC, REN, NON)	-2.047***	-5.402***	-4.362***	-6.934***
CO_2 = f (TO, PEI, GDPC, REN, NON)	-1.098	-2.184***	-3.147***	-2.753***

Note: Author's construction. The table shows the significance of results at robust p-values, where *** means <1%. The results confirm the long-run cointegration for all the models.

Further, the study employs the DCCE estimator to estimate the long-run parameters for all the explanatory variables concerning carbon emissions. The results in table 7.4 show that trade openness aggravates CO_2 emissions in BRICS countries. The findings reveal that a one percent change in openness to trade causes a 0.27 percent increase in carbon emissions in the model (1). The results are in accordance with Zhang et al. (2017), Phong (2019), Le and Ozturk (2020), and Dou et al. (2021). This indicates that energy-hungry production techniques feed a voluminous amount of economic output in these countries. As a result, it confirms an overpowering effect of scale production that offsets the benefits of technology and composition effects absorbed from global trade, resulting in higher carbon emissions. According to the theoretical literature, trade stimulates the environment conducive and advanced innovative technologies in developing countries, like BRICS, that improve the standard of living and economic growth. But these imports include antiquated technologies from developed countries

that increase the consumption of dirty energy sources (non-renewable source) and emits high carbon contents. This intensifies and confirms the existence of the pollution haven hypothesis, where a boost in trade escalates CO_2 emissions. However, the effect reduces with the introduction of the institutional quality index in the model (2). The findings show that the environment degrading effect of trade openness reduces with an effective institutional setting, where a one percent change in trade openness triggers carbon emissions by 0.16 percent in the case of the institutional quality index. This reveals that the combined effect of all the institutional variables is more effective in improving trade's negative impact on environmental quality.

Also, a significant negative impact of economic growth can be evidenced on CO_2 emissions. The findings show that a one percent change in the institutional environment increases carbon emissions by 0.37 percent in the model (2). With political stability and efficiency, the impact of economic growth rises to 0.46 percent and 0.47 percent, respectively. The findings are consistent with Amuakwa-Mensah and Adom (2017), Adams and Nsiah (2019), and Muhammad (2019). This demonstrates that the pursuit of greater well-being through economic development has increased the consumption of energy-hungry technologies emancipating substantial CO_2 emissions. The growth trends in the industrial, transportation, and manufacturing sectors perpetuate massive consumption of non-renewable energy sources such as fossil fuels. As a result, a large number of carbon particles are emitted, which degrades the environmental quality in BRICS. This indicates that economic growth triggers CO_2 emissions and creates severe environmental damage. Therefore, policies promoting renewable source consumption and energy-saving innovative technologies should be prioritised to mitigate enormous carbon emissions.

Table 7.4: Long-run estimation results from DCCE and Driscoll-Kraay standard errors

Variables	DCCE results				Driscoll-Kraay standard errors results		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L.CO_2	-0.6783*** (0.0927)	-0.5198*** (0.0786)	-0.4503*** (0.0516)	-0.5131*** (0.0392)	-	-	-
TO	0.2763* (0.1522)	0.1684* (0.9204)	0.3282* (1900)	0.2976** (0.1339)	0.5265*** (0.1014)	0.3252** (0.1233)	0.4122*** (0.1180)
GDPC	0.3610 (0.2833)	0.3732** (0.1812)	0.4660* (0.2431)	0.4703** (0.2051)	0.4865* (0.2855)	0.3005* (0.1709)	0.3724* (0.1905)
REN	-0.1180 (0.1155)	-0.2719** (0.1154)	-0.2580** (0.1217)	-0.2819** (0.1289)	-0.1537 (0.4347)	0.0561 (0.721)	-0.0912 (0.0572)
NON	0.8301* (0.4883)	0.7755** (0.3749)	0.5969 (0.4983)	0.5841 (0.5167)	0.6292*** (0.1029)	0.5859** (0.2477)	0.6779* (0.3502)
IQI	-	-0.1399** (0.0714)	-	-	-0.1044 (0.0775)	-	-
PSI	-	-	-0.0422* (0.0220)	-	-	-0.0367 (0.1033)	-
PEI	-	-	-	-0.0882* (0.0482)	-	-	-0.0731 (0.1698)
R sq	0.63	0.62	0.65	0.57	0.68	0.69	0.67
CD stat	-0.20	0.13	-0.10	-0.25	-	-	-
p-value	0.8448	0.8990	0.9224	0.8013	-	-	-

Note: Author's construction. The parentheses for models (1), (2), (3), and (4) show standard error values, whereas parentheses for models (5), (6), and (7) show Driscoll-Kraay's standard error values. * means <10%, ** means <5% *** means <1%. The findings show that while trade openness degrades environmental quality, institutions work diligently to mitigate its negative effects

Similarly, non-renewable resources exert a significant negative impact on carbon emissions. The results disclose that a one percent change in non-renewable resources exacerbates carbon emissions by 0.91 percent. The findings are consistent with those of Appiah et al. (2019), Asongu et al. (2020), and Khan et al. 2022) for developing countries. This highlights that the economic activities in BRICS countries rely highly on the consumption of fossil fuels for both domestic and industrial purposes, which increases the emancipation of carbon gases. On the other hand, renewable energy consumption shows a significant positive impact on carbon emissions, where a one percent change in renewable energy consumption lowers carbon gas emissions by 0.11 percent. When combined

with an effective institutional environment, renewable energy resources contribute more significantly toward cleaner environmental quality. Under improved political efficiency and stability, renewable energy consumption significantly lowers carbon emissions by an average of 0.26 percent in models (3) and (4). The findings for positive renewable energy impact are in agreement with the results of Akram et al. (2020) and Hassan, Danish, Khan, Baloch, et al. (2020) for BRICS countries analysis and with Acheampong et al. (2019), Dauda et al. (2021) De La Peña et al. (2022), and Khan et al. (2022) for developing countries analysis. Compared to the impact of renewable energy sources, the negative impact of non-renewable resources is almost triple in model (2) and double in models (3) and (4). This indicates that the environmental degradation effects outweigh any environmental benefits from renewable energy sources. This validates the critical need for an institutional framework that promotes alternatives to traditional energy sources, like fossil fuels, which are less harmful to the environment. The transition to renewable energy sources will not only improve the environmental quality but will also reduce the dependence on other countries for the supply of non-renewable energy sources. Since the generation of solar, geothermal, hydro, and other renewable energy source involves massive energy projection projects, it may not be possible to shift towards renewable resources in a jiff entirely, but an increased use will immensely reduce the carbon emissions in BRICS countries. Therefore, as the major hosts of the leakage phenomenon, India and China are suggested to strengthen their resilience to renewable energy sources. This indicates that the quality of institutions is inextricably related to reducing carbon emissions. The results are in line with the findings of Danish et al. (2019) and Chaudhry et al. (2022) and exhibit that with a one percent improvement in the institutional quality index, carbon emissions reduce by 0.13 percent in the sample countries. Moreover, the positive impact of PSI and PEI on carbon emissions highlights that political stability and efficiency lay the groundwork for an effective environmental regulatory framework that takes the edge off the higher emissions. A one percent change in political stability and efficiency will bring a 0.04 percent and 0.08 percent

reduction in emissions of CO_2. This indicates that a stronger institutional environment controls any political instability, conflicts, and corruption, which improves government regulations' effectiveness. One reason behind this is that the political environment in these countries is becoming aware of general public issues like pollution. Another possibility is the adoption of new initiatives and changes in the bureaucratic mindsets that focus on environmental issues. This highlights that along with higher economic growth, environmental problems are also the among the top priorities of the institutions. Improved bureaucratic control over implementing stringent environmental policies may encourage using environment-conducive and less carbon-emitting technologies. This brings several projects to BRICS countries that not only aim to maximise profit but also boost knowledge spillovers. The transfer of green innovations and technology using renewable energy sources will aid in the reduction of carbon emissions. This will illustrate domestic and foreign investment expeditions toward green production activities, inducing a cleaner environment.

The results of the single indicator analysis to investigate the impact of institutional quality on carbon emissions more thoroughly will provide a clear picture of the indicators degrading or restoring environmental quality. Table 7.5 shows that government stability, military involvement in politics, and bureaucratic accountability reduce CO_2 emissions significantly. The results confirm the classic statement of Graham Allison that "where you stand depends on where you sit," which means the bureaucratic awareness towards the environment changes policy formulation and preferences accordingly. It implies that the higher awareness in these countries is resulting in stronger environmental protection policies. Moreover, stability brings environmental improvements by avoiding any jeopardies in the education system, which also increases ecological awareness, thus leading to sustainable development.

However, these countries remain vulnerable to high corruption levels. Higher corruption degrades environmental quality by reducing the efficiency of institutions. Moreover, it reveals that corruption practices in these countries impede the smooth application and implementation of cleaner energy due to weak environmental laws, hence lower sustainability (Ren et al., 2018). Corruption results in lower environmental standards that may boost the GDP slightly in the short run by high energy consumption. In addition, a lack of focus on quality will reduce efficiency and increase economic and environmental costs, resulting in higher carbon emissions in the long run. It impedes the development process of economies and causes delays in meeting CO_2 emission reduction targets.

The findings also demonstrate a negative relationship between CO_2 emissions and law and order in BRICS countries. This implies that enforcement of government regulations does support growth irrespective of its drivers, such as non-renewable and renewable sources. The results validate the effects of the Porter hypothesis and confirm that environment-friendly technology compensates for the environmental cost and leads to efficient economic growth (H. Zhang et al., 2018). It increases the likelihood of absorbing more benefits from the compounding effect, where enforcing multiple environmental laws helps to attain the green environment goals more swiftly (Hargrove et al., 2019). The results reveal that conflicts, such as internal conflicts, external conflicts, and ethnic tensions, accelerate carbon emissions and curtail economic growth. Active conflicts, such as wars, damages energy infrastructure and natural resources when the demand for fuel remains static. This forces a shift toward more harmful and inefficient alternatives contributing to carbon emissions. The reports have shown that the countries undergoing conflicts cannot deal with these climatic changes efficiently due to their weakened adaptability. The results are in line with Sekrafi and Sghaier (2018), Akhbari and Nejati (2019), Ren et al. (2018), and Zhang et al. (2018).

Table 7.5: Single Indicator analysis results for institutional quality using DCCE

Variables	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
L.CO_2	-0.8588***	-0.0648	-0.5340***	-0.4587***	-0.4616***	-0.5357***	-0.6944***	-0.5715***	-0.4818***	-0.5011***
	-0.0889	-0.0397	-0.0634	-0.0452	-0.0518	-0.0584	-0.0326	-0.0736	-0.0227	-0.0551
TO	0.2009**	0.4295***	0.1023*	0.3753***	0.0563***	0.6238**	0.4332***	0.1564***	0.1251***	0.5876**
	-0.0825	-0.1306	-0.0531	-0.1429	-0.1556	-0.2638	(-0.1582)	-0.0357	(-0.0457)	-0.2404
GDPC	-0.4479	-1.1312**	-0.2048	0.5325	-1.0507**	0.2555	-1.2043*	0.3869*	-2.6468*	-0.3777
	-0.4479	(-0.5621)	-0.3718	-0.6757	-0.5002	-0.6322	-0.5877	-0.2213	-1.4791	-0.7028
REN	-0.2178	-0.3170**	-0.2247*	-0.1925**	-0.3068**	-0.4795***	-0.3691**	-0.2564*	-0.2160**	-0.2452**
	-0.1631	-0.1393	-0.1339	-0.0937	-0.1431	-0.1718	-0.1677	-0.1315	-0.0951	-0.1094
NON	0.7172**	0..9414*	0.445	0.3827***	0.3731**	0.6362	1.0547*	1.2499**	1.7206*	0.4473
	-0.355	-0.552	0.3134	-0.0587	-0.1851	-0.5242	-0.5872	-0.5637	-1.019	-0.4087
COR	0.0762**	-	-	--	-	-	-	-	-	-
	-0.032									
LNO	-	-0.0558*	-	-	-	-	-	-	-	-
		-0.0288								
IP	-	-	0.0307**	-	-	-	-	-	-	-
			-0.0151							
IC	-	-	-	0.0771	-	-	-	-	-	-
				-0.1033						
EC	-	-	-	-	0.0029	-	-	-	-	-
					-0.0342					

DA	-	-	-	-	-	0.0061 -0.0962	-	-	-	-
BA	-	-	-	-	-	-	-0.3147 -0.2486	-	-	-
GS	-	-	-	-	-	-	-	-0.0175** -0.0076	-	-
MIP	-	-	-	-	-	-	-	-	-0.0725* -0.0403	-
ET	-	-	-	-	-	-	-	-	-	0.0834 -0.0651
R sq	0.68	0.61	0.64	0.61	0.63	0.58	0.58	0.56	0.6	0.59
CD stat	-0.55	-0.26	-0.13	0.32	0.33	-0.3	-0.4	-0.67	-0.12	-0.19
p-value	0.583	0.7979	0.8983	0.7456	0.7378	0.7648	0.6897	0.5017	0.9045	0.8465

Note: Author's construction. Parentheses show standard error values. * means <10%, ** means <5% *** means <1%. The findings show that government stability, military involvement in politics, and bureaucratic accountability have a positive impact on carbon emissions. On the other hand, corruption and law and order have a negative impact on carbon emissions in the BRICS.

To check the robustness of these results, the study uses Driscoll-Kraay standard error method. The results in table 7.4 indicate that the findings are consistent with the estimates of the DCCE method. It emphasises that as economic growth increases, so does the consumption of non-renewable resources, which aggravates the emissions of carbon gases and thus harms environmental quality. On the other hand, an efficient and stable political system contributes to lower carbon emissions and a cleaner environment y promoting renewable energy consumption instead of non-renewable energy consumption.

Table 7.6: Dumitrescu-Hurlin causality test results

Dependent Variables	Dumitrescu-Hurlin Causality Test							
	CO_2	TO	GDPC	REN	NON	IQI	PSI	PEI
CO_2	-	2.7579 (0.6080)	5.1457 (0.0068)	1.7053 (0.6493)	5.9027 (0.0007)	2.6015 (0.7120)	2.0365 (0.8805)	4.1583 (0.0718)
TO	1.5768 (0.5667)	-	7.9784 (1.E-07)	4.4166 (0.0416)	10.6684 (7.E-15)	3.3991 (0.2703)	3.7964 (0.1422)	3.7506 (0.1540)
GDPC	7.3885 (2.E-06)	4.8835 (0.0136)	-	1.0982 (0.3111)	8.5224 (6.E-09)	4.4749 (0.0365)	1.1282 (0.3245)	5.9549 (0.0006)
REN	3.5476 (0.2154)	2.5962 (0.7157)	5.1309 (0.0070)	-	3.3672 (0.2832)	3.3769 (0.2792)	2.3618 (0.8817)	2.2210 (0.9846)
NON	4.6601 (0.0237)	3.4280 (0.2589)	6.5094 (8.E-05)	4.1812 (0.0685)	-	3.2965 (0.3134)	4.2697 (0.0571)	4.4591 (0.0378)
IQI	4.0456 (0.0897)	2.8669 (0.5398)	2.4061 (0.8497)	1.7076 (0.6508)	2.2284 (0.9818)	-	3.6486 (0.1829)	3.3782 (0.2805)
PSI	5.0830 (0.0080)	0.8751 (0.2232)	5.8005 (0.0009)	6.4232 (0.0001)	4.669 (0.0232)	2.4071 (0.8490)	-	1.3148 (0.4158)
PEI	5.0188 (0.0096)	1.4638 (0.4986)	5.6579 (0.0015)	5.4742 (0.0026)	5.9486 (0.0006)	2.8041 (0.5787)	3.8658 (0.1256)	-

Note: Author's construction. Parentheses show w-stat with probability values. The results show uni-directional causality from CO_2 to the institutional quality and political stability indexes. Moreover, the feedback relationship between CO_2 and economic growth, non-renewable resources, and political efficiency index can also be observed

After confirming the long-run relationship between the variables, the study proceeds to the results for D-H causality. The results in table 7.6 confirm the bidirectional relationship between CO_2 and economic growth, non-renewable resources, and political efficiency index.

This indicates that the economic activities in these countries are highly inclined towards using non-renewable manufacturing resources, which is continuously increasing pollution. As a result, carbon emissions have reached unprecedented levels, causing severe environmental damage. The results also reveal uni-directional causality from CO_2 to institutional quality index and political stability index. This highlights that environmental issues affect institutional policies and are a significant part of any regulations in maintaining political stability. Similarly, a uni-directional causal relationship can be evidenced from economic growth to renewable resources, trade openness, institutional quality index, and political stability index. With the increasing economic growth, people have become more aware of the environment and seek a cleaner environment. This leads to additional investments in capital to promote the adoption of green and environment-friendly technologies. In addition, the results present a uni-directional relationship from economic growth to the political efficiency index and non-renewable resources. This demonstrates that higher income disturbs the efficiency of environmental regulations and leads to greater use of non-renewable resources, trapping developing countries on the environmentally damaging side of the Kuznets curve (EKC). In addition, the results show a feedback effect between the political stability index and non-renewable resources, and the political efficiency index and non-renewable resources. This signifies non-renewable resources as a harmful factor in maintaining political stability and efficiency, which results in loose environmental regulations. Moreover, one-way causation can be observed from renewable and non-renewable energy sources to trade openness inTtable 7.6. This shows that the consumption of renewable and non-renewable resources significantly affects trade. The higher consumption of fossil fuels will increase the share of imported non-renewable resources in the trading basket, whereas adapting to renewable sources will encourage the import of new innovative modern technologies that are conducive to the environment. Therefore, the

government should focus on improving the institutional environment and limiting non-renewable energy consumption to reduce CO_2 emissions. The graphical representation of these causality results can be observed in Figure 7.3.

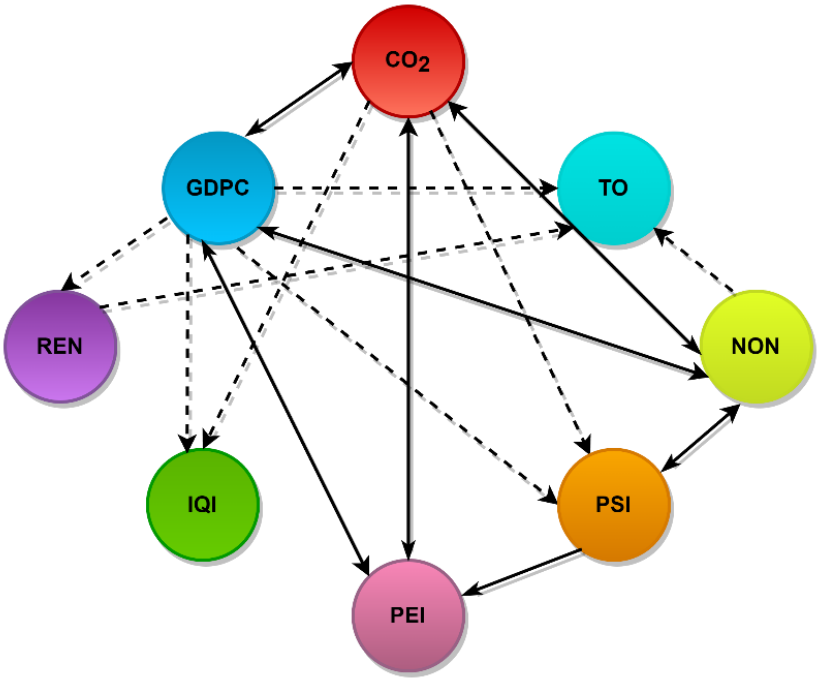

Figure 7.3. Dumitrescu-Hurlin causality test results. Source: Author's construction.

Note: The bold line shows the bi-directional relationship, whereas dotted lines show the uni-directional relationship between the variables.

7.6 Summary

Over the last few decades, the voracious burning of fossil fuels has resulted in high carbon emissions, intensifying the concentration of greenhouse gases in the atmosphere. To achieve environmental balance and long-term economic growth, trade openness, stable institutions, and innovative regulatory paradigms are required. This study looked into whether and how trade openness and institutional quality impacted carbon emissions in BRICS countries from 1991 to 2019. First, the study constructed three indices, using PCA, to measure the institutional impact on CO_2 emissions: institutional quality index, political stability index, and political efficiency index, respectively. For deeper investigation, the study conducted a single indicator analysis for each component representing the quality of institutions. Owing to the existence of

CSD, the study used CADF and CIPS second-generation unit root tests and the Westerlund cointegration test revealing stationarity and long-run cointegration among the selected variables. Further, imperative to the existence of CSD, the modern econometric approach of DCCE was employed to estimate the long-run linkages between the variables. Confirming the pollution haven hypothesis, the findings reveal that 'trade openness' indeed is a cause of environmental degradation in the BRICS nations. Through reduced corruption, improved political stability, bureaucratic accountability, and better law and order, 'institutional quality' is found to be contributing positively to environmental sustainability. It is also confirmed that renewable energy sources have a positive environmental impact; however, they are insufficient to offset the adverse effects of non-renewable energy sources.

Chapter-8

Summary, Conclusion and Policy Implications of the Study

8.1 Summary

In recent years, there has been a notable concentration on trade openness across the globe, as economies endeavor to establish deeper integration within the global economic landscape. Trade Openness refers to the degree to which countries engage in international trade, encompassing the exchange of goods, services, and capital beyond their borders. Since the 1990s, many countries have actively pursued trade openness as a means to boost economic growth and development, reduce poverty, and foster international cooperation. This has led to the proliferation of international trade agreements exemplified by the establishment of World Trade Organization (WTO) alongside a multitude of economic blocs and regional trade agreements.

Among such economic blocs, BRICS emerge as a significant global growth contributor and represent a significant share of the world's population and landmass. BRICS comprises five major emerging economies: Brazil, Russia, India, China, and South Africa. Among these, China is the largest trading partner among the BRICS countries, accounting for a significant portion of the group's total trade. Brazil, Russia, and South Africa likewise hold key positions as trading partners, while India plays a smaller but significant role. However, each BRICS country approaches trade openness in a distinct manner. For example, China has experienced a substantial increase in trade openness since it accessions to the World Trade Organization (WTO) in 2001. India pursued trade liberalization measures, including lowering tariffs and

non-tariff barriers. Brazil and South Africa have been improving their competitiveness in global markets, while Russia has been focusing on improving its infrastructure to facilitate trade. Openness to trade has enabled businesses and consumers to access a wider range of goods and services, facilitated the transfer of technology and knowledge, and helped to promote economic development and prosperity. However, where many perceived trade as a catalyst for economic growth, it has also encountered criticisms. Critics argue that it can lead to job losses in certain sectors and countries, exacerbate income inequality, and create environmental and social challenges.

The opening up of a nation to international trade introduces the import of goods and services from foreign countries, which can affect the domestic price levels in several ways. The relationship between trade openness and inflation is intricate and multifaceted, contingent upon numerous factors and contextual considerations. While some economists argue that increased competition and currency appreciation may lead to lower inflation (Rogoff, 1985; Romer, 1993), others point out that increased global trade interactions bring high economic sensitivity towards imported inflation leading to higher inflation (Aron & Muellbauer, 2007). The empirical literature on these theoretical interests also appears to be complex and context-dependent, with the direction and magnitude of the relationship depending on a range of factors, such as the level of competition in the economy, the degree of exchange rate flexibility, and the degree of economic integration with other countries. Nevertheless, amidst this intricate process, the foreign output gap emerges as a pivotal element influencing inflation dynamics, giving rise to the synchronization of global economic disruptions (Okun, 1981), such as the global recession of 2008, thereby serving as a significant driving force behind price movements.

In addition to its economic implications, trade openness possesses the potential to serve as a potential instrument for eradicating poverty, ensuring that the advantages of trade are equitably distributed among marginalized populations. The proponents of trade openness argue that increased international trade creates new markets for goods and services, promoting economic growth and rising employment opportunities that help reduce poverty. But some argue that trade agreements may favor affluent countries and corporations, exacerbating existing inequalities and hindering poverty eradication efforts (Sen, 1983, 1999). Poverty and inequality are intricately intertwined phenomena, as mounting inequality drives the incidence and severity of poverty, thereby introducing economic instability. Thus, it becomes imperative to address these two interrelated dimensions as essential components within the study. On the other hand, empirical literature suggests that trade alone is insufficient and should be accompanied by other economic factors, such as the economy's institutional quality, to reduce poverty effectively. Studies argue that well-functioning institutions act as safeguards against resource misallocation and market inefficiencies by formulating pro-poor growth policies and curbing rent-seeking behaviors (Acemoglu et al., 2001; Carothers, 2003). Nonetheless, this phenomenon encounters challenges, particularly within developing economies. Despite effective poverty eradication strategies, these nations exhibit slower rates of poverty reduction due to governance issues. This unequivocally highlights that the effect of trade openness on poverty is not automatic and depends on the nuanced interplay of institutional factors that necessitate careful attention and examination.

Besides, trade integration expands the accessibility to a diverse array of goods and services that help to increase productivity, competitiveness, and innovation. It leads to economies of scale, which can help reduce production costs, increase output, and contribute to higher economic growth rates. However, it is worth noting that as countries become richer, they consume more energy and emit more greenhouse gases. This is often referred to as the

"Environmental Kuznets Curve", which posits that environmental degradation initially escalates alongside economic growth but eventually subsides as societies become wealthier and prioritize environmental preservation. On the one hand, increased trade facilitates the transfer of clean technologies, enabling more efficient production processes and specialization, which can reduce carbon emissions (Fakher, 2019). On the other hand, trade results in the relocation of dirty industries, especially to developing countries with lax environmental regulations, which can increase carbon emissions (Dogan & Seker, 2016; Ertugrul et al., 2016; Kuik & Gerlagh, 2003; Le et al., 2016). As a result, it is reasonable to assert that trade can affect economic growth, which can, in turn, effect carbon emissions. However, it is essential to emphasize that institutional policies and structures wield substantial influence over these interconnected activities. Theories corroborate that the countries with better institutional quality foster foreign investments, resulting in higher economic growth rates that incentivise investment in clean technologies (Ajide, 2017). While countries with weaker institutional quality tend to experience slower growth. The empirical literature highlights that the relationship may not be straightforward, as the positive effects of institutional quality may be constrained in contexts where economic activity is dominated by rent-seeking and corruption (Welsch, 2004). Despite its significant role in mechanism, its implications have been largely ignored in realising trade benefits for economic growth and limiting carbon emissions, thus, requires further investigation.

Apart from that, mostly empirical studies conducted in this context have overlooked the phenomena of CSD, potentially leading to skewed outcomes. This highlights the imperative to implement state-of-the-art econometric techniques to ensure robust and reliable findings.

Based on the preceding information, it is evident that several significant gaps exist and need to be addressed to gain a better and more in-depth understanding of the effects of trade

openness in BRICS. To address these gaps, the study established a set of objectives through which it aims to improve understanding of the complex dynamics and provide valuable insights into the effects of trade openness on key economic and environmental factors.

8.2 Conclusions

For the first objective, the study aims to investigate the impact of trade openness and output gap on inflation. Given the expanding economic integration and the consequential CSD, the study utilizes the DCCE model to explore the enduring relationship between these variables. Furthermore, the study employs the Dumitrescu & Hurlin (2012) approach to discern the causal relationship between the variables.

The results show that higher trade openness is a panacea for the rising domestic inflation in the BRICS countries. The results are consistent with the 'new growth' theory suggesting higher economic integration as a tool to combat inflation. Analysing the openness measures separately reveals that import and export openness have an insignificant effect on prices. The results reflect that higher import openness creates an unfavorable impact on inflation, whereas a higher inclination towards exports creates a favorable impact on inflation. In BRICS nations, the price-reducing impact of export openness outperforms the unfavorable effect of imports resulting in a flattened Phillips curve. Notably, the results contradict the conventional wisdom that only domestic measures determine domestic inflation in the economy. The findings show that the prices in these countries are relatively more responsive to global factors than domestic factors. This indicates that contrary to the previous belief, the under-powering effect of the domestic output gap is insufficient to reduce inflation. The impact of global factors on domestic prices expands more with the increasing export activities. This makes export-inclined countries like Brazil, China, and India more vulnerable to foreign demand shocks. Furthermore, the findings support the monetarist's arguments that expansionary monetary policy contributes to rising

inflationary pressures. In contrast, an expansionary fiscal policy promotes price reduction. Since the prices are more responsive to the monetary policy tools than fiscal policy, the results demonstrate monetary policy is more effective when implemented cautiously.

For the second objective, this study endeavors to examine the effects of governance and trade openness on poverty reduction. To achieve this aim, the study employs the DCCE methodology, employing a recursive mean adjustment approach to analyze the intricate relationship among the heterogeneous panel variables accounting for CSD. In addition, the study uses the Dumitrescu-Hurlin causality test to determine the direction of causation between the variables.

According to the results, trade openness and economic growth benefit the poor by increasing income, which increases consumption expenditure. However, estimates show that benefits to the poor contract as a result of the negative impact of governance indicators on poverty reduction. This demonstrates that a poor institution environment is restricting the trade and economic growth benefits to the poor living in these countries. This weakens the trickle-down effect on the economy. The condition worsens with the negative impact of income inequality on poverty and highlights the disruptive distribution channels. The reason behind this can be the higher depth of poverty that restricts the ability to realise the government-provided benefits to accentuate economic growth in favor of the poor. The results are in line with Fambeu (2021), Goff & Singh (2014), Pradhan & Mahesh (2014), Sehrawat & Giri (2016), Tebaldi & Mohan (2010), and Wang et al. (2022).

Further, in the contemporary era characterized by the rapid integration of economies, the factors influencing economic growth continue to evolve. Notably, trade openness and institutional quality have emerged as significant determinants of achieving accelerated economic growth in recent times. Hence, with a specific focus on the third objective, this study

seeks to delve into the impact of institutional quality and trade openness on the economic growth of BRICS countries. To accomplish this objective, the study employs advanced econometric techniques, namely the System GMM and Pooled Mean Group (PMG) models, to estimate both long-run and short-run elasticities. Additionally, a Fully-Modified Ordinary Least Squares (FMOLS) model is employed to uncover country-specific results.

The results show that, in the dynamic setting, trade openness boosts economic growth in the long-run but impedes economic growth in the short run across the whole panel. Similarly, export and import openness directly promote economic growth in all countries. In addition, the direct effect of institutions on economic growth is found to be harmful as they seem to stifle economic growth. However, the inclusion of trade openness and institutions interaction term reverses the positive impact of overall trade openness on economic growth. The inclusion of interaction terms also reduces the effect of export openness in the short run. Therefore, the findings suggest that institutions create an indirect positive impact when interacting with trade openness, but only in the short-run. This implies that increased trade may improve the quality of institutions in the long-run, eventually resulting in better economic growth. In addition, the findings show that the exchange rate and capital stock have a positive impact, whereas financial development and inflation impact have a negative impact on economic growth. However, the individual country results achieved using FMOLS show that trade openness promotes economic growth only in Russia and South Africa while adversely affecting Brazil and India. This reveals that, despite a weak institutional structure, Russia and South Africa are able to boost their economic growth due to their relatively high export dominance.

However, the influence of trade and institutions extends beyond economics and raises environmental concerns. The pursuit of rapid economic development by modern nations has resulted in an unprecedented surge in carbon emissions. The dissemination of knowledge

through increased trade activities and the implementation of effective environmental regulations have been proposed as potential means of curbing these escalating emissions. Hence, in its fourth objective, this study examines the impact of trade openness and institutional quality on CO_2 emissions in BRICS countries from 1991 to 2019. Three indices, namely, institutional quality, political stability, and political efficiency are constructed to measure the overall institutional impact on emissions. A single indicator analysis is conducted for a deeper investigation of each index component. Given the CSD among variables, the study uses the modern dynamic common correlated effects (DCCE) method to estimate their long-run relationships.

The findings indicate that trade openness induces an environment-degrading effect that exacerbates carbon emissions in BRICS. The dominance of the scale effect over the technological and composition effect reduces the overall environmental quality. Similarly, the results show that economic growth is associated with increased carbon emissions, confirming these countries' role as pollution havens. In accordance with the theoretical evidence, the results indicate that consumption of non-renewable energy sources like fossil fuels and crude oils upsurges the release of carbon dioxide. While renewable energy helps to reduce CO_2 emissions to some extent, the harm caused by conventional sources still outweighs them. In addition, political stability and efficiency improve bureaucratic control that encourages the use of green technologies and innovations. In addition, the findings show that with stringent environmental regulations, good institutional quality promotes a cleaner environment. Although institutions and carbon emissions constitute a negative relationship, the impact of institutions on combating deteriorated environmental quality is very low. Out of all the indicators of institutional quality, control of corruption, better law and order, and government stability promote sustainable growth and reduced CO_2 emissions. Any internal and external conflicts or tensions are harmful to the environment.

8.3 Policy Implications of the Study

This sub-section of the study provides policy implications for BRICS based on the empirical results from four aspects.

First, the results of trade openness analysis on inflation highlight trade openness as a tool to combat the rising prices in BRICS. In addition, the study highlights that both domestic and foreign output gaps are crucial to domestic prices. Therefore, policymakers should pay close attention to the fluctuating price levels of foreign commodities in the global market. By anticipating higher import prices, the central banks and authorities should cushion the price levels in the domestic market with the help of effective monetary and fiscal policy. This will help to reduce the susceptibility of domestic prices to international markets. It is also suggested to emphasize offsetting other economic factors such as oil and petroleum products, which weigh heavily in import goods baskets of these developing countries. Since export openness comes out as an effective tool for price reductions, policymakers should encourage export-based firms by providing subsidies and tax concessions while keeping the monetary policy in check. Also, in recent years, the rapidly rising geopolitical and geoeconomic tensions around the globe have resulted in the gradual erosion of bilateral and multilateral trade agreements causing disturbances in trading circles. This endangers global economic cooperation among major economic powers like BRICS. To counter this, it is suggested that policy structures are framed to promote coordinated actions with trading and neighboring countries. This will help sustain economic growth in the long run and help nations realise maximum trade benefits through lower prices.

Second, regarding the impact of trade openness and institutions on poverty, the study reveals that institutional structures and economic development have witnessed multiple shifts, but they can all be attributed to persistently high levels of income inequality, which excludes and stifles inclusive growth that benefits everyone. As a result, it is recommended to strengthen the

institutions and governance to ensure better regulatory practices that improve the quality of governance and address poverty and any structural inequality directly. Furthermore, it should prioritise trade expansion policies that directly increase income for the poor to mitigate the impact of disruptive distribution channels. As a result, it is advised to increase the labor-force participation of economically disadvantaged households and the poor by investing in labor-intensive industries like crafts and small, medium, and micro businesses in labor-abundant countries such as India and China. The successful implementation of the policy will create more jobs and income that will help alleviate poverty in the long run. However, for the poor to reap the benefits of trade and economic growth, political structures and institutions must be improved as part of this process.

Third, in the context of trade openness, institutions, and economic growth, the results highlight that good quality institutional structures are critical for laying out policies that facilitate trade and export openness potentials, resulting in faster economic growth. Therefore, it is suggested that trade policies emphasise export-led growth to be revamped as a pivot to the long-term development strategy. In this vein, reorienting resources, particularly financial resources, toward industries producing comparative advantage goods must be encouraged. This will increase the productivity of the exporting sector, implying faster economic growth. Above all, the study suggests that policies be made more effective by implementing measures that promote better regulatory practices and lower corruption. This will aid in securing the greatest possible economic trade benefits and promote economic growth.

Last, for the impact of trade openness and institutional quality on environmental degradation, the results show that trade adversely impacts the environment, and good institutions are vital to the sustainability of the environment. Moreover, the negative impact of non-renewable

resources suppresses the positive effect of renewables on carbon emission reduction. The study concludes that policy actions are required to lower carbon emissions via post-combustion control technologies. To procure that, BRICS should strengthen their cooperation with the developed countries recognised for leading modern clean technologies. Secondly, policymakers should incentivise the use of cleaner and renewable energy sources to cut the emissions of GHGs. The use of renewable resources should be aligned with industrial policies so that firms' adoption of green technologies does not lead to extra costs but tangible profits. Since several indicators of governance in the study show a negative impact on carbon emissions, this indicates the existence of a wide gap between policy formulation and implementation. As a result, policymakers should concentrate on enhancing the institutional structure to control corruption by conducting periodic reviews of environmental regulations and assessing their effectiveness in all economic sectors, especially the industrial sector, which is a significant source of surging CO_2 emissions in these countries. Further, it is proposed that the BRICS economies pursue and encourage more environmentally friendly industrial technologies that drive knowledge spillovers to mitigate the adverse effects of trade openness. To realise these ends, with advanced, cleaner, and more sustainable development, it is recommended that policies stimulating the adaption of new technologies should be promoted. Regarding the institutional impact in BRICS, the study suggests that a tighter grip on corruption and more implementation of environmental laws will positively influence institutions in the BRICS countries. Since enhancing environmental quality is always a democratic choice, the bureaucratic control must prioritise educating the public and its employees on the importance of protecting the planet's natural resources to spur greener economic expansion via green policy formulation. Thus, it is vital to fortify both institutions and a democratic framework to foster long-term viability.

8.4 Contribution of the Study

The study contributes to the literature in six distinct ways.

1. Most of the existing studies have exclusively focused on analyzing the impact of trade openness on inflation, ignoring the impact of the output gap on trade openness and inflation nexus. Even more so for the BRICS, there is a paucity of research that specifically focuses on how the output gap affects the connection between trade openness and the output gap. This study helps close this knowledge gap by examining how the output gap affects the link between trade openness and inflation for BRICS.

2. While previous research has focused on the effects of either exports or imports or the combined effect via trade-to-GDP, this is the first to consider both for its impact on inflation in BRICS. Due to the unequal distribution of exports and imports in the BRICS trading basket, it is crucial to analyse the effects of each component individually and as a whole. To the author's knowledge, there is a dearth of literature on the subject regarding the BRICS countries. As a result, the research tries to utilise all three criteria to examine the issue.

3. The study extends the analysis to examine the impact of export and import openness and their interaction effect with institutional quality on economic growth, as this assertion lacks empirical evidence in BRICS. Compared to previous studies, which only examined the direct impact of institutional quality on GDP growth, this one makes a unique contribution by examining the indirect effects of institutions on trade openness.

4. Since the dominance of exports and imports appears to vary with individual countries, policy-making only from an overall trade perspective is not a viable option

to boost economic growth. To that end, the study is first to examine the impact of institutions ad trade openness on economic development on an individual-country basis for BRICS. This would aid policymakers in reaching diverse policy conclusions.

5. To the best of the authors' knowledge, very few studies have examined the influence of institutions on environmental degradation in BRICS. However, these studies either evaluated the impact of institutions using the governance index as a whole or focused on only one element, such as corruption or the legal and regulatory framework. None of the studies investigated the segregated impact of governance indicators, especially for BRICS. Therefore, rather than focusing on just one facet of an institution's quality, it's vital to dissect the effect of all the variables separately for a more complete view (Chaudhry et al., 2022; Egbetokun et al., 2020; Haldar & Sethi, 2021). Hence, this study contributes by conducting a single indicator analysis to examine the impact of each indicator of institutional quality separately on carbon emissions in BRICS countries. It will show if openness and democracy electorate pressure the government.

6. Most of the established results by the previous studies for every issue assume unrelated error terms, and thereby, no CSD is considered (Egbetokun et al., 2020; Hassan et al., 2020; Khan et al., 2022). Due to rising mutual dependence among the countries, it is impractical in today's real world to ignore the issues of CSD, heterogeneity, and endogeneity. This makes it essential to consider these issues, as ignoring them may lead to inaccurate and biased results. Therefore, the results from this study will point toward more bias-free attributes of the variables in different aspects, which would be attributed to the novel techniques of DCCE, system GMM, Driscoll-Kraay standard errors, etc., that addresses CSD, endogeneity, and heterogeneity among countries.

8.5 Limitations of the Study

1. The major limitation of the study is that it only covers the BRICS for the investigation of the respective issues, which limits the policy implications to the respective country group only.

2. However, the study analyses the impact of trade openness for its overall effect or export and import openness, but it lacks to differentiate its scale, composition, and technological effect on the environment, which limits our ability to analyse its environmental impacts.

3. Even though the study examines the influence of institutional quality on economic growth and poverty reduction, it does not provide a detailed analysis of how the specific indicator of institutional quality works in the process.

4. Since the study undertakes panel data for the analysis of the relationship between trade openness and inflation, poverty, institutional quality, economic growth, and carbon emissions, it only provides the policy implications applicable to BRICS as a group and lacks to provide any country-specific policy implications.

8.6 Future Scope of the Study

First, based on the findings for BRICS countries, the quality of institutions is the most prominent for poverty reduction and economic growth. For a clear vision about which aspects of the institutions need more attention, it is recommended to address the impact of different governance indicators separately in future research for a more targeted policy framework to reduce poverty. This will further aid policymakers in designing more specific policies for addressing particular governance indicators at both regional and global levels.

Second, though the study covers most of the recent literature related to the estimation of effect of trade openness on carbon emissions, it lacks to incorporate the impact of technological, scale, and composition effects separately for BRICS. Therefore, it is recommended to analyse these effects to get a more comprehensive picture of the trade outlook. It will help to achieve the balance among the three that may promote environment sustainability.

Third, the critical turning point in the process is assessing economic analysis in the individual countries, which will help suggest country-specific policy paths. As a result, this study suggests conducting a time series analysis, which will cater to each country.

Fourth, the study recommends looking at more country groups than just the BRICS, such as the G20, because many players in the global trade basket affect other countries' macroeconomic indicators. Thus, in order to get a better understanding and make trade more beneficial for all parties involved, it is important to gain an appreciation for the policy perspective of other related countries as well.

Fifth, future studies can explore the linkage between trade, environment, and investment. Environment provides many basic inputs of economic activity – water, forests, fisheries, minerals, and energy used to process these resources. Trade and environment, in turn, are affected by environmental concerns and regulations. Producers and market must respond to the growing demand for greener goods and services. Hence, research may be extended linking environmental regulations, trade, and investment for a group of countries or a specific country.

Sixth, studies may link technology with trade. In this context, assessing the impact of artificial intelligence on trade, digital infrastructure, human capital, and trade linkages, and ICT impacts on trade and development can be a few areas of future research scope.

Seventh, on the methodological aspect, the study may be extended to include structural break methodologies and appropriately model the possibilities of economic fluctuations on the trade and development relationships for BRICS and other groups of countries. This is necessary due to the COVID-19 pandemic and the Ukraine-Russia war had a huge impact on the macroeconomic variables in the recent past.

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Publications

Thesis Publications

- Chhabra, M., Giri, A.K. and Kumar, A. (2023). "Do trade openness and institutional quality contribute to carbon emission reduction? Evidence from BRICS countries". Environmental Science and Pollution Research. [Indexed in Scopus, Science Citation Index Expanded (SCIE), Quartile - Q1]. http://dx.doi.org/10.1007/s11356-023-25789-w
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Other Publications

- Chhabra, M., Giri, A. K., & Kumar, A. (2022). "Do technological innovations and trade openness reduce CO2 emissions? Evidence from selected middle-income countries." Environmental Science and Pollution Research, 1-16. [Indexed in Scopus, Science Citation Index Expanded (SCIE), Quartile - Q1]. http://dx.doi.org/10.1007/s11356-022-20434-4
- Chhabra, M., Giri, A. K., & Kumar, A. (2021). "The impact of trade openness on urbanization: Empirical evidence from BRICS economies." Journal of Public Affairs, e2637. [Indexed in Scopus (Elsevier), Clarivate Analytics' Web of Science - Emerging Sources Citation Index (ESCI), ABDC - B]. http://dx.doi.org/10.1002/pa.2637
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Under Review

- Chhabra, M., Giri, A.K. and Kumar, A. “Does Good Governance and Trade Openness contribute to Poverty Reduction in BRICS? An Empirical Analysis”. (Under Review)
- Verma, A., Chhabra, M., and Giri, A. K. “Impact of ICT diffusion, energy consumption, and institutional quality on CO2 emissions in major emerging market economies”. (Under Review)
- Chhabra, M., Agarwal, M., and Giri, A. K. “Renewable Energy for Green Economic Growth: Evidence from Selected Emerging Countries”. (Under Review)

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- Attended Online GIS Training Program conducted by the Central University of Karnataka, India, jointly with the State Institute of Urban Development, Karnataka, India (September 07-27, 2020).

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