Trade and Sustainable Development Goals: Issues and Evidences from Emerging Economies

THESIS

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CERTIFICATE

This is to certify that the thesis entitled, "**Trade and Sustainable Development Goals: Issues and Evidences from Emerging Economies**" submitted by **Ms. NEHA JAIN** ID No. **2020PHXF0024P** for award of Ph.D. degree of the Institute, embodies original work done by her under my supervision.

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To my grandparents

खुदा की बरकत, परिवार का आशीर्वाद,
हर कदम पर सहारा, दोस्तों का साथ।
प्यार से उनके, हर अश्रु को आस,
आभार में उनको, हर दिन हर शाम।।

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"Acknowledge people, not their jobs."

"Life without thankfulness is devoid of love and passion. Hope without thankfulness lacks fine perception. Faith without thankfulness lacks strength and fortitude. Every virtue divorced from thankfulness is maimed and limps along the spiritual road…". All the thanks are due to the ***Almighty***, whose protective hand over my bowed head proved sustaining and enlivening at every critical juncture during this project and enabled me to conclude and present this work.

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Abstract

The economic growth and development of an economy has always been a prime concern for nations. International trade is one of the ways to develop an economy and serves as an engine of economic growth. Trade is a vital instrument that promotes growth through the reallocation of resources, increased competition, foreign direct investment (FDI), and its spillover effects.

As nations become more interconnected in the global market, the factors affecting international trade have become an area of research. International trade is a complex phenomenon shaped by various motivating and discouraging factors that collectively mold a nation's stance on international trade. Furthermore, to encourage economic growth and development through trade, it is crucial to comprehend the factors that drive international trade in emerging economies.

However, trade not only promotes growth but stimulates the various aspects of development. To eradicate socio-economic problems like poverty and inequality, foreign trade is the best choice to be opted. By increasing growth through trade, more necessary resources will be available that can be utilized in achieving development goals other than economic growth, such as environmental and social targets. Furthermore, with the transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs), the concept of development has shifted from development to sustainable development.

Presently, the most important question that revolves around the minds of policymakers all over the world is how to achieve the seventeen SDGs in countries. To address this question, international organizations such as the World Trade Organization

(WTO), the Asian Development Bank (ADB), and the United Nations Conference on Trade and Development (UNCTAD) emphasize trade as a factor leading to sustainable development for countries. Opening up the economy with the world makes new markets, technology, and investment accessible for countries, particularly for developing countries, making their development sustainable. Hence, international trade plays a vital role in achieving the SDGs illustrated in the 2030 Agenda.

Although studies address sustainable development through trade, relatively sparse literature is found on emerging economies (EEs). Furthermore, it is recommended that sustainability has been grabbing attention in recent years, mainly in EEs. It is projected that the role of EEs will grow in importance in the future. As communication around the world becomes cheaper and transportation faster due to international trade, lower-income countries could utilize the resulting chance to close the gap with developed ones. Trade is seen to foster economic growth and the social well-being of emerging economies.

The first major issue of the study is to re-examine the elements that impact international trade, recognizing the drivers that encourage countries to become more integrated into the world economy and the inhibitors that erect obstacles and reservations. The main findings from the first issue are that economic growth, financial development, institutional quality, and foreign direct investment (FDI) positively impact trade. However, exchange rate, world uncertainty index, and geo-political risks significantly and adversely impact trade. The study suggests that policymakers in emerging economies need to take the necessary steps to manage the macroeconomic environment efficiently to increase globalization. Hence, growth and development in the near future.

The second major issue of the study is to examine the link between trade and overall sustainable development, including economic, social, and environmental aspects in emerging economies. The study found the favorable impact of trade on sustainable development through sustainable development index (SDI). Trade affects SDI in many ways. It is a critical component that should not be ignored in sustainable development policies. Moreover, FDI, economic growth, and renewable energy consumption (REC) positively impact the sustainable development index (SDI). The study also highlights the need to invest in education and skill development to ensure equitable growth, social protection to reduce inequality, and environmental restrictions and incentives to promote sustainable practices.

Further, in the subsequent chapters, the thesis tries to address the three pillars of sustainability: economic, social, and environmental, separately. Since SDI may not be a sufficient index to represent the each and every phenomenon of sustainable development comprehensively. Firstly, the impact of trade on the Growth-Inequality-Poverty (GIP) triangle is analysed. It addresses the three goals of sustainable development, namely SDG:1 (no poverty), SDG:8 (decent work and economic growth), and SDG:10 (reduced inequalities) simultaneously. The study emphasizes direct and indirect linkages between trade and the GIP triangle. The study finds that trade promotes growth. Trade also helps in deteriorating income inequality, while it is not a factor in poverty eradication in emerging economies. The study recommends that to maximize the effectiveness of trade policies, they must be complementary and implemented in tandem with trade reforms.

Secondly, the analysis focuses on the relationship between trade and income inequality under the Kuznets curve hypothesis. The empirical results of the study confirm the existence of an inverted ‘U-shaped’ relationship between trade and income inequality and thus provide evidence for the trade-led Kuznets curve in the panel of emerging countries. This implies that trade initially increases income inequality, while a higher level of trade significantly reduces income inequality. In addition to the nonlinear model, the value of the threshold is estimated for the trade-led Kuznets curve that ranges between 3.5 to 4 percent of the gross domestic product (GDP). The findings support that trade contributes significantly towards reducing income inequality, thus addressing goal 10 of SDGs. Hence, trade policies appear to have been more egalitarian.

Thirdly, the study emphasizes the role of trade in reducing unemployment addressing SDG:8. As emerging economies strive to establish themselves internationally, they must navigate the intricate relationship between trade, economic growth, and job creation. The analysis shows a reduction in unemployment due to increased trade and natural resources rent (NRR) in the long run.

Fourthly, the study further deals with the environmental dimension of sustainable development. The study investigates the impact of trade on environmental sustainability using a single indicator approach, i.e., CO_2 emissions. Thus, the study deals with environment-related SDGs, such as SDG:13 (climate action) and SDG:7 (affordable and clean energy). The study also examines the validity of the Environmental Philips Curve (EPC) for emerging economies by looking at the impact of unemployment on CO_2 emissions. The results show that the EPC is validated in emerging economies, indicating the trade-off between unemployment and CO_2 emissions. Moreover, a rise in international trade and NRR decreases CO_2 emissions in the long run. The improvement in the quality of the environment is also reported due to an increase in REC.

However, using a single indicator to measure environmental sustainability does not provide a comprehensive picture of environmental sustainability. Thus, the composite index approach is utilized. To this end, the study constructs the Composite Environmental Sustainability Index (CESI) using the Principal Component Analysis (PCA). The study finds that the overall CESI values lie between 2 and 4.8 for the 20 emerging countries considered in the study. It depicts a diverse picture of environmental sustainability among emerging countries. The study also shows the trend of CESI values from 1991 to 2020. The bottom three countries whose CESI is very low compared to others are Iran, South Africa, and Saudi Arabia. However, Brazil, Columbia, and Chile are the top three highest scorers in 2020.

Furthermore, the study investigates the impact of trade components - trade openness, direction, and composition- on the CESI for emerging countries. The research evaluates environmental sustainability via the CESI while addressing particular SDGs such as SDG:6 (clean water and sanitation), SDG:7 (affordable and clean energy), SDG:9 (Industry, innovation, and infrastructure), SDG:11 (sustainable cities and communities), and SDG:12 (responsible consumption and production). The empirical analysis reveals that trade openness (goods and services) has a negative effect on CESI. Moreover, while environmental sustainability is inversely related to trade in goods and exports (goods and services), it is positively affected by trade in services and imports (goods and services). The empirical results support the claim that trade and its components substantially impact a nation's ability to preserve its environment.

Conclusively, the study found that trade is a favorable instrument in promoting sustainable development in all of its dimensions for emerging economies. Policymakers must use trade openness to achieve sustainable development goals while minimizing risks and challenges. Moreover, increased trade contributes to the efficient management of the environment by fostering economic development, social welfare, and growth. More importantly, free markets provide access to new technologies that improve the efficiency of local industrial processes by reducing the need for inputs such as energy, water, and other harmful environmental variables. Similarly, industries should be incentivized to adopt stricter environmental standards by liberalizing trade and investment. A nation's export industry is more subject to environmental regulations imposed by its leading importers as it gets more integrated into the global economy. The thesis also provides directions for future research.

Keywords: *Trade, Trade openness, Sustainable development, Economic sustainability, Social sustainability, Environmental sustainability, Emerging economies,* CO_2 *emissions, Cross- section Dependence (CSD), Second-generation tests, Panel data, Autoregressive distributed lag models (ARDL), Driscoll-Kraay standard error approach, Panel regression.*

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List of Abbreviations

ADB	*Asian Development Bank*
ADF	*Augmented Dickey-Fuller*
ARDL	*Auto Regressive Distributed Lag*
BRICS	*Brazil, Russia, India, China, South Africa*
CADF	*Cross-sectional Augmented Dickey-Fuller*
CCE	*Common Correlated Effect*
CESI	*Composite Environmental Sustainability Index*
CIESIN	*Centre for International Earth Science Information Network*
CIPS	*Cross-sectional Augmented Im-Pesaran-Shin*
CIS	*Commonwealth of Independent States*
CO_2	*Carbon Dioxide*
CSD	*Cross-sectional Dependence Test*
DCCE	*Dynamic Common Correlated Effect*
ECT	*Error Correction Term*
EEs	*Emerging Economies*
EKC	*Environment Kuznets Curve*
ELG	*Export-led Growth*
EP	*Ecological Footprints*
EPI	*Environment Performance Index*
ESI	*Environmental Sustainability Index*
FD	*Financial Development*
FDI	*Foreign Direct Investment*
FTA	*Free Trade Agreement*
GDP	*Gross Domestic Product*
GFCF	*Gross Fixed Capital Formation*
GHG	*Green House Gas*
GIP	*Growth-Inequality-Poverty*
GMM	*Generalised Method of Moments*
GPI	*Genuine Progress Indicator*
GPR	*Geo-political Risk*
HCE	*Household Final Consumption Expenditure*
HCI	*Human Capital Index*
HDI	*Human Development Index*
H-O	*Heckscher-Ohlin Theorem*
ICT	*Information and Communication Technology*
IGGI	*Inclusive Green Growth Index*
ILG	*Import-led Growth*

IMF	*International Monetary Fund*
IPS	*Im-Pesaran-Shin*
IQ	*Institutional Quality*
KC	*Kuznets Curve*
LLC	*Levin Lin Chu*
MRs	*Multilateral Resistance Terms*
N_2O	*Nitrous Oxide*
NRR	*Natural Resource Rents*
OAPEC	*Organisation of Arab Petroleum Exporting Countries*
OECD	*Organisation for Economic Co-operation and Development*
OIC	*Organisation of Islamic Cooperation*
OPEC	*Organisation of Petroleum Exporting Countries*
PCA	*Principal Component Analysis*
PP	*Phillips and Perron*
PWT9	*Penn World Table 9*
SDGs	*Sustainable Development Goals*
SO_2	*Sulfur Dioxide*
SSA	*Sub-Saharan African*
SST	*Stolper-Samuelson Theorem*
SWIID	*Standardized World Income Inequality Database*
TO	*Trade Openness*
VECM	*Vector Error Correction Model*
WDI	*World Development Indicator*
WEF	*World Economic Forum*
WTO	*World Trade Organisation*
YCELP	*Yale Centre for Environmental Law and Policy*

Chapter 1. Introduction

1.1 Background of the Study

The economic growth and development of an economy has always been a prime concern for nations. Through the centuries, the objective of economic growth and development has been significant for the countries. There are various ways by which growth in an economy can be achieved, considering economic, social, political, and external factors. International trade is one of the economic ways to develop an economy and serves as an engine of economic growth (World Development Report (WDR), 1987; Maitra, 2020). International trade is a complex phenomenon shaped by a wide range of motivating and discouraging factors that collectively mold a nation's stance on international trade. Keeping in mind the impact of trade on the growth of an economy, as nations become more interconnected in the global market, the factors affecting trade have become an area of research. In addition, to encourage economic growth and development through trade, it is crucial to comprehend the factors that drive international trade in emerging economies (Suleman et al., 2023).

Furthermore, the trade-led growth hypothesis states that trade causes an increase in growth and works as an engine of growth for an economy in the long run. Trade is a vital instrument that promotes growth through the reallocation of resources, increased competition, increased foreign direct investment, and increased spillover effects. The endogenous growth models developed by Romer (1990) and Grossman and Helpman (1990), found that trade leads to growth through total factor productivity (TFP) and the accumulation of knowledge.

The empirical literature on the impact of trade openness on economic growth is vast (Keho, 2017; Tahir et al., 2018). According to Barro and Sala-i-Martin (1997), openness promotes efficient resource allocation, easy access to goods and services, and the achievement of total factor productivity, all of which have a positive effect on economic growth. Similarly, other researchers are of the view that trade openness promotes the diffusion of technology and knowledge, which in turn accelerates economic growth (Musila and Yiheyis, 2015; Ulasan, 2015; Polat et al., 2015; Kouwoaye, 2021; Ali et al., 2022; Jain and Mohapatra, 2023a).

Moreover, the concept of immiserizing growth given by Bhagwati (1958) relating trade and growth mentions that trade through technological progress, leads to terms of trade deterioration and further declining the national welfare. As we can see theoretically and empirically, the association between trade and economic growth has been widely studied and found ambiguous results (Jayme, 2001; Keho, 2017). The advantages of trade liberalization are readily apparent and generally acknowledged by scholars and policymakers (Tahir and Azid, 2015; Tahir et al., 2018).

However, trade not only promotes growth but stimulates the various aspects of development. Seers (1969) emphasized the various aspects of development, such as the decline in poverty, tackling unemployment, and reducing income inequality. This approach is different from the previously used indicator i.e. income per capita, commonly used measure for the economic capacity and improvement in the economy. Additionally, Sen (1999) widens the concept of development by focusing on expanding choices and eliminating deprivations (Redmond and Nasir, 2020).

To eradicate socio-economic problems like poverty and inequality, foreign trade is the best choice to be opted. It is suggested that trade improves the quality of economic growth through innovation and promoting factor productivity by endogenous growth theorists (Belloumi and Alshehry, 2020). Higher growth is linked to a higher quality of life. A higher standard of living is hampered by poverty and unemployment, especially in developing nations.

By increasing growth through trade, more necessary resources will be available that can be utilize in achieving development goals other than economic growth, such as environmental and social targets. Trade also offers new opportunities for employment and reduces the prices of goods and services, which will further help eradicate poverty. Opening up the economy with the world makes new markets, technology, and investment accessible for countries, particularly for developing countries, making their development sustainable. For all these reasons, international trade plays a vital role in achieving the sustainable development and its goals illustrated in the 2030 Agenda (Helble and Shephered, 2017; WDR, 2018).

1.2 Need for the Study

A common blueprint for peace and prosperity for people and the planet, both now and in the future, is provided in the 2030 Agenda for sustainable development, which was adopted by all United Nations Member States in 2015. Sustainable development is defined as "*the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" in the Brundtland report (Beekman, 2004; Sakalasooriya, 2021). The seventeen Sustainable Development Goals (SDGs) (see Figure 1.1), which represent an urgent call to action for all nations—developed and developing—in a global partnership, are at the center of it. They understand that eradicating poverty and other forms of deprivation requires concerted efforts to combat climate change, protect our oceans and forests, enhance health and education, and lower inequality in addition to promoting economic growth. Hence, there are three pillars of sustainable development: economic, social, and environmental, as shown in Figure 1.2. The sustainable development goals (SDGs) are a broader concept.

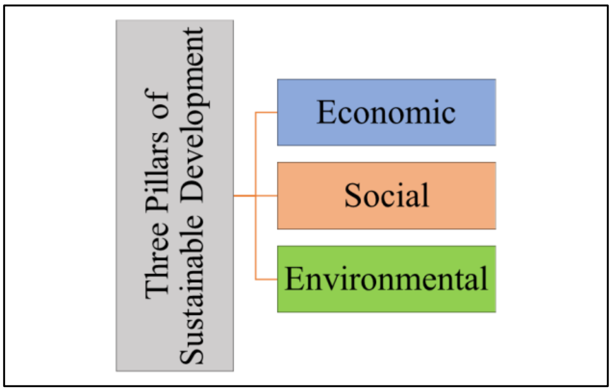
It includes all countries, be they lower, middle, or upper-income, to make substantial improvements in the lives of every person. SDGs leave no one behind and benefit all (United Nations, 2013).

Figure 1.1 Sustainable Development Goals

Source: UN Office for Sustainable Development

Presently, the most important question that revolves around the minds of policymakers all over the world is how to achieve the seventeen sustainable development goals by a country. To address this question, international organizations such as the World Trade Organization (WTO), the Asian Development Bank (ADB), and the United Nations Conference on Trade and Development (UNCTAD) emphasize trade as a factor leading to sustainable development for countries. In September 2015, the report of SDGs and especially in SDG:17, international trade is identified as a key policy instrument to achieve all other SDGs. There is a need to develop trade strategies that would help in boosting economic growth and safeguard the environment for coming generations (Belloumi and Alshehry, 2020). The 2030 Agenda for Sustainable Development defines "*international trade as an engine for inclusive economic growth and poverty reduction that contributes to the promotion of sustainable development*". An increasingly used approach to become a 'sustainable engine' is to internalize social, economic, and environmental concerns in international trade. Thus, in the transformation of the global system for sustainable development goals, trade takes centre stage (International Institute for Sustainable Development (IISD), 1992; UNCTAD, 2021).

Figure 1.2 Pillars of Sustainable Development



Source: UN Office for Sustainable Development

1.3 Significance of the Study

From the most developed industrial societies to the least developed countries (LDCs), trade is one of the main drivers of economic development in every nation (Glover et al., 1999). People and governments also encourage trade because it is beneficial for a country. Openness to trade and market goes simultaneously with better economic performance of countries at all levels. International trade creates new job opportunities and resources that help people to lift out of poverty. Open economies grow faster than relatively closed economies. As a result, global prosperity and opportunities contribute to stability and security for all worldwide (Organisation for Economic Co-operation and Development (OECD), 2017).

For both emerging and developed countries, the percentage of trade in gross domestic product (GDP) increased more or less steadily between the late 1960s and 2014. Particularly for emerging and developed nations, the trade-to-GDP ratios rose from 29.9

and 36.9% in 1980 to 51.3 and 45.7% in 2000, respectively, and then to 55.2 and 55.3% in 2014. The liberalization of trade and foreign direct investment (FDI), the reduction in transportation costs brought about by technological advancements, and the deregulation of the transportation services sectors are the primary causes of the rising trade-GDP ratios (Helble and Shepherd, 2017). Furthermore, the value of global goods trade as of the third quarter of 2021 is $5.6 trillion (UNCTAD, 2021). According to the new forecasts included in UNCTAD's global trade update, trade in goods and services is expected to reach $28 trillion by the end of 2021, up from 23% in 2020 and 11% above pre-coronavirus disease 2019 (COVID-19) levels. Nonetheless, there is a great deal of inequality in trade performance across nations and industries.

Nowadays, it is acknowledged that sustainable development is needed to guarantee a long-term economic outlook that balances the economy with environmental protection (Glover et al., 1999). Within this framework, it is anticipated that trade will serve as a vehicle for bringing the SDGs to fruition. In reality, though, it is still challenging for trade policymakers to identify the connections between trade policy and sustainable development, let alone guarantee that the results of trade policy have a positive impact on sustainable development. In today's globalized world, achieving the SDGs as a universal agenda necessitates policy coherence at all levels (national, regional, and global), where trade policy and its institutional interfaces with each SDG is one piece of the puzzle (UNCTAD, 2016).

All initiatives aimed at achieving a balanced global development that considers the social, environmental, and economic facets are included in sustainable development. Trade, sustainable development, and its three aspects of sustainability (economic, social, and environmental) are generally addressed in isolation from each other. Given the wide-ranging effects of each of these issues and the mutual connection among them, determining the link between them is not an easy task. The study tries to bridge this gap by empirically examining the link between trade and sustainable development goals (for example, SDG:1, SDG:3, SDG:4, SDG:8, SDG:10, SDG:13) in the context of emerging economies.

1.4 Overview of Emerging Economies

Among many groups of countries, emerging economies (EEs) emerged as a significant contributor to trade and growth and represent a substantial share of the world's population. For centuries, these economies have shown remarkable progress in underpinning macroeconomic policies, enabling them to more than double their average per capita income. The growing proportion of emerging economies in international trade reflects their high level of openness to international trade.

International trade strengthens the growth and development of emerging economies. The word 'emerging countries' was originated by Antiole Agtmeal in 1981. While there is no precise description, emerging markets are typically distinguished by characteristics like consistent market access, advancement toward middle-class status, and increased global economic significance. The thesis used the classification by an International Monetary Fund (IMF) study, which identifies the 20 economies in the emerging economies category (Dattagupta and Pazarbasioglu, 2021) as shown in Figure 1.3.

Figure 1.3 Geographical Location of Emerging Economies

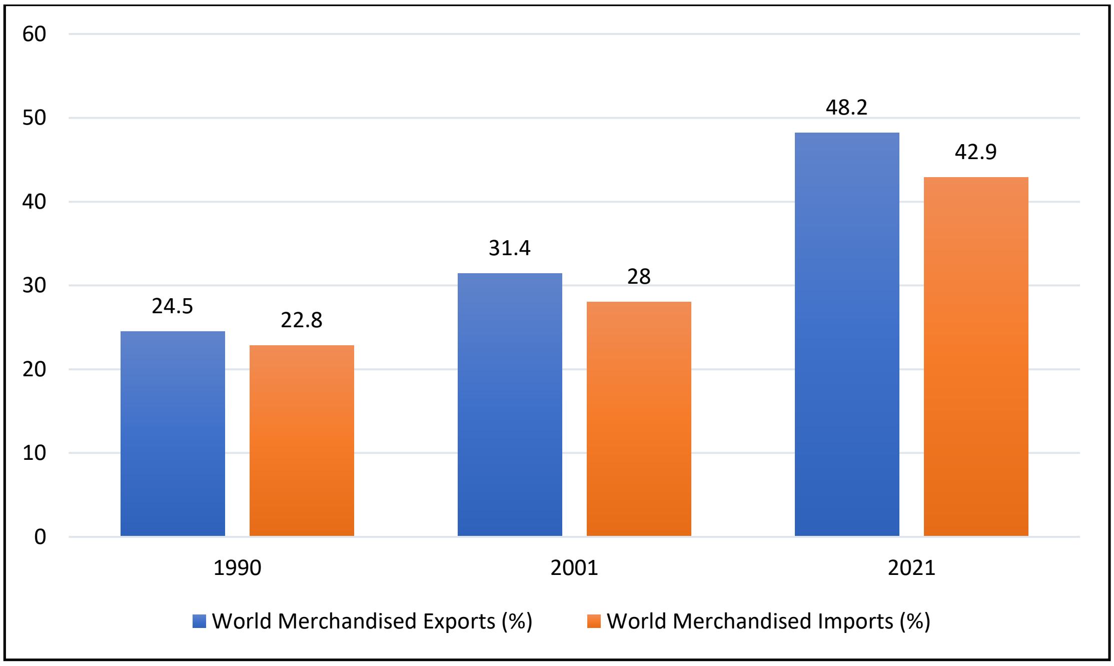
Note: The 20 emerging economies employed in the study are: Argentina, Brazil, Chile, China, Columbia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arab, South Africa, Thailand, Turkey and the United Arab Emirates.

In terms of purchasing power parity, these 20 emerging nations account for 46 percent and 34 percent of the world's nominal GDP in US dollars. Additionally, these nations are included in widely used emerging market indices, including Bloomberg, J.P. Morgan, and Morgan Stanley Capital International. This study for emerging economies is more accurate because they confront more challenges. The impact of trade on sustainable development is not much explored in the case of emerging countries (Hassan et al., 2014; WTO, 2015; Duttagupta and Pazarbasioglu, 2021). Figure 1.4 shows the performance of trade (% of GDP) of 20 emerging economies over the years 1991-2020.

Figure 1.4 Performance of Emerging Economies in Trade (% of GDP) 1991-2020

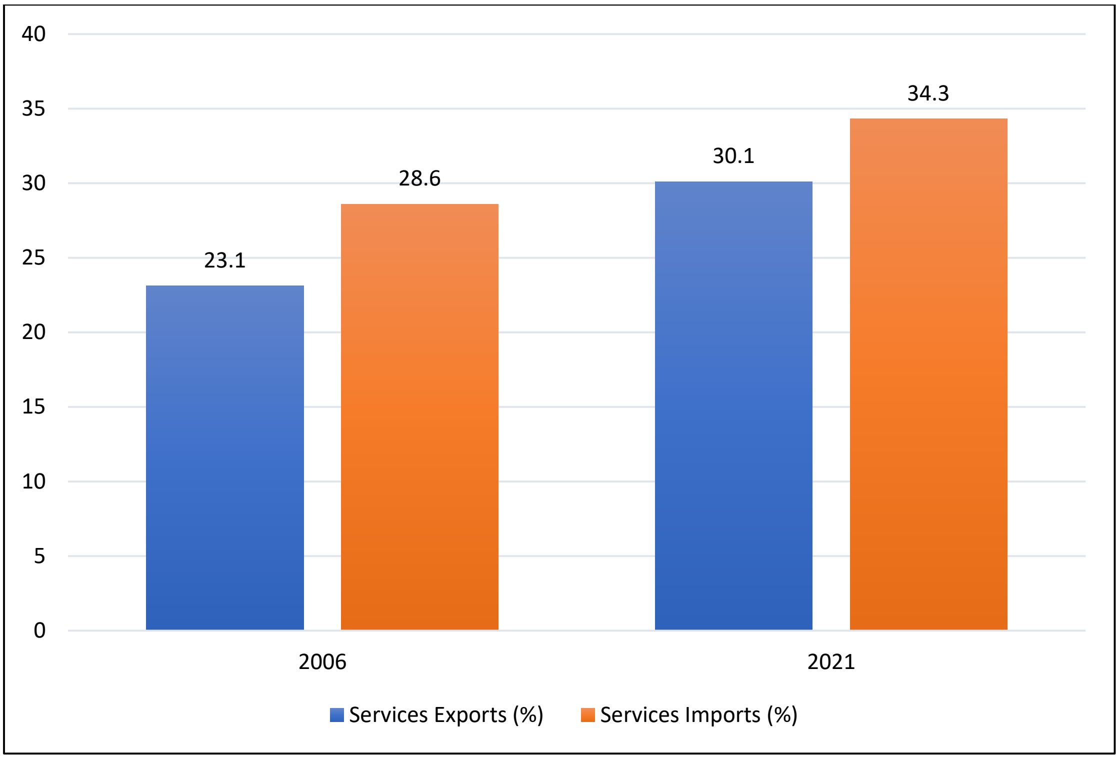
Source: Authors' Computation; Note: 1 to 20 are the panel IDs for 20 Emerging Economies.

Figure 1.5 Share of Emerging Economies in World Merchandised Trade



Source: UNCTAD

Figure 1.6 Share of Emerging Economies in World Services Trade



Source: UNCTAD

Moreover, the share of emerging economies in merchandised trade and services trade has increased, as depicted in Figure 1.4 and 1.5, respectively. The proportion of emerging economies in global merchandise exports has witnessed a notable rise, ascending from 24.5 percent in 1990 to 31.4 percent in 2001 and further escalating to 48.2 percent in 2021. The services export share increased from 23.1 percent in 2006 to 30.1 percent in 2021. The proportion of emerging economies in global merchandise imports has experienced a notable increase over time. Specifically, their share has grown from 22.8 percent in 1990 to 28 percent in 2001 and further expanded to 42.9 percent in 2021. The share in services imports rose from 28.6 percent in 2006 to 34.3 percent in 2021 (UNCTAD, 2023).

However, emerging countries face many development challenges, such as unemployment, rising population, and burden on natural resources. Therefore, emerging countries require a framework that goes beyond GDP growth to address the challenges.

The framework for achieving sustainable development goals is important for emerging countries. According to a report by Asian Development Bank (ADB) (2018), most emerging Asian countries fall short of involving all citizens in the process of development, and ensuring environmental sustainability will take decades. A significant portion of the population is subject to the effects of air pollution, limited access to water resources, escalating land degradation, and limited adoption of renewable energy sources. As economies continued to grow and develop in recent decades, environmental degradation has become a "common concern" (Shrinkhal 2019).

Furthermore, Naeher and Narayanan (2020) recommend that sustainability has been grabbing attention in recent years, mainly in developing countries. It is projected that the role of EEs will grow in importance in the future. EEs are a reasonably diverse group in terms of population, income per capita, geography, growth rate, and size of the economy during the last decade. For instance, India and China are among the world's largest economies and the two most populous countries, whereas South Africa and Argentina have comparatively smaller economies. As communication around the world becomes cheaper and transportation faster due to international trade, lower-income countries could utilize the resulting chance to close the gap with developed ones. Trade is seen to foster economic growth and the social well-being of emerging economies (United Nations, 2013).

1.5 Objectives of the Thesis

Against this backdrop, the objectives of the present study are as follows:

1. To identify the major determinants of international trade in emerging economies.
2. To assess the role of trade in overall sustainable development in emerging economies.

3. To explore the impact of trade on major economic and social SDGs in emerging economies.
4. To examine the impact of trade on environmental sustainability in emerging economies.

1.6 Time Period and Data of the Thesis

The study primarily utilizes the annual data on the relevant variables for the period 1991-2020. Moreover, in recent decades, trade has increased tremendously and contributed in many ways, such as rising economic growth, higher job opportunities, and declining poverty. The study focuses on the 20 emerging economies. The selection of countries and the time period is dictated by consistent and comparable data availability. The data is mainly obtained from World Development Indicators (WDI), the World Bank, International Monetary Fund (IMF), and various international organization's reports and publications.

1.7 Organization of the Thesis

The rest of the thesis is arranged in seven chapters. Chapter 2 discusses a theoretical and empirical review of the literature pertaining to the issues addressed in the study. The chapter is accordingly divided into five sections. The first section is devoted to the review of the literature on the determinants of trade. The second section illustrates a review on trade and sustainable development. The third section deals with the literature on trade and economic and social sustainability. The fourth section provides a review of trade and environmental sustainability. In every section, empirical studies in the context of emerging economies are reviewed, and the main research gaps are identified. Finally, the fifth section provides the summary and main research gaps identified from the existing studies.

Chapter 3 emphasizes the specific econometric methodologies used for empirical investigation in the study. The chapter is further divided into three sections. The first section provides an overview of the various panel approaches to assess stationarity, co-integration, value of coefficients, and causal relationship since the study uses a panel of 20 emerging economies. This includes both first-generation (without cross-section dependence (CSD)) and second-generation (with CSD) techniques. The second section describes the Principal Component Analysis (PCA) used to construct an index.

Chapter 4 focuses solely on identifying the determinants of international trade for emerging economies. Thus, the chapter is categorized into two sections. The first section provides an analysis of identifying the stimulating as well as deterrent factors of trade. The second section summarizes the findings of the chapter.

Chapter 5 emphasizes on the role of trade in achieving overall sustainable development using SDI. The chapter is divided into two section. The first section econometrically analyses the relationship between trade and sustainable development. The second section provides the summary and findings of the chapter.

Chapter 6 deals with the analysis of the role of trade in achieving economic and social SDGs. Therefore, the chapter is organized into four sections. The first section analyses the role of trade in GIP (growth-inequality-poverty) triangle for emerging economies. The second section is devoted solely to the econometric analysis of trade and income inequality in emerging economies. The third section examines the link between trade and unemployment. The fourth section provides the summary and findings of this chapter.

Chapter 7 focuses on the analysis of the relationship between trade and environmental sustainability. Thus, this chapter is segmented into four sections. First section illustrates the impact of trade on environmental sustainability focusing on the single indicator that is CO_2 emissions. The second section provides an empirical analysis on the relationship between trade and environmental sustainability utilizing the composite index. The second section is further divided into two parts. The first part describes the construction of the composite environmental sustainability index (CESI) using the principal component analysis (PCA). The second part analyses the impact of trade on CESI. Lastly, the third section provides the summary and findings of this chapter.

Chapter 8 presents the summary of the study and a brief discussion of the major findings and implications of the study. The first section of the chapter discusses summary and conclusion of the study. The second section discusses some important policy implications of the study. The third section illustrates the major contributions of the study. The fourth and fifth sections consist of limitations and future scope of the study, respectively.

Chapter 2. Theoretical Underpinnings and Review of Literature

2.1 Introduction

This chapter provides an overview of the theoretical frameworks and the empirical literature related to the main issues of the study. The chapter is divided into five sections. The first section is devoted to the review of the literature on the determinants of trade. The second section deals with a review of trade and overall sustainable development, focusing on the three dimensions namely, economic, social, and environmental. The third section illustrates the literature specifically on trade and economic and social sustainability. The fourth section provides a review of trade and environmental sustainability. In every section, empirical studies in the context of emerging economies are reviewed, and the main research gaps are identified. Finally, the fifth section provides the summary and main research gaps identified from the existing studies.

2.2 Determinants of Trade

As discussed in Chapter 1, international trade is essential to economic growth. Keeping in mind the impact of trade on the growth of an economy, as nations become more interconnected in the global market, the factors affecting trade have become an area of research and discussion. International trade is a complex phenomenon shaped by a wide range of motivating and discouraging factors that collectively mold a nation's stance on international trade. Furthermore, to encourage economic growth and development through trade, it is crucial to comprehend the factors that drive international trade in emerging economies (Suleman et al., 2023). This section describes the theoretical and empirical review of the literature. Thus, it is divided into two parts. The first part provides a theoretical review of international trade and its determinants, while the second part describes the empirical literature.

2.2.1 Theoretical Review

International trade has a positive impact on the economic growth of an economy, as established in the trade theories. Several theories have been developed so far to explain the determinants of international trade. Different economic theories use different economic factors to answer why countries trade. What are the gains from trade? Trade theories have developed since the 18th century from Adam Smith's theory of absolute advantage (1776). Trade is determined by the comparative advantage of a country as established by David Ricardo, and the technological differences define comparative advantage. Trade is beneficial if a country exports the commodity of its comparative advantage and imports the commodity of its disadvantage. However, Ricardo fails to explain the determinants of comparative advantage, and further, the Heckscher-Ohlin theorem states that the relative factor endowments of countries determine international trade. A country with more labor endowment will domestically produce and export labor-intensive goods only; the same goes for a capital-abundant country. Any increase in the endowment of factors of production will lead to a rise in the production of the country. A surge in production tends to lead to increased trade volume, further affecting overall economic growth (Jafari and Ismail, 2011; Bakhodirovna et al., 2022; Ngouhouo et al., 2021). However, traditional trade theories are unable to explain the recent changing pattern of exports across countries (Matthee and Naude, 2008).

The new trade theory predicts that large countries will have an export advantage in consumer goods. The "new" trade theory identifies trading costs as a barrier to trade. Some of the other theories argue that the quality of institutions also matters in determining the comparative advantage (Bakhodirovna et al., 2022). Moreover, trade flows are also affected by the exchange rate changes. In international trade, changes in the real exchange rate are known to affect exports and imports under general Marshall-Lerner conditions.

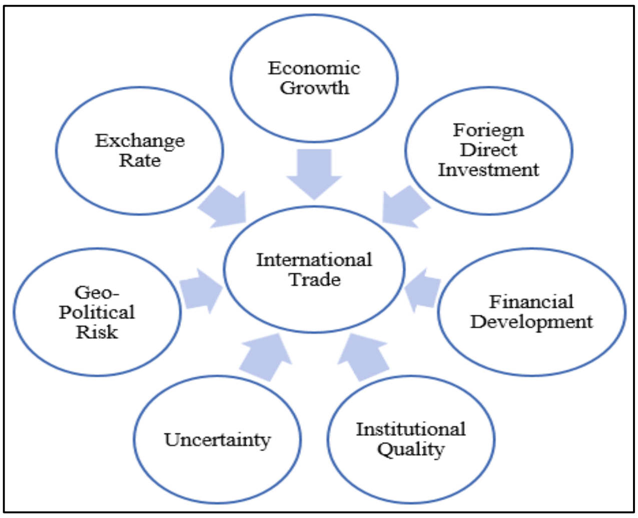
In theory, devaluation can improve trade flows if the relative prices among countries, their trading partners, and other factors do not differ.

Furthermore, trade flows and uncertainty have been clearly linked by theoretical literature. According to Albornoz et al. (2023) and Nguyen (2012), if firms have to invest in sunk costs in order to enter an export market, uncertainty increases the option value of waiting for the firm, reducing entry into export markets. Handley (2014) demonstrates that as a result of trade policy uncertainty, businesses postpone investment, which lowers trade creation. Similarly, Handley and Limão (2015) and Handley and Limão (2017) show increased firm entry into export markets. Subsequently, trade flows result from reduced uncertainty brought about by WTO membership and trade agreements. In a general equilibrium model involving two goods and two countries, Baley et al. (2020) show that increased uncertainty reduces trade unless the elasticity of substitution between domestic and foreign goods is low (Groshenny et al., 2021).

2.2.2 Empirical Review

There are several determinants of trade that impact trade positively and negatively. These factors are shown in Figure 2.1 and discussed below.

Figure 2.1 Determinants of International Trade



(Source: Authors' conceptualization)

2.2.2.1 Trade and Economic Growth

Osei et al. (2019) highlighted the determinants of trade without regard for country income classifications to see if the determinants differ depending on income level. This study re-examines the drivers of trade openness in Africa using panel data, particularly emphasizing the role of economic growth. Their findings suggest that while economic growth significantly increases openness in low-income countries, the impact in lower-middle-income countries is weak and largely negative, implying that higher growth is associated with less openness. The study also discovers that the economic growth-openness nexus for lower-income countries exhibits nonlinearities with an inverted U-shaped relationship. As a result, while increases in real GDP per capita improve openness, any increases in economic growth above an estimated threshold reduce openness. Furthermore, in a study on the determinants of trade flows among D8 countries, Jafari et al. (2011) identify key factors that influence the volume of export flows among member countries. The factors influencing export flows are trading partners' GDP, exchange rate, exporter country's population, border, and distance.

On the other hand, according to Rigobon and Rodrik (2005), trade has a significant detrimental effect on income levels. There is little correlation between trade openness and economic growth, as found by Fenira (2015). According to Rassekh's (2007) analysis of the relationship between trade and growth for 150 countries, lower-income nations gain more from trade than economies with higher incomes. Vamvakidis (2002) and Ulasan (2015) did not support the trade-led growth hypothesis in their studies. Against this backdrop, the study proposes a hypothesis that:

H_1: Economic growth significantly impacts trade.

2.2.2.2 Trade and Foreign Direct Investment (FDI)

Economies can increase their trading activities in foreign markets through FDI (Jithin and Suresh Babu, 2021). According to Alfaro et al. (2010), backward links between domestic and foreign trade are shaped by well-established financial markets. The presence of foreign companies encourages investment in home upstream sectors. The entry of multinational companies generates new opportunities for domestic firms that they exploit through the well-developed financial markets (Liu et al., 2019). The FDI inflow is a desirable tactic to advance global trade (Seyoum et al., 2014). The FDI inflow provides growth opportunities for the industrial and banking sectors and industries like manufacturing, telecommunication, transportation, etc. (Salim et al., 2017). These opportunities assist host nations in increasing the scope of their global operations (Liargovas and Skandalis, 2012).

In contrast, few studies (e.g. Raff, 2004; Seim, 2009) found a negative relationship between TO and FDI. Raff (2004) contends that even though FDI would improve welfare, there are some circumstances in which a free trade agreement (FTA) does not result in FDI. This could occur when there are multiple equilibria and countries are trapped in one that discourages foreign direct investment, or it could arise when equilibrium external tariffs are too low to encourage FDI. Consequently, the study proposes the hypothesis as follows:

H_2: FDI inflow significantly impacts trade.

2.2.2.3 Trade and Financial Development (FD)

A better financial infrastructure encourages trade since industries have enough capital to invest in new goods, markets, and ventures (Kim et al., 2011). The findings of a study by Kim et al. (2011), limited to non-OECD nations, lend credence to the idea that developing countries are significantly more affected by financial development than developed ones. Additionally, the results of their threshold analysis point to a non-linear long-run relationship in which trade openness declines as financial development increases. Similar results are shown by Kim et al. (2010). Further, Kim et al. (2012) observe a negative effect of TO on FD in poorer countries.

Nevertheless, both developed and developing economies find it difficult to sculpt FD in a way that encourages trade. Multinational companies (MNCs) are drawn to stable financial markets, which boosts trade activity within a nation (Nguyen et al., 2018). Companies require a strong financial system because FD not only advances IT (information technology) systems but also supports trade and industrial growth in an economy (Cheng et al., 2021). Yakubu et al. (2018) mentioned that developing the financial sector may be advantageous for economies with access to enough private credit. In a similar vein, Pradhan et al. (2017) discovered a positive long- and short-term correlation between TO and the banking system using the Panel data technique. Osei et al. (2019) highlight that financial development is crucial to trade openness in LMICs (lower-middle-income countries). As previously mentioned, the financial limitations prevent emerging economies' industrial sectors from being well-developed (Anwar et al., 2018; Degong et al., 2018). Stabilizing an economy's financial system is crucial to free market reform and free trade (Wajda-Lichy et al., 2020). This article, therefore, suggests the following hypothesis.

H_3: Financial development significantly affects trade.

2.2.2.4 Trade and Institutional Quality

Institutions ensure fair and inexpensive transactions between economic units and remove market distortions brought on by incomplete data; as a result, their effectiveness promotes the growth of industry and the resurgence of trade (Ozpolat et al., 2016). Using ordinary least squares, Jansen and Nordas (2004) found a positive correlation between trade openness and all institutional variables, including the rule of law, the effectiveness of the government, and the ability to combat corruption. This finding implies that the greater the marginal effect of a decrease in tariff on trade openness, the higher the institutional quality (IQ).

Using the GMM (generalized method of moments) methodology, Ojeaga et al. (2014) examine the relationship between trade and incentives across regions between 1980 and 2010. Their findings suggest that institutions have a significant impact on trade. Depending on the kind of institutions used, their outcomes differ. International institutions promote trade, while domestic institutions hinder it. Using the GMM methodology, Gnangnon (2019) claims that trade openness in less developed nations is positively impacted by reduced development aids, tax reforms, financial development, population growth, improved current account balance, lower inflation, and higher-quality institutions. This article, therefore, suggests the following hypothesis.

H_4: Trade is strongly positively impacted by the quality of institutions.

2.2.2.5 Trade and Uncertainty

The recent blockage of the Suez Canal and the COVID-19 lockdowns and border closures have demonstrated how supply chain disruptions can cause uncertainty shocks that affect trade flows. Since exporting entails sunk costs, we anticipate that trade flows will be especially vulnerable to shocks related to uncertainty. Because emerging economies are more vulnerable to uncertainty, it is crucial to comprehend the effects of shocks bringing uncertainty. As evidenced by Koren and Tenreyro (2007) and Rose and Spiegel (2009), their output growth is more erratic than that of developed economies, and their financial markets are either underdeveloped or too far away from financial centers to provide a buffer against these swings (Groshenny et al., 2021). According to Hanson (2012), emerging economies are particularly vulnerable to uncertainty shocks because they frequently pursue export-led growth strategies and "hyper-specialize" in producing and exporting a limited range of goods. This could make them more susceptible to external shocks.

According to research by Groshenny et al. (2021), global economic and trade policy uncertainty lessens the degree of openness in the seven largest emerging economies. Their discovery that shocks to trade policy and global economic uncertainty cause emerging economies to become less open could indicate the increased resistance to trade liberalization that recent attempts have faced in an environment of increased uncertainty. The findings demonstrate the advantages of a more stable and calm economic environment, especially when it comes to talks about trade policy. One good example is Carrière-Swallow and Céspedes (2013). They demonstrate that the effects of an uncertainty shock are more severe for emerging economies than for developed economies using standard VARs (vector auto-regressions) estimated country by country. After weighing the reasons, the following is suggested by this article.

H_5: The effect of uncertainty on trade is significantly negative.

2.2.2.6 Trade and Geo-Political Risk

Geo-political risks (GPR) refer to dangers or uncertainties associated with acts of terrorism, state-to-state conflicts, and tensions that impede the regular and peaceful flow of international relations (Wang et al., 2019). Even though free trade is a key factor in raising a nation's productivity and income, geo-political risks, international conflicts, tensions within a nation, enforcement actions, and boycotts can all have a significant detrimental impact on export trade flows. Furthermore, countries' investment decisions, transportation costs as well as production, and economic growth may all be impacted by geo-political risks (Balcilar et al., 2018; Webster and Ivanov, 2014; Gozgor and Ongan, 2017; ÖZÇELİK O.,2023).

ÖZÇELİK (2023) investigated the impact of geo-political risks on the trade flow of 11 countries using nonlinear ARDL (autoregressive distributed lag) method. The study found the symmetrical and asymmetrical effects on imports and exports separately. Kim and Jin (2023) examined the impact on bilateral trade flows for South Korea and observed the detrimental effect of GPR on trade flows. Gupta et al. (2019) assessed the impact of GPR on trade flows among 164 developing and developed countries using the gravity model. They also found the adverse effects of GPR on trade flows. The GPR is a recently explored determinant of trade, but its impact on trade openness has not been paid much attention to in recent literature. Therefore, the study suggests the hypothesis as follows:

H_6: Geo-political risk significantly impedes the trade.

2.2.2.7 Trade and Exchange Rate

Although exchange rate fluctuations have long been a source of interest, the focus of this interest has shifted significantly since the generalized floating era. Exchange rate movements affect imports and exports, and nominal depreciation or appreciation is assumed to change the real exchange rate, directly affecting a country's trade (Arize et al., 2017). Mehtiyev et al. (2021) noticed that exchange rate fluctuations significantly affect a nation's imports and exports. It also showed that the exchange rate is a non-trade barrier that impacts international trade.

Tahir et al. (2018) use the panel methodology to examine the effects of macroeconomic factors on the trade openness of SAARC (South Asian Association for

Regional Cooperation) countries from 1971 to 2011. The 2SLS (Two-Stage least squares) estimation results show that investments in both human and physical capital positively impact trade openness. In contrast, trade openness is negatively affected by the size of the labor force and the exchange rate. Jafari et al. (2011) demonstrate that the GDP, border and distance, exchange rate, and population of trading partners are the factors that affect the volume of trade among the D8 group of countries. Thus, the following hypothesis is proposed by the study.

H_7: The exchange rate has a significant negative relationship with trade.

2.3 Trade and Sustainable Development

International trade is described as “an engine for inclusive economic growth and poverty reduction that contributes to the promotion of sustainable development” in the 2030 Agenda for Sustainable Development. In an effort to transform it into a “sustainable engine”, one strategy that appears to be being employed is internalizing social, economic, and environmental concerns more and more in international trade. Numerous methods, tools, and policy instruments can be used to accomplish this (UNCTAD, 2021). As opposed to merely higher gross domestic product (GDP), intergenerational development has received much attention lately. However, GDP does not take into account societal challenges and environmental damages such as the effects of CO_2 emissions, reduced biodiversity, level of equality, happiness and so on. Thus, as a means of addressing social and environmental issues, the shift from economic growth to development, especially sustainable development, arose (Sheikh et al. 2021). And the objective of achieving the Sustainable Development Goals (SDGs) dominates the contemporary development discourse (Leal Filho et al., 2020). The present section reviews the literature on trade and sustainable development, emphasizing the three dimensions of sustainable development: economic, social, and environmental.

This section discusses the impact of trade on economic development and the sustainability of economic growth. The common view is that trade induces economic growth (Jalil and Rauf, 2021; Raghutla, 2020; Tahir and Azid, 2015) through various channels. Raghutla (2020) finds that trade contributes significantly to both economic development and growth in emerging economies. Tahir and Azid (2015) find similar results in developing economies. Stensnes (2006) mentioned that the quality of institutions acts as a mediating variable that promotes economic growth through economic integration. Trade restrictions may hamper the economic growth of countries at their early stage of economic growth (Jalil and Rauf, 2021). Capital formation is also a complementary variable to trade that promotes economic growth (Keho, 2017). Examining the connection between development and trade According to Kim and Lin (2009) and Kim et al. (2011), there is an income threshold below which increased trade has adverse effects on economic growth and above which it has positive effects. According to Sakyi et al. (2015) and Herzer (2013), countries with higher income levels tend to see a more significant impact of trade on income. Trade's growth effect can vary depending on the degree of economic development.

Social sustainability mainly focuses on the welfare of people and communities. It is about advocating for fairness, human rights, decent work, and access to healthcare and education. Numerous studies have examined the linkage between trade openness and social sustainability with reference to inclusive human development. Nessa and Imai (2023) observed that trade openness significantly helps reduce the working poverty rate, majorly in upper-middle-income developing countries. Trade should rise in developing nations with middle- and upper-class incomes to lower the working poverty. The low-income developing nations with the highest rates of working poverty ought to investigate ways to harness the positive effects of trade on this issue. Gonese et al. (2023) contend that while imports have a long-term positive impact on unemployment, trade openness and exports have a negative effect on it. This implies that increasing exports and real trade openness reduces unemployment and imports increase job losses over time in the SADC (South African development community) region. Dorn et al. (2022) studied the link between trade and income inequality. They found that in emerging and developing economies, trade openness tends to disproportionately benefit the relative income shares of the very poor, though not always all poor. Trade openness increased income inequality in the majority of advanced economies; this effect is driven by outliers. Jain and Mohapatra (2023b) also found that trade openness reduced income inequality and observed an inverted U-shaped relationship between them.

Moreover, trade openness positively impacts human development (Kabadayi, 2013; Hamdi and Hakimi, 2022). Trade openness primarily improves population health through channels like labor employment, wage income, public health investment, and personal health investment. Trade openness, however, can also result in environmental pollution, which has a detrimental effect on public health (Ou et al., 2023). Byaro et al. (2021) also state similar findings that trade openness significantly contributes to health improvement. There is a significant positive correlation between trade share and expenditure on education, suggesting that nations with greater trade openness also invest in higher levels of education (Basu et al., 2008; Moskalyk, 2008). Social sustainability aims to maintain social justice and cohesion while fostering inclusive societies, lowering inequality, and securing everyone's long-term well-being.

The effects of centuries' worth of environmental damage are currently being felt by human civilization. Consequently, it is now imperative to take actions that will advance civilization without harming the environment (Khan et al. 2021). Trade has attained attention as a factor of environmental sustainability, among others (Zafar et al., 2023). Khan et al. (2021) studied the association between trade openness and CO_2 emissions for an emerging nation. They found the negative impact of trade openness (TO) on CO_2 emissions and mentioned that rising trade openness helps shrink toxic waste from energy consumption. The effect of trade on decoupling carbon emission levels in terms of GDP growth is examined by Wang and Zhang (2021). Using the datasets for developing countries from 1990 to 2015, they look into the varied effects of trade on carbon emission levels. According to empirical findings, improved trade reduces carbon emissions in middle-class and higher-income economies. In addition, it raises the levels of carbon emissions in low-income nations.

Lheonu et al. (2021) examine the association between international trade, urbanization, and CO_2 emissions in Sub-Saharan Africa (SSA) for the period 1990-2016. Using the panel quantile regression, it is observed in the study that trade promotes environmental sustainability in countries with the highest and lowest CO_2 emissions. However, countries with intermediate levels of CO_2 emissions should be subject to trade restrictions. Orhan et al. (2021) investigated the association between CO_2 emissions and economic growth in India while accounting for energy use, agricultural production, and trade openness. The study's outcome reveals that India's increased energy use, agriculture, and trade openness negatively impact environmental sustainability. The study conducted by Rehman et al. (2021) examined the linkage between globalization, energy use, and trade on environmental sustainability using ecological footprints as an indicator in Pakistan. A linear ARDL model with limited information maximum likelihood and linear Gaussian model estimation is utilized for the annual data from 1974-2017. The results show that globalization, energy use, trade, and GDP growth are positively associated with ecological footprints in the long run. A study conducted in Tunisia by Mahmood et al.

(2019) found that trade openness has a positive impact on CO_2 emissions, suggesting that an increased trade openness contributes to enhanced environmental sustainability.

2.4 Trade and Economic & Social Sustainability

The goals of economic, and social sustainability through trade are to guarantee the present and future well-being of human societies and the planet. Trade has revolutionized the availability of goods for low-income households by granting them unprecedented access to goods and services. The improvement of general working conditions and income levels are also influenced by trade. Social sustainability mainly focuses on the welfare of people and communities. Social sustainability can be improved by economic policies that encourage inclusive growth and lessen inequality because they give everyone in society better access to opportunities and resources. Prioritizing social policies in the areas of education, healthcare, and social protection helps to ensure a skilled and healthy labor force as well as lower levels of poverty and inequality, all of which can promote long-term, sustainable economic growth.

The present section elucidates the theoretical and empirical review of the literature on trade and its link with economic and social aspects of sustainability. This section is categorized into three sections. The first section describes the review of trade and the growth-inequality-poverty (GIP) triangle that includes both economic and social sustainability. The second and third section specifically emphasizes on trade and its impact on income inequality and unemployment, respectively.

2.4.1 Trade and Growth-Inequality-Poverty (GIP) Triangle

This section pertains to theoretical and empirical literature on the relationship between trade and GIP triangle.

2.4.1.1 Theoretical Review

The association between economic growth, inequality, and poverty is substantial and has been an area of interest among economists throughout the history of economic thought. According to the development programs, poverty reduction is one of the essential objectives of economic development, and economic growth is the most excellent antidote for poverty. In the 1950s and 1960s, a widely accepted theory known as the trickle-down hypothesis emphasized the significance of economic development. The concept states that the benefits of growth will initially accrue to the wealthy and will ultimately trickle down to the less fortunate members of society (poor people) (Kakwani and Pernia, 2000; Permadi, 2018). Lin (2003) and Montalvo and Ravallion (2010) validate that economic growth in China has effectively reduced poverty since the promotion of economic reforms.

Many other studies, such as Lopez (2004) and Mohapatra and Giri (2021), also support the trickle-down hypothesis. Some economists also argue about the validity of the trickle-down hypothesis, stating that economic growth benefits the richer class more than the poor, thus, increasing income inequality. Bhagwati (1988) referred to this type of situation as 'immiserizing growth' in which the negative effects of inequality outweigh the positive impact of economic growth. This, in turn, deteriorates the condition by increasing the number of poor persons (Kakwani and Pernia, 2000).

Consequently, there are arguments that the poverty alleviation program will be effective when growth is accompanied by a more equitable income distribution (Kakwani and Son 2003; Kakwani et al. 2010). This argument asserts that when economic growth is followed by a more equitable distribution of individual income, the impoverished will likely have a greater opportunity to earn more money, improve their living conditions, and escape poverty (Permadi 2018). Moreover, according to the popular Okun's law of macroeconomics, real economic growth improves poverty by lowering unemployment rates, but less proportionately (Awad-Warrad and Muhtaseb 2017).

2.4.1.2 Empirical Review

Tabassum and Majeed (2008) and Mekenbayeva and Karakus (2011) identify the strong negative relationship between economic growth and income inequality. The possible reasons for the negative relationship in developing countries are capital and credit market imperfections, an unstable political environment, and restrictions on human capital investment imposed on poor people. Cheema and Sial (2012) analyze the long-run relationship between poverty, income inequality, and growth in Pakistan. The results indicate that growth and income inequality significantly help in poverty reduction, with the former having a considerably larger impact than the latter. At the same time, a considerable positive correlation between inequality and growth exists in Pakistan. Tridico (2010) examined the relationship in a panel of 50 emerging economies. Using ordinary least squares (OLS), the study found that growth is not poverty-reducing and worsens inequality. Kurita and Kurosaki (2007), using unique panel data from provinces in the Philippines (1985–2003) and Thailand (1988–2002), found that inequality hinders poverty reduction and economic growth.

Similarly, Chemli and Smida (2013) investigated the impacts of economic growth and inequality on poverty in a MENA (Middle East and North Africa) region, suggesting that economic development and income disparity are moving in different directions. The analysis of the literature regarding the GIP triangle yields two major findings. On the one hand, the empirical literature is virtually unanimous in its conclusion that growth reduces poverty. In emerging and low-income economies, economic growth has directly impacted poverty reduction. Growth through the increase in education, health, and employment opportunities for the poor, improves their access to public products and services, thereby boosting their incomes and prospects. In contrast, the effect of growth on inequality is ambiguous and dependent on the sources of growth. For instance, growth fueled by skill-biased technological change can disproportionately benefit capital owners and skilled workers at the expense of unskilled workers, whose earnings are generally low and tend to be in the lowest income distribution quantiles. Even though this form of technological innovation is typically beneficial for economic growth, it can increase inequality. Consequently, identifying the underlying sectors that drive economic development is essential for comprehending the effect on inclusiveness (Cerra, Lama, and Loayza 2021).

To sum up, the empirical results of the GIP triangle are mixed depending on the group of countries under consideration, the methodology employed, or the nature of the poverty alleviation program adopted by the institutions in a particular country. Several empirical studies have also combined the GIP triangle with other macroeconomic variables such as mobile banking (Asongu and Odhiambo 2019), financial development (Dhrifi 2015), crime (Anser et al. 2020), institutional quality (Dhrifi 2013; Touitou 2021), and environment (Hassan, Zaman, and Gul 2015).

Trade is also considered a very prominent and essential macroeconomic variable for an economy. Many empirical studies have separately studied the link between trade and growth, trade and poverty, and trade and inequality. Several researchers studied the impact of trade on growth. They argued that international trade encourages employment in the home country and promotes the transmission of technology between countries, leading firms to gain comparative advantage and thus promote growth. However, studies on the trade and growth nexus found mixed results. A study by Gnangnon (2018) presents that trade positively affects growth, while Ulaşan (2015) found a negative link and suggests that free trade is not associated with more economic growth.

Moreover, Zahonogo (2016) found a non-linear relationship between trade openness and economic growth in Sub-Saharan African countries. Economic growth is essential but not sufficient for reducing poverty and income inequality. Thus, the research focus shifted from growth to poverty and inequality to address inclusive growth more inclusive. Several studies explain the impact of trade on poverty and found that the linkage is inconsistent and non-comparable across countries. The link between trade and poverty depends on the various socio-economic and institutional factors (Awad-Warrad and Muhtaseb, 2017). According to a study by Tsai and Huang (2007), trade openness in Taiwan worked towards alleviating poverty. Trade openness has helped increase the income share of the poorest quintile through the income and distribution effect. Anetor, Esho, and Verhoef (2020), in a study of 29 countries in Sub-Saharan Africa, applied the feasible generalized least square (FGLS) method and found that trade has a positive and significant relationship with poverty reduction. Fauzel (2022) investigated the impact of trade on poverty reduction using the vector error correction model (VECM) for the period 1990–2017. According to the study, though trade reduces poverty in the long run, economic growth and education are found to be more critical in reducing poverty in the small island of Mauritius. A recent study by Rahman et al. (2022) found no causal link between trade and poverty in BRICS countries. Similarly, the effect of trade on income inequality is ambiguous and depends on the level of development of a particular country.

Empirical studies have also found ambiguous results (Goldberg and Pavcnik 2007; Harrison, McLaren, and McMillan 2011; Huang et al. 2022). Using meta-regression analysis, Huang et al. (2022) found mixed results. They argued that trade reduces inequality in middle-and-high income countries only when endogeneity is addressed but no statistically significant effect in low-income countries. Some studies found that trade causes income inequality to rise in developing countries (Aradhyula, Rahman, and Seenivasan 2007; Meschi and Vivarelli 2009); but reduces income inequality in developed countries (Aradhyula, Rahman, and Seenivasan 2007). Lin and Fu (2016) investigated the impact of trade on income inequality in small developing countries and found that trade reduces income inequality in autocracies and increases income inequality in democracies. Using time series analysis, Barusman and Barusman (2017) found that trade increases income inequality in the United States (US). Khan and Nawaz (2019) found an inverted U-shaped relationship between trade and income inequality. Xu et al. (2021) support the positive association between trade openness and income inequality in SSA countries.

2.4.2 Trade and Income Inequality

This section discourses theoretical and empirical literature on the relationship between trade and income inequality.

2.4.2.1 Theoretical Review

As inequality persists worldwide, combating it has been a global concern for centuries. In 1955, Simon Kuznets predicted the inverted 'U-shaped' relationship between income inequality and development, suggesting that as the economic growth of a country improves, inequality initially increases and afterward decreases via changes in the economy's structure. The literature on this issue is extensive. The two key facets of the transformation in the structure are (1) the falling share of agriculture in total production and (2) the movement of labor from the low-income (agriculture) sector to the rich (industrial) sector (Paul 2018; Kuznets 1955). The theory has been discussed for decades and is backed up by many empirical studies such as Nielsen (2017), VanHeuvelen (2018), Younsi and Bechtini (2018), Comin (2019), and Navarro et al. (2020). Though, some studies refute the hypothesis e.g., Meneejuk and Yamada (2016), Kanbur (2017), Costantini and Paradiso (2018), and Baymul and Sen (2019).

The discussion described above with inconclusive results further encourages researchers to investigate it by incorporating new factors that influence an economy, particularly income inequality, such as trade. The relationship between income inequality and trade openness has also been studied by researchers interested in income inequality. Theoretically, the Heckscher-Ohlin (HO) theorem is the main theory that links international trade and income inequality, where a country exports goods that use its abundant factor of production intensively and imports goods that use its scarce factor intensively. Similarly, based on the Stolper-Samuelson Theorem (SST), in a developed economy with abundant high-skilled labor, expanding international trade through tariff reductions improves demand and pay for high-skilled workers while decreasing demand and earnings for low-skilled labor (usually in developing economies), leading to an overall increase in income inequality. Thus, in the case of developing economies, trade has a positive effect on the real and nominal wages of the workers, leading to a decline in income inequality, while in the case of developed economies, trade will raise the income of the factors, thus increasing income inequality (Stolper and Samuelson 1941; Faustino and Vali 2011; Siddique 2021).

2.4.2.2 Empirical Review

Correspondingly, the results of studies empirically examining the association between income inequality and trade are varied. Several studies found linear relationships that can be positive or negative (Faustino and Vali 2011; Asteriou et al. 2014; Siddique 2021; and Dorn and Levell 2021). A group of studies found a negative relationship between trade and income inequality, which believes that trade openness reduces the wage gap between skilled and unskilled labor and, thus, income inequality in the economy. Using the system generalized method of moments (GMM) estimator, Faustino and Vali (2011) examined the connection between globalization (using trade openness and FDI) and income inequality in OECD nations from 1995 to 2007. They found that trade openness negatively affects income inequality while the effect of FDI is insignificant. While Barro (2000), Andersson and Palacio Chaverra (2016), and Andersson and Palacio (2017) explained the relationship in terms of labor productivity. They argued that trade openness increases the productivity of unskilled labor and thereby reduces the productivity gap between the agriculture and industry sectors, maintaining a diminishing effect on income inequality. Asteriou et al. (2014) analyzed the same for 27 EU countries from 1995 to 2009 using regression and GMM estimator. They discovered that trade openness had the same influence on income inequality, while FDI, stock market capitalization, and capital account openness are the impetus of inequality. On the contrary, the second group of researchers posits a positive relationship between trade openness and income inequality. They argued that with the increase in trade openness, income inequality increases and worsens income inequality because trade may not be complemented by the development of proper institutions and governance. In addition, trade may marginalize particular groups of people or regions (Stiglitz 1998; Gordon et al. 2007; Bergh and Nilsson 2010).

Furthermore, several studies have also found a non-linear relationship between trade openness and income inequality. Topuz and Dagdemir (2020) examined the effect of trade liberalization on income inequality based on Kuznets' hypothesis from 1987 to 2016 in Turkey by employing the ARDL method. The study does not support the hypothesis as it found a 'U' type of relationship. A similar study was conducted by Dobson and Ramlogan (2009) for Latin American countries, where the study reports a curvilinear relationship and supports the hypothesis. Jalil (2012) investigated the above link in the framework of openness-led Kuznets Curve (KC) in China using the ARDL model, where the results are in line with the Kuznets hypothesis from 1952 to 2009.

2.4.3 Trade and Unemployment

In examining the relationship between trade and unemployment, Ali et al. (2022) and Liu et al. (2022) observed a negative association in overall and lower–income OIC (Organization of Islamic Cooperation) economies and a positive in higher-income OIC economies. Felbermayr et al. (2011) investigated the openness–unemployment nexus for 20 OECD countries and found a negative correlation between trade openness and unemployment. Later, Hassan et al. (2012) found that trade openness decreased unemployment in urban areas in states with flexible labor markets and substantial employment in net exporter industries. Anjum and Perviz (2016) confirmed the Heckscher–Ohlin theory of comparative advantage by discovering an adverse effect of trade openness on unemployment in labor-endowed economies and a positive impact in capital-endowed nations. In addition, Onifade et al. (2020) found that trade openness and domestic investment have contradictory effects on unemployment in Nigeria.

Opponents of trade openness, on the other hand, argue that trade openness increases unemployment. For instance, Awad and Yussof (2016) and Madanizadeh and Pilvar (2019) found a positive correlation between trade openness and unemployment. Ali et al. (2020) analyzed the asymmetric association between trade openness and unemployment for capital-abundant and labor-abundant OIC countries. Seven out of ten labor-abundant nations exhibited a negative correlation between trade openness and unemployment. In contrast, eight out of ten capital-abundant nations demonstrated a positive effect of trade openness on unemployment. To sum up, the impact of trade openness on unemployment depends on various country-specific factors such as factor endowment and structure of the labor market.

2.5 Trade and Environmental Sustainability

Trade promotes growth and development in a country (Zahonogo, 2016). Trade in goods and services leads to the growing inter-dependencies between production and consumption across countries. Strong trade relationships among countries boost the country's production and standard of living of the people, hence facilitating poverty reduction and economic growth (Tipping and Wolfe, 2016; WTO, 2020; Zafar et al., 2020). Although international trade provides a growth impetus among countries, its implications on environmental sustainability are becoming a growing concern through increasing pollution and depleting natural resources. However, as trade has expanded, questions about its impacts on the environment and, more generally, about the ability of nature to withstand the environmental effects of economic activity have also been raised. This section deals with theoretical and empirical literature on the impact of trade on environmental sustainability in the first and second sub-sections, respectively.

2.5.1 Theoretical Review

Strong trade ties between nations increase a nation's output and citizens' standards of living, thereby promoting economic growth and reducing poverty. (Tipping and Wolfe, 2016; WTO, 2020; Zafar et al., 2020). Global production and consumption are becoming more interdependent due to trade in products and services. The expansion of international trade and the development of global value chains raised a question about trade and its impact on environmental quality. Trade offers a double-edged sword that can have positive and negative effects on the same. On the one hand, international trade provides a better opportunity to improve environmental management while also promoting economic development and societal well-being. Furthermore, trade facilitates access to new technologies that improve production efficiency by reducing the use of environmentally harmful inputs. For instance, the pollution halo hypothesis states that greener technologies, such as pollution abatement technologies and renewable energy techniques, can be transferred through foreign direct investment (FDI), which mitigates carbon emissions (Das, 2019; Nguyen-Thanh et al., 2022). On the other hand, increasing pollution and degrading natural resources are the direct negative environmental effects of trade expansion. Since environmental regulation varies between nations, trade openness could lead to specialization in pollution-intensive activities in countries – the so-called pollution haven hypothesis (OECD, 2019).

Numerous studies examine the relationship between the economy and the environment in the literature. Certain studies examine the relationship between economic growth and the environment using the Environmental Kuznets Curve (EKC) hypothesis. On the other hand, some studies investigate the relationship between trade openness and the environment within the context of the EKC hypothesis, pollution haven hypothesis, and pollution halo hypothesis. As per the theory proposed by Grossman and Krueger (1993) and Copeland and Taylor (1994) distinguished three environmental impacts of internationalization. The scale effect is the first effect, which demonstrates that the increased output of a country may result in a rise in harmful emissions. The second effect is the composition effect, which affects the sectoral structure of markets when there is a shift in the ratio of cleaner to dirtier industries due to international trade. The third consequence is a technical one brought on by adopting eco-friendly technological advancements. As a result, combining these three effects will have an overall impact on the ecosystem (Appiah et al., 2022; Awad and Mallek, 2023).

2.5.2 Empirical Review

Numerous scholars have conducted extensive investigations into the relationship between trade openness and environmental sustainability over an extended period, employing diverse indicators to measure environmental sustainability. Nonetheless, their results are mixed. Using data from 1965 to 2008, Shahbaz et al. (2013) studied the correlation between CO_2 emissions and trade in South Africa. The authors employed the autoregressive distributed lag (ARDL) model, and the results reveal that trade openness has a detrimental effect on CO_2 emissions in South Africa, indicating that greater trade openness improves environmental sustainability. However, a study conducted in Tunisia by Mahmood et al. (2019) found that trade openness has a positive impact on CO_2 emissions, suggesting that an increased trade openness contributes to enhanced environmental sustainability.

Moreover, Hossain (2011) evaluated the relationship between trade openness and CO_2 emissions by employing data spanning from 1971 to 2007. The empirical findings found no indication of a causal relationship between trade openness and CO_2 emissions in newly industrialized countries. The research mentioned by Sun et al. (2019) and Dauda et al. (2021) offers contradictory results about the relationship between trade openness and CO_2 emissions. Mutascu (2018) evaluated the effects of trade openness and CO_2 emissions by analyzing a dataset from 1963 to 2013. The study used wavelet methods to assess this linkage, including wavelet coherence, multiple wavelet coherence, and partial wavelet coherence. The findings of this study showed that there was little correlation between CO_2 emissions and trade openness. The findings of Sebri et al. (2014) for the BRICS countries and Cetin et al. (2018) for Turkey confirmed the relationship between CO_2 emissions and trade openness as beneficial.

The study conducted by Rehman et al. (2021) examined the linkage between globalization, energy use, and trade on environmental sustainability using ecological footprints as an indicator in Pakistan. A linear ARDL model with limited information maximum likelihood and linear Gaussian model estimation is utilized for the annual data from 1974-2017. The results show that globalization, energy use, trade, and GDP growth are positively associated with ecological footprints in the long run. Based on the analytical conclusions of this study, it is advisable for policymakers and authorities to persist in their efforts to strengthen interventions targeted at facilitating efficient trade strategies, fostering economic development, managing fuel consumption, and specifically mitigating carbon emissions. This would increase economic production, minimize ecosystem damage, and preserve sustainable settings.

Baajike et al. (2022) investigated the impact of economic growth, trade liberalization, and financial development on the environmental quality in the West African region during the period of 2005-2018. The findings derived from the empirical analysis indicate that trade liberalization has a detrimental impact on environmental sustainability. However, this negative effect can be mitigated by the presence of strong and effective institutions, as well as a well-regulated market. It also validates the EKC hypothesis within the ECOWAS (Economic Community of West African States) sub-region.

Recently, Ali et al. (2020) addressed the effects of trade openness on environmental quality using ecological footprints in OIC countries. The positive effect of trade openness on ecological footprints is discovered by the Dynamic Common Correlated Effect (DCCE) method. It is also suggested that green investment and technology, clean production, and improved institutions must be encouraged by OIC countries for better environmental quality and sustainable development. Baek et al. (2009) used a co-integration approach to evaluate the ecological effects of globalization on both developed and developing nations. The findings indicate that while income growth and trade tend to have negative effects on the environment in most developing nations, they tend to have positive effects in advanced nations. A causality test revealed that a divergence in trade and income growth in developed nations led to a deviation in ecological quality. Conversely, the opposite is true for emerging nations.

Though there are studies discussing the influence of trade on the environment, they seldom elaborate on the effects of the components of trade on the same. Rafique et al. (2021) aim to examine the relationship between human capital, economic complexity, renewable energy, urbanization, export quality, trade, economic growth, and ecological footprints. The research utilized FMOLS (fully modified ordinary least squares), DOLS (dynamic ordinary least squares), and system GMM methods for the top ten economic complex countries over the period 1980-2017. The outcome of the study reveals that trade and export quality increases ecological footprints. Human capital and the generation of renewable energy reduce ecological footprints. It is recommended that investments in increased renewable energy production, consumption, and human capital use will enhance economic complexity, export quality, and the environment in both developed and emerging nations. In addition to trade in commodities, trade in services can also have a significant impact on environmental sustainability.

Andrew (2000) notes that the effects may arrive through direct or indirect channels and can be felt during upstream and downstream activities. Restaurants and food service, tourism, transportation, entertainment, health care, construction, etc., are among the most significant exports of services with an environmental impact. Chakraborty and Mukherjee (2013) examined the relationship between investment flows, trade, and environmental sustainability using EPI (Environment Performance Index) for 114 countries over 2000-2010. According to the regression results, service exports and FDI outward movements have a favorable impact on environmental sustainability. In contrast, merchandise export orientation and FDI inflow have a negative relationship with it. It raises fundamental questions about how trade and economic policies interact with environmental sustainability in developing nations and LDCs.

2.5.2.1 Measurement of Environmental Sustainability

There are persistent arguments and disagreements about measuring environmental sustainability at national and global levels. The two strands of literature are available in this regard. The first measurement includes the single environmental indicators to measure environmental sustainability, such as CO_2, GHG (greenhouse gas), and methane emissions. The use of a single indicator considers only one component of the environment. The second measurement includes composite indices such as Ecological Footprint (EP), Environment Performance Index (EPI) and Environmental Sustainability Index (ESI). This measure not only considers one component but also considers socio-economic and political factors, providing a complete picture of sustainability. The present section further segmented into two parts. The first and second part deals with the single indicator and composite indicator studies, respectively.

Single Indicator Studies

A substantial body of work on the factors that influence environmental sustainability has been written in the previous two decades. Several empirical investigations use single environmental indicators to measure the state of the environment on a national or international basis. Researchers have previously employed a variety of environmental proxies, including emissions of sulfur dioxide (SO_2) (Selden and Song, 1994), nitrous oxide (N_2O) (Janke et al., 2009; Zhang et al., 2019) and particulate matter (PM 2.5) (Ouyang et al., 2019). Carbon dioxide (CO_2) emissions, however, are the most pertinent and widely used environmental indicator (Ikram et al., 2020; de Souza Mendonça et al., 2020). In estimating the impact on environmental sustainability, Umaret al. (2020), Nepalet al. (2021) and Orhan et al. (2021) used CO_2 emissions as a measure of environmental sustainability. In addition to carbon dioxide, methane emissions (CH_4) have also received a lot of interest as an environmental indicator. In examining the Environment Kuznets Curve (EKC), Adeel Farooq et al. (2021) and Benavides et al. (2017) have used methane emissions as an indicator of environmental quality.

Numerous scholars have conducted extensive investigations into the relationship between trade openness and environmental sustainability over an extended period, employing diverse indicators to measure environmental sustainability. Nonetheless, their results are mixed. Using data from 1965 to 2008, Shahbaz et al. (2013) studied the correlation between CO_2 emissions and trade in South Africa. The authors employed the autoregressive distributed lag (ARDL) model, and results reveal that in South Africa trade openness has a detrimental effect on CO_2 emissions, indicating that greater trade openness improves environmental sustainability. However, a study conducted in Tunisia by Mahmood et al. (2019) found that trade openness has positive impact on CO_2 emissions, suggesting that an increased trade openness contributes to enhanced environmental sustainability.

Moreover, Hossain (2011) evaluated the relationship between trade openness and CO_2 emissions by employing data spanning from 1971 to 2007. The empirical findings found no indication of a causal relationship between trade openness and CO_2 emissions in newly industrialized countries. The research mentioned by Sun et al. (2019) and Dauda et al. (2021) offers contradictory results about the relationship between trade openness and CO_2 emissions. Mutascu (2018) evaluated the effects of trade openness and CO_2 emissions by analysing a dataset from 1963 to 2013. The study used wavelet methods to assess this linkage, including wavelet coherence, multiple wavelet coherence, and partial wavelet coherence. The findings of this study showed that there was little correlation between CO_2 emissions and trade openness. The findings of Sebri et al. (2014) for the BRICS countries and Cetin et al. (2018) for Turkey confirmed the relationship between CO_2 emissions and trade openness as beneficial. Orhan et al. (2021) investigated the association between CO_2 emissions and economic growth in India while accounting for energy use, agricultural production, and trade openness. The study's outcome reveals that India's increased energy use, agriculture, and trade openness negatively impact environmental sustainability.

Qamruzzaman (2022) assessed the EKC hypothesis with the relationship between renewable energy, environmental innovation, environmental sustainability, and trade in India and Russia. He also employed per capita CO_2 emissions as a metric to assess environmental sustainability. Similarly, Pham et al. (2020), Longe et al. (2020), Boamah et al. (2020), Sun et al. (2020), and others studied the impact on the environment of trade openness. Lheonu et al. (2021) examine the association between international trade, urbanization, and CO_2 emissions in Sub-Saharan Africa (SSA) for the period 1990-2016. Using panel quantile regression, it is observed in the study that trade promotes environmental sustainability in countries with the highest and lowest CO_2 emissions. However, countries with intermediate levels of CO_2 emissions should be subject to trade restrictions.

Recently, Chhabra et al. (2023) examined the impact of trade openness on CO_2 emissions in BRICS countries and revealed that trade openness causes an increase in CO_2 emissions and deteriorates the quality of the environment. In addition, Ertugrul et al. (2016) discovered that trade openness and energy consumption are among the primary determinants of carbon emissions that lead to an increase in pollution in the leading ten developing nations. Similarly, Zhang et al. (2017) analyzed the relationship in ten countries and discovered that trade openness has a negative effect on carbon emissions.

Dou et al. (2021) for China-Japan-South Korea free trade agreement (FTA) countries found that trade increases greenhouse gas (GHG) emissions in these countries, with the FTA agreement potentially mitigating this effect.

In addition, Omri (2013) examined the relationship between trade openness and carbon emissions in 14 North American and Middle Eastern nations and found that trade openness has a negative effect on GHG emissions. Recent research by Dauda et al. (2021), Khan et al. (2022), and Appiah et al. (2022) indicates that trade has a significant negative effect on environmental sustainability. In contrast, Yu et al. (2019) found that while trade openness increases emissions globally, it has a double-edged effect on CIS (Commonwealth of Independent States) countries by indirectly decreasing emissions. In Belt and Road countries, Sun et al. (2019) discovered both positive and negative impacts of trade on emissions, contingent on the different country samples. Therefore, there are disagreements regarding the effects of trade openness on carbon emissions.

However, the disadvantage of single indicators is that they only cover a small portion of the environmental quality spectrum and do not offer a comprehensive picture of sustainability from a social, economic or political perspective. According to critics, the balance between the natural and human environments should be prioritized, who contend that these systems are multifaceted and comprise distinct economic, social and environmental components (Cabezas and Fath, 2002; Mayer et al., 2004; Pezzoli, 1997). Single environmental indicators typically only reflect one particular property of the system; hence, they fall short of meeting these requirements (Mayer, 2008).

Composite Indicator Studies

Over the past 20 years, a rising number of composite indices have been created to address the shortcomings of single indicators. The fundamental premise is that when a wider range of variables and indicators are combined into an index, the resulting figure displays at a glance a “simplified, cohesive, multidimensional image of a system” (Mayer, 2008). Composite indices enable the comparison of findings for other objects, which are frequently countries, as well as the aggregation of complicated phenomena into a single number. The information provided by composite indicators is more attractive and easily understandable for general public that allows to identify common trends of performance across various indicators. Composite indices in an aggregate indicator provide meaningful information and can be used for policy recommendations (Kararach et al., 2017).

Composite indices for environmental sustainability, in particular, have a number of benefits. For instance, it tracks and evaluates sustainable development and environmental pressures; facilitates the comparison between countries; grabs the attention of the general public; underlines components that are most responsible for driving the system; predicts the trends; helps in policy-making; provides early warning information to avoid causing harm to the economy, society and environment (Mayer, 2008; Singh et al., 2009; Pillarisetti and van den Bergh, 2010).

There are many indicators and indices available for gauging environmental sustainability, but only a selected number has become well known. The Genuine Progress Indicator (GPI) proposed by Cobb and Daly (1989) strives for the genuine and real progress of society to assess the economy’s ecological sustainability and welfare in particular. It was earlier named as Index of Sustainable Economic Welfare (ISEW). GPI modifies the net national product to account for welfare losses brought on by social and environmental issues. In total, 20 sub-indicators are combined to create the final index, of which 7 indicators show welfare growth and 13 reflect welfare decline.

However, there are shortcomings in this index for valuation and normalization issues in its methodology (Bohringer and Jochem, 2007; Lawn, 2007; Singh et al., 2009; Bonnet et al., 2021). On the other hand, there is ecological footprint (EP), a composite index among numerous ecosystem indices. This index was developed by Wackernagel and Rees in 1996. The EP measures how much natural resources are used by humans and determines whether a country is living within or over its biological limits (Pillarisetti and van den Bergh, 2010). The EP is the only statistic that accounts for the amount of nature we have and the amount of nature we utilize. The footprint helps countries to improve sustainability and well-being, local leaders to optimize public project investments and individuals to understand their impact on the planet (Global Footprint Network). Since its inception, the EP has undergone a number of improvements and is currently regarded as a significant index in environmental research. Several studies utilize the EP to assess the relationship of EP with human capital (Ahmed and Wang, 2019; Chen et al., 2022; Zafar et al., 2019), financial development (Omoke et al., 2020; Yilanci and Pata, 2020), trade openness (Zahra et al., 2022; Yılancı et al., 2022; Dada et al., 2022) and many more.

The Environmental Sustainability Index (ESI), which incorporates socio-economic, environmental and institutional factors, proposes a broader idea of sustainability measurement. The ESI was the first attempt to classify nations based on 76 different environmental sustainability components and 21 indicators. The scope of ESI is very broad; therefore, in order to focus on a more manageable number of environmental issues for which governments may be held responsible, the Yale–Columbia research team created the Environment Performance Index (EPI) in 2006.

The EPI tracks outcome-oriented indicators based on the best data currently available in fundamental policy categories. The EPI was published in 2006, 2008, 2010, 2012 and 2020 with some revisions. Since 2012, a Pilot Trend EPI has been used in addition to the EPI to track long-term performance changes. It makes it possible to compare different nations and evaluate the entire world's performance with set environmental policy objectives. The latest revised EPI for 2020, 32 performance indicators are included, covering 11 issue areas. It rates nations based on two categories, environmental health and ecosystem vitality, highlighting the effects of environmental pollution on both human health and the ecosystem. Environmental health indicates the quality of air, water and exposure to heavy metals. The ecosystem vitality includes issues like climate change and biodiversity. EPI is a more appropriate and comprehensive indicator to evaluate environmental performance and provides specific recommendations for countries looking to move toward a sustainable future (Schmiedeknecht, 2013; Babcicky, 2013; Raza et al., 2021).

However, it is also not free from limitations. The EPI does not include critical indicators such as water quality, erosion and waste management. This can make it harder for the index to measure and evaluate environmental quality. The quality of data is questioned in the construction of EPI. Moreover, the methodology adopted in EPI is also questioned, such as using equal weights, low inter-correlation amongst variables, ignoring outliers and ambiguity in the index (Jha and Murthy, 2003; Fischer et al., 2022). Additionally, the EPI is earlier called the ESI, leading to debate and confusion. The EPI focuses on evaluating significant environmental policy results using trend analysis and performance targets. In contrast, the ESI records indicators that impact environmental sustainability at the national level (Schmiedeknecht, 2013).

2.6 Summary and Research Gaps

The present chapter provides an overview of the theoretical and empirical literature review related to the study's main issues, namely, trade and its determinants, trade and overall sustainable development, trade and economic and social sustainability, and trade and environmental sustainability. There has been much discussion about the role that international trade plays in sustainable development and economic growth both in developed and emerging economies. Moreover, it is evident from recent events that economic integration is becoming more widespread worldwide. It is nearly hard to survive in the global economy without economic integration (Tahir et al., 2018; Suleman et al., 2023).

The literature on the impact of trade on economic growth is vast (Keho, 2017; Tahir et al., 2018). According to Barro and Sala-i-Martin (1997), openness promotes efficient resource allocation, simple access to goods and services, and the achievement of total factor productivity, all of which have a positive effect on economic growth. Some argue that trade openness promotes the diffusion of technology and knowledge, which in turn accelerates economic growth (Musila and Yiheyis, 2015; Ulaşan, 2015; Polat et al., 2015; Kouwoaye, 2021; Ali et al., 2022; Jain and Mohapatra, 2023b). Keeping in mind the impact of trade on the growth of an economy, as nations become more interconnected in the global market, the factors affecting international trade have become an area of research. Trade is a complex phenomenon shaped by a wide range of motivating and discouraging factors that collectively mold a nation's stance on international trade. Furthermore, to encourage economic growth and development through trade, it is crucial to comprehend the factors that drive trade openness in emerging economies (Suleman et al., 2023).

Numerous studies have explored the linkages between trade and various aspects such as economic growth (Raghutla, 2020; Amna Intisar et al., 2020; Kumari et al., 2023), financial development (FD) (Wajda-Lichy et al., 2020; Ho and Iyke, 2021), foreign direct investment (FDI) (Liargovas and Skandalis, 2012; Lindelwa Makoni, 2018; Banday et al. 2021), trade protection (Grossman and Helpman, 1993; Goldberg et al., 2010), trade cost

(Linarello, 2018). However, the existing studies have paid less attention to the latest macroeconomic determinants affecting emerging economies' trade, for instance, institutional quality (IQ). On the other hand, the existing studies do not identify the factors that impede trade. Some of the more recent ones, though, examined the relationship between various risks and uncertainties, exchange rate, and trade openness separately, but these variables are not identified as negative determinants or barriers to trade for an economy (see, for example, Groshenny et al., 2021; Carrière-Swallow and Céspedes, 2013; Gupta et al., 2019; ÖZÇELİK, 2023).

Trade policies and sustainable development is a developing area of research. There are limited studies in the existing literature that focus on overall sustainable development utilizing sustainable development index (SDI). The thesis suggests that trade may have a big impact on SDI components, making them crucial policy issues. More precisely, this research aims to investigate whether, how, and to what degree trade openness affects the sustainable development goals in emerging economies. SDI includes all the pillars of sustainable development. It also addresses the various sustainable development goals (SDGs) such as SDG:3 (good health and well-being), SDG:4 (quality education), SDG:7 (affordable and clean energy), SDG:8 (decent work and economic growth), SDG:11 (sustainable cities and communities), and SDG:13 (climate action).

Sustainable development index may not provide the comprehensive picture of sustainability in all of its dimensions and indicators. Therefore, the study further focuses on each sustainability separately. It can be seen from the previous literature that there are limited studies that have explored the direct and indirect link between trade and the GIP (growth, inequality, and poverty) triangle together for emerging economies. As a result, this study breaks from the usual approach, examining direct and indirect relationships between trade, growth, income inequality, and poverty reduction. The present study mainly addresses SDG:1 (no poverty), SDG:8 (decent work and economic growth), and SDG:10 (reduced inequalities) by incorporating the role of trade in them.

In the context of trade and income inequality, the studies provide a gloomy outlook (see, for example, Siddique 2021; Dorn and Levell 2021; Andersson and Palacio Chaverra 2016; Andersson and Palacio 2017; and Topuz and Dagdemir 2020). To the best of our knowledge, there are limited studies on the non-linear relationship between trade and income inequality. Moreover, none of the studies have been done for emerging countries under the Kuznets Curve framework. The study also estimates the threshold value for the nonlinear curve.

Environmental sustainability is a much broader concept. A study by ADB (Jha et al., 2018) constructed the Inclusive Green Growth Index (IGGI), which includes a much broader dimension using three pillars of economic growth, social equity, and environmental sustainability. The findings of the study show that 9 out of a sample of 24 Asian countries in 2015 focused more on economic growth, whereas environmental sustainability remains the most neglected pillar in 22 countries. Environmental sustainability is the main area for improvement in countries. It is observed from the review of the literature that these studies widely employed CO_2 emissions; some used ecological footprints as an indicator of the environmental sustainability. It is challenging to find a significant number of studies that consider a composite index of environmental sustainability. Though there are studies discussing the influence of trade on the environment, they seldom elaborate on the effects of the components of trade (composition and direction) on the same. Therefore, the study constructs a composite index to measure environmental sustainability and analyzes the impact of trade and its components on the index.

Further, the next chapter provides the detailed explanation of the econometric methodologies employed in the thesis to empirically examine the various issues pertaining to the study.

Chapter 3. Econometric Methodology

3.1 Introduction

In the previous chapter, we discussed many empirical studies that use various econometric methodologies in their analysis. This chapter discusses the specific econometric methods used for empirical investigation in this study. Since the study is considering a group of emerging economies, the study considers the panel data approach. The first section deals with the various panel approaches to assess stationarity, co-integration, value of coefficients, and causal relationship. This includes both first-generation (without cross-section dependence (CSD)) and second-generation (with CSD) techniques. The second section describes the Principal Component Analysis (PCA) used to construct the composite environmental sustainability index.

3.2 Panel Data Models

This section describes the panel data methodologies employed in the thesis. The section is further divided into two sections. The first section illustrates the preliminary tests needed to decide the final estimation methodology. Afterward, the second section discusses the estimation methodologies used in the analysis.

3.2.1 Preliminary Tests

3.2.1.1 Slope Homogeneity Test

The slope homogeneity test is an essential statistic that needs to be mentioned in the case of panel data to check the panel heterogeneity. The study employs two delta test statistics ($\tilde{\Delta},\ and\ \widetilde{\Delta_{adj}}$) by Pesaran and Yamagata (2008), which is an improved version of Swamy's slope homogeneity test (1970).

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \sim X_k^2 \qquad (3.1)$$

$$\widetilde{\Delta_{adj}} = \sqrt{N}\left(\frac{N^{-1}\bar{S} - k}{v(T,k)}\right) \sim N(0,1) \qquad (3.2)$$

Where N is the number of cross-sectional units, S represents the test statistics by Swamy, and k indicates the explanatory variables. The null hypothesis of the test is the existence of slope homogeneity among coefficients. The assumption of no autocorrelation is a prerequisite since $\widetilde{\Delta_{adj}}$ depicts the mean adjusted version of the standard delta $\tilde{\Delta}$.

3.2.1.2 Cross-section Dependence (CSD) Tests

Recently, CSD has drawn a lot of attention. The existence of CSD in the modern economy is undeniable due to increased trade, financial, and economic integration. It cannot be overlooked considering the shared worldwide shocks such as the financial crises, oil crises and geo-political risks, common global organisations, and spillover effects between nations. Since our study is based on panel data, it is crucial to check for the CSD in the data. The study aims to examine the relationship among the variables in the panel framework in which the issue of heterogeneity and CSD may arise. It can appear in response to uncertain shocks and unobserved common factors in countries. The presence of CSD may cause spurious results. To deal with this issue, we first conducted the tests for CSD for variables as well as for the model using the three CSD tests developed by Breusch and Pagan (1980), Pesaran et al. (2004), and Baltagi et al. (2012) (three separate Lagrange Multiplier-based tests) and also the Dickey-Fuller test developed by Pesaran et al. (2004). These tests are helpful in presenting solid evidence of the existence of a common correlation among the variables and in the model. The null hypothesis (H0) of the CSD test is presented as follows:

$$H_0 : \eta_{ij} = corr\left(\varepsilon_{it}; \varepsilon_{jt}\right) = 0 \forall i \neq j \qquad (3.3)$$

The mathematical expression of the CSD test (Pesaran, 2004) is as follows:

$$\text{CD}_P = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}\right) \rightarrow N(0,1)\ i,j \tag{3.4}$$

$$R = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}\right)\frac{(T-k)\,\hat{p}_{ij}^2 - E\,(T-k)\,\hat{p}_{ij}^2}{\text{Var}\,(T-k)\hat{p}_{ij}^2} \tag{3.5}$$

where i is the specific cross-section, t depicts the time dimensions and the term $\hat{p}_{ij}$ signifies the projected multivariate correlation of the error term across all cross-sections i and j.

3.2.1.3 Panel Unit Root Tests

It is typically discovered that most financial and economic time series are non-stationary. Therefore, regressing one series against the other may produce erroneous statistical findings. Additionally, performing panel cointegration and causality tests is contingent upon verifying the stationarity of the variables. Therefore, verifying the stationary properties of a series is the first stage in the analysis. There are many panel unit root tests widely available in the literature. The first-generation unit root tests used in the study include Im-Pesaran-Shin (IPS) test (Im et al., 2003), Fisher-type test (Choi, 2001), Levin Lin Chu (LLC) test (Levin et al., 2002), Maddala & Wu Fisher Augmented Dickey-Fuller (ADF) test, Maddala & Wu Fisher Phillips and Perron (PP) test (Maddala & Wu, 1999) to test the stationary properties of the series.

ADF, PP, and IPS are heterogeneous, whereas LLC is a homogeneous panel unit root test. The LLC test, which is based on the conventional ADF test, accounts for individual effects, time effects, and time trends in the panel while assuming a common AR coefficient across all units in the panel. However, it only looks at the heterogeneity of the intercept across panel members. The null hypothesis of these tests is that each panel includes a unit root. The presumption that all panels have the same value of rho is one of the main limitations of the Levin-Lin-Chu, Harris-Tzavalis, and Breitung tests. The IPS test is less restrictive than the LLC test since it permits the inclusion of heterogeneous coefficients and loosens the homogeneity postulation. The IPS test relaxes the requirement for a single rho and permits each panel to have a unique rho_i. The IPS test does not require firmly balanced data, but each time series cannot have any gaps. In addition, individual effects, time trends, and time effects within the panel are taken into account by the IPS test. The Fisher-type test uses a meta-analysis perspective to test for panel-data unit roots. In other words, these tests conduct unit-root tests on each panel independently before combining the p-values to generate a comprehensive overall test. Additionally, two non-parametric tests—the ADF and PP tests—were proposed by Maddala and Wu (1999) based on the Fisher test, combining the p-values from each unit root test.

First-generation unit root tests, however, cannot be used in the presence of slope heterogeneity and CSD because they have insufficient size properties and produce an excessive rejection of the null hypothesis, both of which lead to misleading results. As a result, second-generation unit root tests, which assume CSD across cross-sections in heterogeneous panels, are used. Pesaran (2007) suggested cross-sectional augmented Dickey-Fuller (CADF) and cross-sectional augmented Im-Pesaran-Shin (CIPS), which can be depicted as:

$$x_i = \alpha_{it} + \beta_i x_{it-1} + \rho_i t + \sum_{j=1}^{n} \theta_{ij} \Delta x_{i,t-j} + \varepsilon_{it} \quad (3.6)$$

where, α_{it} refers to the intercept, *t* denotes the time, Δ is the difference operator, x_{it} represents the variables under study and ε_{it} is the error term. The null hypothesis states that the investigated series are not stationary.

3.2.1.4 Co-integration Tests

After confirming the stationarity of variables, the next step is to employ the suitable co-integration test as the subsequent step. Cointegration is an analytical concept that investigates the long-term relationship between the non-stationary variables. The series can be considered cointegrated with each other if the difference between any two non-stationary series turns out to be stationary. Furthermore, the long-run equilibrium relationship between the two series can be reached if they are cointegrated. On the other hand, if the series are not cointegrated, then there is no relationship between variables, and they might diverge from one another. Both the mean and the variance of a stationary process are time-invariant. A nonstationary process, on the other hand, can have a time-varying variance, a time-varying mean, or both. Since a nonstationary process's first two moments change over time, it can stray arbitrarily. A nonstationary process is considered integrated of order one, or I(1), when its first difference is stationary. Cointegrated series are those in which a linear combination of multiple I(1) series is stationary (Engle and Granger 1987). We test for cointegration because it suggests that the I(1) series are in a long-run equilibrium; that is, they move together even though their group may wander arbitrarily. There are various approaches to cointegration available in the literature, such as Kao (1999), Pedroni (1999, 2004), Maddala and Wu (1999), and Westerlund (2007). The present study employs first- and second-generation cointegration approaches such as Pedroni, Kao, and Westerlund.

Pedroni (2004) presents two sets of statistics, one based on panel statistics within dimensions and the other on statistics between dimensions. The variable regression procedure with CSD constraints is included in the cointegrating equation while taking the intercept heterogeneity into consideration. Total test statistics obtained are "panel v, panel rho, panel pp, panel ADF, group rho, group pp, and group ADF statistics," which are all based on the group and panel cointegrated statistic, which specifies the asymptotic normal distribution. The null hypothesis of "No Cointegrating" is rejected in order to prove the existence of a long-term relationship. Furthermore, the Pedroni test results were validated in the study using the Kao-residual-based test. The Kao test includes the cross-homogenous coefficients on the first-level regressors.

However, in order to deal with the issues of heterogeneity and CSD, the study also utilizes the Westerlund (2007) technique, which provides more accurate and dependable information about long-term cointegration relationships between the variables. A structure dynamic-based error correction panel cointegration test was created by Westerlund (2007) to address the heterogeneity and CSD issues in panel data analysis. The Westerlund test is based on the two panel-specific autoregressive (AR) parameters. The test focuses on panel (Pτ and Pa) and two types of groups (Gτ and Ga) statistics. In contrast to the alternative hypothesis, which holds that there is a long-term relationship between the variables, the null hypothesis of the Westerlund cointegration test is that there is no long-term cointegration among the variables. The Westerlund test's error correction mechanism is as follows:

$$\Delta Y_{it} = \delta'_i d_t + \alpha_i (Y_{it-1} - \beta'_i x_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{it-j} + \sum_{j=-p_i}^{p_i} \gamma_{ij} \Delta x_{i,t-j} + \mu_{it} \qquad (3.7)$$

3.2.2 Model Estimation

3.2.2.1 Panel Regression Model

The fundamental static methods recommended in econometrics for estimating the coefficients of a panel model are pooled ordinary least squares (POLS), random effects (RE), and fixed effects (FE). When there is no unobserved country-constant effect that could have an impact on the dependent variable, the POLS is presumed to be suitable.

This is because it would result in a reliable and accurate estimate. But if the presumption that the unobserved country-constant effect is linked with the error component and is, therefore, time-invariant remains true, FE is more suitable. On the other hand, if the assumption that the unobserved country-constant effects are not fixed invalidly and the unobserved effects are purely random as well as identically and independently distributed, the RE would be the proper estimator to be utilized. The chi-square test statistic is used to compare FE with RE, as suggested by Hausman (1978), to determine which produces more effective and reliable estimates.

3.2.2.2 Panel Autoregressive Distributed Lag (ARDL) Approach

The PMG (Pooled Mean Group) estimator developed by Pesaran, Shin, and Smith (1999; 2001) is employed., which involves pooling and averaging the coefficients across the cross-sectional units. As opposed to this, the MG (Mean Group) estimator entails evaluating each unit separately and averaging the calculated coefficient across the cross-sectional units (Pesaran and Shin 1995). A Dynamic Fixed Effect (DFE) is the third estimator. The PMG estimator and the DFE estimator are similar and comparable. The vector co-integration coefficient is constrained to be constant across all long-run panels. Other than that, it restricts the rate of adjustment, keeping the short-run coefficient constant and allowing the particular panel coefficient (Olayungbo and Quadri 2019; Shaari, Abdul Karim, and Zainol Abidin 2020). The ARDL model has gained popularity since it can be utilized regardless of the order of integration of a series, and it can yield both long-term and short-term estimates at the same time. The PMG estimator keeps long-term parameters constant across country groups while allowing short-term estimates, error variance, and intercepts to fluctuate. Therefore, short-run estimates vary for each country and can be reported individually or as a group average, while the long-run coefficients remain the same for all countries in the panel. Furthermore, it is more appropriate when dealing with dynamic panels with large N and large T. The generalized ARDL model is as follows:

$$y_{it} = \sum_{j=1}^{p} \delta_i \, y_{i,t-j} + \sum_{j=0}^{q} \beta'_{ij} \, x_{i,t-j} + \varphi_i + e_{it} \tag{3.8}$$

Re-parameterised ARDL (error correction model)

$$\Delta y_{it} = \theta_i [y_{i,t-1} - \lambda'_i x_{i,t}] + \sum_{j=1}^{p-1} \xi_{ij} \, \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \beta'_{ij} \, \Delta x_{i,t-j} + \varphi_i + e_{it} \tag{3.9}$$

Where x_{it} is a K X 1 vector that allows I(0) or I(1), φ_i is the unit-specific fixed effect, p and q are optimal lag orders for dependent and independent variables, respectively, λ'_i depicts vector of long-run relationships, ξ_{ij} and β'_{ij} are short-run dynamic coefficients, θ_i equals $-(1 - \delta_i)$ that is the group-specific speed of adjustment. Error correction term equals $[y_{i,t-1} - \lambda'_i x_{i,t}]$. Additionally, the Hausman test is applied since choosing the best estimator between PMG or MG and PMG or DFE is essential. Between PMG and MG, if the p-value is above 0.05, PMG is preferred over MG. Between PMG and DFE, if the null hypothesis is accepted, then PMG is better than DFE as it is more efficient. The other panel models, such as fully modified ordinary least squares (FMOLS), fixed-effect, and random-effect, do not simultaneously provide short-run and long-run relationship coefficients. Moreover, coefficients can be biased in the presence of endogeneity among regressors. Considering all these drawbacks, the panel autoregressive distributed lag (PARDL) technique appears to be a very successful and appropriate method for addressing them. By efficiently accommodating endogeneity among the variables, overcoming serial correlation, and using the optimal selection of lags, the ARDL delivers robust results. PMG-ARDL is also superior to the Three Stage Least Square (3SLS) and Generalised Method of Moments (GMM) because it allows for pooling and averaging.

However, traditional approaches, like random effect, fixed effect, FMOLS, and DOLS, assume homogeneity and only permit alteration of the cross-sectional intercepts, even though the panel members are actually heterogeneous. Because of this, the current study also uses econometric techniques that are resistant to CSD, such as DCCE, CS-ARDL, and the DK standard errors approach.

3.2.2.3 Dynamic Common Correlated Effects (DCCE) Estimation

The methods suggested by Pesaran (2006) and Chudik and Pesaran (2015) to address the issue of common correlation include the CCE and DCCE. The common correlated effect (CCE) is a mean group estimator that accounts for slope heterogeneity because it calculates the mean of the coefficients from each cross-section. Additionally, it allows for country-specific fixed effects and country-specific deterministic trends. The CCE estimators are unbiased in terms of CSD because they contain the unobserved common components and a multi-factor error structure. A panel model using the CCE estimator can be specified as follows:

$$Y_{it} = \delta_0 + \delta_1 X_{it} + e_{it} \tag{3.10}$$

Where Y_{it} is the dependent variable, X_{it} is the vector of independent variables and e_{it} is the residual term which is a multifactor residual term. This term is calculated as follows:

$$e_{it} = \lambda_i' UF_t + u_{it} \tag{3.11}$$

Where UF_t is the mX1 vector of unobserved common factors. Moreover, the CCE estimator counters for CSD of residuals in panel data. However, the application of the CCE estimator is limited when weak exogenous independent variables or lags of the dependent variable are included in the model. Additionally, CCE estimates are only valid for static panels, not dynamic ones. Therefore, Chudik and Pesaran (2015) argued and developed the DCCE panel regression approach based on the panel ARDL approach. This can be expressed as:

$$y_{it} = c_{iy} + \emptyset_i y_{i,t-1} + \beta_{0i} x_{it} + \beta_{1i} x_{i,t-1} + \sum_{\updownarrow=0}^{pT} \delta'_{i\updownarrow} \bar{z}_{t-\updownarrow} + e_{yit} \quad (3.12)$$

Where i = 1, 2, …., N and t = 1, 2,…, T, c_{iy} indicates fixed effect for i-th cross-section, x_{it} signifies k_x X 1 covariate vector for cross-section i at time t, e_{yit}indicates a serially correlated vector. Thus, the DCCE approach overcomes the limitation of the CCE method because it considers the i-th cross-section at time t while considering unobserved common factors. The study estimates DCCE along with the CCE method to attain long-run coefficients that are more consistent, efficient, and robust. One of the key advantages of this technique is its robustness in the presence of structural breakdowns. Furthermore, by applying the jack-knife correction strategy, this approach is equally relevant in cases of small sample size. Also, the DCCE model works well when the panel data is unbalanced.

3.2.2.4 Driscoll and Kraay Standard Errors Approach

The Driscoll-Kraay standard errors approach is proposed by Driscoll and Kraay (1998). These standard errors are robust to every general form of cross-sections and temporal dependence when the time dimension becomes large because they are flexible and not based on assumptions. Driscoll-Kraay standard errors are a nonparametric test, not restricted to a particular number of panels. Therefore, even if the number of panels N, is substantially greater than T, the size of the cross-sectional dimension in finite samples does not pose a constraint on feasibility. The approach offers more efficient long-run estimates because it can counter the dataset's CSD, serial correlation, and heteroscedasticity. Additionally, the method is appropriate for both balanced and unbalanced panels and can also handle missing values (Park et al. 2018; Verma et al.

2022). Therefore, the relationship between the variables was examined using the DK standard error technique. First, the average values and residuals are analyzed. Thereafter, the estimates of weighted heteroscedasticity and consistent autocorrelation (HAC) were computed, and standard errors were generated against the CSD problem (Heberle & Sattarhoff, 2017). The linear model of DK standard errors is so represented as follows:

$$y_{i,t} = x'_{i,t}\beta + \varepsilon_{i,t} \tag{3.13}$$

where i and t depict the cross-sectional and the time-series units, respectively.

3.2.2.5 Cross-sectional Autoregressive Distributed Lag Model (CS-ARDL)

CS-ARDL methodology, proposed by Chudik and Pesaran (2015), has also lately become more popular than conventional estimate techniques (i.e., OLS, FMOLS, DOLS). It outperforms alternative cointegration approaches as it accounts for endogeneity, serial correlation, and heterogeneity issues in the model. Furthermore, it considers CSD and the order of variable integration. One of the most notable benefits of employing CS-ARDL is that it produces consistent findings despite the small sample size. According to Chudik and Pesaran (2015), the CSD effects, also known as CCE, may be mitigated using a cross-section average,

$$lnU_{it} = \sum_{i=0}^{p} \alpha_{it} U_{it-1} + \sum_{i=0}^{p} \delta_{it} V_{it-1} + \sum_{i=0}^{p} \Upsilon_{it} \overline{W}_{it-1} + \varepsilon_{it} \tag{3.14}$$

where,

$$\overline{W}_{t-1} = (\overline{U}_{it-1}, \overline{V}_{it-1}) \tag{3.15}$$

U_{it} is used for the dependent variable, whereas V_{it-1} indicates all independent variables. The average of both dependent and independent variables is indicated as $\overline{W}_{t-1}$to ease the cross-section dependency problem (t-1). While p represents the lag of each variable.

3.2.3 Causality Test

The final stage in the empirical analysis is to determine if any causal relationship exists among the variables under study. The short-run and the long-run causality association among the variables are examined using the Granger causality method proposed by Engle and Granger (1987). This method states that when the two series are integrated of order one and cointegrated with one another, at least one causal relationship exists in any direction. Additionally, the study performs the Dumitrescu and Hurlin (DH) panel test for Granger non-causality, proposed by Dumitrescu and Hurlin (2012) and is appropriate for the heterogeneous and commonly correlated panel. The test allows for slope heterogeneity as the coefficients can take different cross-section values. The test addresses the concern of CSD in the dataset and is subjected to individual Wald statistics of average non-causal relationships across all individual units (Usman et al., 2020). All coefficients are assumed to vary among cross-sections in this test. The DH test estimates the three statistics i.e. W-bar, Z-bar, and Z-bar tilde. The following is the baseline regression equation given by Dumitrescu and Hurlin (2012):

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_{ik} y_{it-k} + \sum_{k=1}^{K} \gamma_{ik} x_{it-k} + \varepsilon_{it} \quad (3.16)$$

where the lag order of K is assumed to be the equivalent for all panel members, and the panel must be balanced. The null and alternative hypotheses for the test can be defined as:

$H_0: \beta_i = \vartheta_i = 0$

$$H_1: \beta_i \neq \vartheta_i \neq 0 \qquad V_i = N_1 + 1, N_2 + 2, \dots, N \quad (3.17)$$

The null hypothesis depicts that no causal relationship exists between the variables. The causality test is indispensable in drawing policy inferences for an economy (Zaman et al. 2020).

3.3 Principal Component Analysis (PCA)

The study employed PCA to construct the index. The principal component analysis is a frequently used multivariate data analysis approach in large datasets. PCA reduces the dimensions of the multivariate dataset. While reducing its dimensions, it retains its original, informative value as much as possible. In this manner, complex datasets can be easily understood and analyzed. The principal components are the resulting orthogonal variables created by decomposing correlated data into uncorrelated or orthogonal variables. The PCA approach is described as an orthogonal linear transformation that imports data to a new coordinate system such that the first and second largest variances are on the first and second coordinate axes, respectively. The same process is followed for the remaining variances. The direction of the greatest variation in the data is identified by the first principal component, which is a linear combination of the significant predictions with the largest level of variance in the dataset. The principal components (PCs) are arranged so that the first component explains the most variation in the original variables. While all the PCs collectively account for the greatest variation in the original data, the following components (the second, third, etc.) are entirely uncorrelated with the first component (Bro and Smilde, 2014; Cozzolino et al., 2019; Tripathi and Singal, 2019; Lamichhane et al., 2021; Fakher et al., 2021). The index is constructed based on the formula mentioned below:

$$\delta = \sum_{i=1}^{t} h_i \frac{X_{it}}{sd(x_i)} \qquad (3.18)$$

Where δ indicates the index formed using PCA, X presents the i_{th} items in t_{th} year, and h_i is the factor loadings procured from the analysis. Hence, PCA is a reliable methodology for constructing indices. The Kaiser-Meyer-Olkin (KMO) test is used to assess the robustness and adequacy of the data sampling. The results of the test range from 0 to 1, and statistical values closer to 1 represent better sampling. By removing the variables that do not fit the criteria, the test helps to produce a trustworthy index.

In the subsequent chapters, we will discuss the empirical analysis of the objectives of the thesis one by one using the methodologies discussed in the present chapter.

Chapter 4. Determinants of Trade

4.1 Introduction

The present chapter focuses on empirically identifying the determinants of trade for emerging economies from 1996 to 2020. As mentioned in the chapter 1 and 2, it is evident from recent events that economic integration is becoming more widespread worldwide. It is nearly hard to survive in the global economy without economic integration. One way of economic integration is to open the economy to international trade. Therefore, it is necessary to understand the dynamics of international trade to appreciate the intricate interplay of political, socio-cultural, and economic forces that facilitate or hinder a nation's participation in international trade.

Determinants of trade are a well-established area of research within the field of international economics. To date, several models have been created to explain factors such as international trade, reasons for trade, reasons for specialization, and effects of trade. Factors such as population size, income, and distance are essential trade determinants. Trade agreements and foreign direct investment (FDI) are two significant variables that affect trade openness (TO). In the present study, international trade is indicated by the trade openness. Trade openness refers to the degree to which a country participates in the international economy by exchanging goods and services (Bakhodirovna et al., 2022).

Most studies believe that the relationship between trade openness and economic growth is positive (Musila and Yiheyis, 2015; Ulasan, 2015; Polat et al., 2015; Keho, 2017; Tahir et al., 2018; Kouwoaye, 2021; Ali et al., 2022; Jain and Mohapatra, 2023b). Keeping in mind the impact of trade openness on the growth of an economy, as nations become more interconnected in the global market, the factors affecting trade openness have become an area of research and discussion. It is a complex phenomenon shaped by a wide range of motivating and discouraging factors that collectively mold a nation's stance on international trade. Furthermore, to encourage economic growth and development through trade openness, it is crucial to comprehend the factors that drive trade openness in emerging economies (Suleman et al., 2023).

However, the existing studies have paid less attention to the other latest macroeconomic determinants that affect the trade openness of emerging economies, such as institutional quality (IQ). On the other hand, this study adds significantly to the body of knowledge by identifying the factors that impede the openness of trade. The existing studies examined the relationship between various risks and uncertainties, exchange rates, and trade openness separately with each other. Further, these variables are not identified as negative determinants of trade openness for an economy. The third contribution to the literature made by this study is the construction of an institutional quality index (IQI) for emerging economies using principal component analysis (PCA) over 25 years and the determination of the causal relationship between the variables. The emerging economies are trending toward greater economic liberalization, and because of its large labor pool and wealth of natural resources, the region has enormous potential. Given these circumstances, the current empirical exercise appears to be very beneficial, and the region's policymakers should anticipate significant benefits from the outcome of the study. Thus, the chapter is categorized into two sections. The first section provides an analysis of identifying the stimulating as well as deterrent factors of trade openness. The second section summarizes the findings of the chapter.

4.2 Econometric Analysis of the Determinants of Trade

The section is further divided into two sub-sections. The first section deals with the data, its sources, the expected signs and model specifications. The second section discusses the empirical results of the study.

4.2.1 Data and Model Specifications

The present section explains the chosen variables and their presumptive expectations. This study identifies the stimulating and deterrent factors of trade openness for emerging economies (excluding Iran and UAE) from 1996 to 2020. The selection of the data is based on the availability of data for the variables incorporated in the study. A brief discussion of the variables is described in Table 4.1. The dependent variable used in the study is trade as a percentage of GDP (l_trade) to represent trade openness. For independent variables, economic growth depicted by GDP per capita (l_gdp), geo-political risk (l_gpr), world uncertainty index (l_wui), real effective exchange rate (l_reer), financial development (l_fd), foreign direct investment (l_fdi). Additionally, the institutional quality index (l_IQ) is constructed to represent the quality of the institutions using PCA since good quality institutions promote trade openness. All the variables are used in their natural logarithmic form.

Table 4.1 Data Description of the Variables

Variables	Expected Signs	Source
Trade Openness (l_trade)	Dependent variable	WDI, World Bank
Geo-political Risk (l_gpr)	Negative	Caldara & Iacoviello (2022)
World Uncertainty Index (l_wui)	Negative	Ahir et al. (2022)
Real Effective Exchange Rate (l_reer)	Negative	Bruegel
Financial Development (l_fd)	Positive/Negative	WDI, World Bank
Institutional Quality Index (l_IQ)	Positive	WDI, World Bank
Foreign Direct Investment (l_fdi)	Positive/Negative	WDI, World Bank
Economic growth (l_gdp)	Positive/Negative	WDI, World Bank

Source: Authors' Compilation

Based on the model specifications given below, the study examines the stimulating and deterrent factors of trade openness in emerging economies for 1996-2020. Model (4.1.1) incorporates the positive aspects that promote the openness of trade based on our hypotheses.

$$l\_trade_{it} = \alpha_{it} + \beta_1 l\_gdp_{it} + \beta_2 l\_fd_{it} + \beta_3 l\_fdi_{it} + \beta_4 l\_IQ_{it} + \varepsilon_{it} \quad (4.1.1)$$

Model (4.1.2) includes the factors that act as barriers to trade openness based on their a priori expectation.

$$l\_trade_{it} = \alpha_{it} + \beta_1 l\_gpr_{it} + \beta_2 l\_wui_{it} + \beta_3 l\_reer_{it} + \varepsilon_{it} \quad (4.1.2)$$

And finally, Model (4.1.3) embodies all the negative and positive factors to identify the overall determinants of trade openness.

$$l\_trade_{it} = \alpha_{it} + \beta_1 l\_gdp_{it} + \beta_2 l\_fd_{it} + \beta_3 l\_fdi_{it} + \beta_4 l\_IQ_{it} + \beta_5 l\_gpr_{it} + \beta_6 l\_wui_{it} + \beta_7 l\_reer_{it} + \varepsilon_{it} \quad (4.1.3)$$

4.2.2 Empirical Results

This section illustrates the results of the empirical analysis. Firstly, the observations from the preliminary analysis are discussed. Secondly, major findings from the estimation of the long-run parameters are described.

Table 4.2 Descriptive Statistics of the Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
l_trade	4.062	0.525	2.749	5.395
l_gpr	-2.664	1.141	-5.177	0.131
l_wui	0.870	0.847	-1.386	2.904
l_reer	4.591	0.204	3.931	5.459
l_fd	3.818	0.768	-3.112	5.208
l_IQ	-0.065	0.503	-1.773	0.890
l_fdi	1.224	0.738	-4.902	4.700
l_gdp	8.502	0.892	5.991	10.136

Source: Authors' Compilation

Since the number of independent variables under study is large, multi-collinearity is checked among the variables beforehand. The value of VIF is found to be 1.49, indicating that multi-collinearity is not present among the variables. Further, table 4.2. describes the significant statistics of the variables. Table 4.3 represents the pairwise correlation between the variables based on which a priori expectations are made. Financial development, GDP, institutional quality, and FDI are positively correlated with trade openness, whereas GPR, WUI, and REER are negatively correlated.

Table 4.3 Pairwise Correlation

	l_trade	**l_gpr**	**l_wui**	**l_reer**	**l_fd**	**l_IQ**	**l_fdi**	**l_gdp**
l_trade	1.000							
l_gpr	-0.224***	1.000						
l_wui	-0.165***	0.019	1.000					
l_reer	-0.144***	0.012	-0.215***	1.000				
l_fd	0.343***	-0.051	-0.131***	0.225***	1.000			
l_IQ	0.401***	-0.501***	-0.170***	0.039	0.373***	1.000		
l_fdi	0.198***	-0.305***	-0.057	-0.022	0.114**	0.325***	1.000	
l_gdp	0.204***	-0.188***	0.105**	0.083*	0.096**	0.405***	0.191***	1.000

Source: Authors' Compilation;
*Note: *, **, and *** show significance levels at 10, 5, and 1 %, respectively.*

Tables 4.4 and 4.5 test for the slope homogeneity and CSD among the variables, respectively.

Table 4.4 Slope Homogeneity Test Results

Models	**Delta**	**$\text{Delta}_{adj.}$**
Trade = f(FD, GDP, IQ, FDI)	14.933***	17.204***
Trade = f(GPR, WUI, REER)	16.164***	18.651***
Trade = f(FD, GDP, IQ, FDI, GPR, WUI, REER)	11.213***	14.807***

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 4.4 indicates the presence of slope heterogeneity in all three models since the slope coefficients reject the null hypothesis. Further, the observations of Table 4.5 depict that the variables are cross-sectionally dependent.

Table 4.5 Cross-section Dependence Test Results

Variables	CD-test
l_trade	10.66***
l_gpr	13.79***
l_wui	3.46***
l_reer	6.86***
l_fd	18.33***
l_IQ	-2.45***
l_fdi	5.07***
l_gdp	54.14***

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 4.6 Unit Root Test Results

Variables	Pesaran ADF	IPS test
l_trade	-1.626	-0.352
Δl_trade	-4.052***	-9.800***
l_gpr	-2.585***	-4.953***
Δl_gpr	-	-
l_wui	-6.842***	-6.396***
Δl_wui	-	-
l_reer	-1.957	-0.713
Δl_reer	-4.311***	-9.584***
l_fd	-1.329*	2.369
Δl_fd	-	-7.476***
l_IQ	-0.891	2.686
Δ l_IQ	-4.149***	-9.682***
l_fdi	-5.427***	-4.855***
Δl_fdi	-	-
l_gdp	-2.526***	2.289
Δl_gdp	-	-7.666***

*Source: Authors' Computation; Note: *and *** present a significance level at 10 and 1 percent, respectively.*

After observing the presence of slope heterogeneity and CSD among the variables, the study utilizes the panel unit root tests. The results of the test are shown in table 4.6. The findings of Pesaran's CADF (cross-section Augmented Dickey-Fuller) test represent that l_trade, l_reer, and l_IQ are stationary at first difference while other variables are stationary at level. In addition, for the robustness, the IPS (Im-Pesaran-Shin) test is also used. The findings of the IPS test imply that other than l_trade, l_reer, and l_IQ, l_fd, and l_gdp are also stationary at the first difference, whereas l_gpr, l_wui, and l_fdi are stationary at level.

The results in Table 4.7 present the findings of the panel co-integration test. The first-generation panel co-integration test, such as the Kao test, shows the rejection of the null hypothesis of no co-integration for all the models. As a consequence, the long-run relationship is present in the models. Furthermore, the second-generation co-integration test, namely the Westerlund test, also rejects the null hypothesis and confirms that the variables are co-integrated in the long run in all the models. The results of both tests validate the finding, and thus, the results are robust.

Table 4.7 Co-integration Test Results

Kao statistics	**Model (4.1.1)**	**Model (4.1.2)**	**Model (4.1.3)**
Modified Dickey-Fuller t	-1.899**	1.491*	-0.443
Dickey-Fuller t	-2.125**	1.344*	-0.602
Augmented Dickey-Fuller t	-2.267**	13.034***	10.922***
Unadjusted Modified Dickey-Fuller t	-2.735***	0.359	-1.700**
Unadjusted Dickey-Fuller t	-2.534***	0.279	-1.385*
Westerlund test for cointegration			
Variance Ratio	1.911**	2.366***	1.655**

Source: Authors' Compilation;
*Note: *, **, and *** show significance levels at 10, 5, and 1 percent, respectively.*

Furthermore, the study employs the DK test to estimate the long-run coefficients for all the explanatory variables. Table 4.8 shows the results of the DK test. Model (4.1.1) reveals that financial development, institutional quality, and economic growth significantly promote trade openness. The results are supported by Kim et al. (2011), Tahir et al. (2018), and Ngouhouo et al. (2021). The higher GDP of a country leads to higher trade openness. However, FDI also positively impacts trade openness, but the coefficient is insignificant. The magnitude of institutional quality is large. A one percent change in the quality of institutions causes a 0.26 percent increase in trade openness. Better quality of institutions wins over the confidence of consumers and other economic entities in the international space, enhancing trade openness. The results are consistent with Ngouhouo et al. (2021). In addition, a one percent increase in financial development also increases trade openness by 0.16 percent. The development of the financial system drives the degree of trade openness.

In model (4.1.2), all the variables negatively impact trade openness. All these variables act as a barrier/deterrent to trade openness. The most effective barrier is the real effective exchange rate. A one percent increase in REER causes a 0.47 percent decline in trade openness. The real exchange rate was incorporated into the model with the expectation that it would have a negative impact on trade openness. This is predicated on the claim that exchange volatility typically deters trade (Ethier, 1973; Abbott, 2004). This is due to the fact that fluctuations in exchange rates raise risk, which prevents economic activity and, consequently, trade in terms of imports and exports. These results are supported by studies such as OZCELIK (2023) and Tahir et al. (2018). Additionally, WUI and GPR are also adversely affecting trade openness. The results are in line with Gupta et al. (2019), Groshenny et al. (2021), and Kim and Jin (2023). With uncertainty and political instability, countries are reluctant to open for trade, reducing trade openness. This also implies that international trade in emerging economies is vulnerable to the adverse effects of geo-political events and uncertainty around the world.

Model (4.1.3) integrates all the positive and negative factors affecting trade openness. Taking all the factors together, the relationship of all the variables with trade openness remains the same. Moreover, from the coefficients in the model (4.1.3), it is observed that the magnitude of financial development has increased from 0.165 to 0.199 and decreased for institutional quality from 0.266 to 0.186. Similarly, the degree of WUI and GPR has decreased, and REER has increased among barriers. This implies that trade is simultaneously affected by both the drivers and barriers. The most influential promoter of trade openness is financial development, and the most effective deterrent is REER.

Table 4.8 Driscoll-Kraay Standard Errors Test Results

Variables	Model (4.1.1)	Model (4.1.2)	Model (4.1.3)
l_fd	0.165*** (0.025)		0.199*** (0.033)
l_IQ	0.266*** (0.040)		0.186*** (0.054)
l_fdi	0.051 (0.033)		0.043 (0.033)
l_gdp	0.030* (0.016)		0.067*** (0.019)
l_gpr		-0.103*** (0.013)	-0.025 (0.016)
l_wui		-0.125*** (0.023)	-0.102*** (0.028)
l_reer		-0.484*** (0.099)	-0.656*** (0.121)
constant	3.108*** (0.172)	6.114*** (0.442)	5.709*** (0.491)

Source: Authors' Computation;
Note: Standard errors are in parentheses;
, **, and * show significance levels at 10, 5, and 1 percent, respectively.*

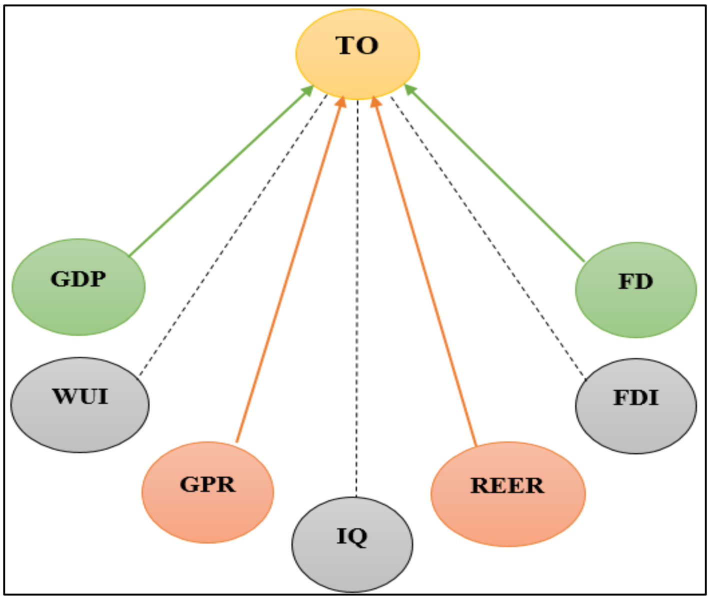
After confirming the long-run relationship between the variables, the study proceeds to the results of the causality test. The results in Table 4.9 confirm that the causality runs from GPR, REER, economic growth, and financial development to trade openness. There is no causality between WUI and TO. The results also reveal that there is no causality from trade openness to institutional quality and FDI while testing for the opposite direction. Trade can change agents' preferences over institutions and the relative political power of agents in the economy, leading to changes in institutional quality (Levchenko, 2017). Figure 4.1 graphically represent the results of the Causality test.

Table 4.9 Dumitrescu-Hurlin Causality Test Results

Causality	Z bar Statistics	Z bar tilde	Causality
l_gpr → l_trade	2.312** (0.020)	1.665* (0.095)	Present
l_wui → l_trade	0.211 (0.832)	-0.087 (0.930)	No Causality
l_reer → l_trade	6.276*** (0.000)	4.972*** (0.000)	Present
l_IQ → l_trade	1.413 (0.157)	0.915 (0.359)	No Causality
l_gdp → l_trade	10.851*** (0.000)	8.788*** (0.000)	Present
l_fd → l_trade	11.807*** (0.000)	9.585*** (0.000)	Present
l_fdi → l_trade	-0.039 (0.968)	-0.296 (0.767)	No Causality

Source: Authors' Computation;
Note: Standard errors are in parentheses;
, **, and * show significance levels at 10, 5, and 1 percent, respectively.*

Figure 4.1 Dumitrescu-Hurlin Causality Test Results



Note: The green arrows show the direction of causality and positive relationship between the variables. The red arrows show the direction of causality and negative relationship between the variables. The dashed arrows show the no causality. The bi-directional causality is not tested between the variables.
Source: Authors' Computation

4.3 Summary and Findings

The present chapter of the study investigates the determinants of trade openness for emerging economies owing to data availability. The study focuses on the determinants of trade openness, including drivers and barriers.

The study identifies the conventional as well as modern factors that influence international trade, considering both drivers and inhibitors in emerging economies for the period from 1996 to 2020. The study found strong evidence supporting a significant relationship between various determinants and trade openness. To sum up, economic growth, quality of institutions, and financial development are the primary drivers of international trade. However, geo-political risk, world uncertainty index, and real effective exchange rate are trade inhibitors that lower trade openness.

The next chapter provides the empirical analysis on the second objective of the thesis that is to assess the role of trade in overall sustainable development for emerging economies.

Chapter 5. Trade and Sustainable Development

5.1 Introduction

After considering the various determinants of trade openness, the present chapter focuses on analyzing the relationship between trade and overall sustainable development, including economic, social, and environmental dimensions. As discussed in the previous chapters, international trade is described as "an engine for inclusive economic growth and poverty reduction that contributes to the promotion of sustainable development" in the 2030 Agenda for Sustainable Development. In an effort to transform it into a "sustainable engine", one strategy that appears to be being employed is internalizing social, economic, and environmental concerns more and more in international trade. Numerous methods, tools, and policy instruments can be used to accomplish this (UNCTAD, 2021).

As opposed to merely higher gross domestic product (GDP), intergenerational development has received a lot of attention lately. Thus, as a means of addressing social and environmental issues, the shift from economic growth to development, especially sustainable development, arose (Sheikh et al. 2021). And the objective of achieving the Sustainable Development Goals (SDGs) dominates the contemporary development discourse (Leal Filho et al., 2020). However, the introduction of the Human Development Index (HDI) was an essential step towards the measurement of economic growth, including social and economic goals. The weaknesses of HDI have become evident in light of the escalating climate change and ecological collapse crises in the 21st century, as development and the environment are not distinct elements. Therefore, Hickel (2020) introduced the concept of sustainable human development (SHD) and created an index called the Sustainable Development Index (SDI). The SDI is an indicator of strong sustainability that assesses the ecological effectiveness of a nation's contribution to human development (Hickel, 2020).

The UNDP has defined, quantified, and popularized the concept of SHD through its extensive annual human development reports since 1990. Human development is described by UNDP (1996) as "*a process of enlarging people's choices*". Therefore, SHD is a people-centric concept that puts all forms of progress—cultural, economic, political, social, and technological—at the service of people. In the context of emerging economies, CO_2 emissions and material footprint are the two most critical dimensions of SDI (Opoku et al., 2022).

Due to increased integration, radical social, economic, and environmental changes have occurred in the last few decades. The world's natural capital is under tremendous strain as a result of careless production and consumption, which has resulted in severe issues such as biodiversity loss, global warming, ozone depletion, poverty, and unequal wealth distribution. Due to these issues, the "sustainable development" policy objective is now the focal point of policy action. Trade policy continues to be a key area of focus for addressing the relationships with sustainable development, both directly and indirectly, along with other policies. Because it has the ability to increase the amount of economic space needed to generate the managerial and entrepreneurial skills necessary for economic growth and development, as well as new job opportunities and efficient resource utilization. It is commonly acknowledged that trade can serve as a potent catalyst for sustainable development (Balassa, 1986; Sheikh et al., 2020).

Trade openness can influence SDI by affecting each and every aspect (economic, social, and environmental) of SDG and human development. For example, trade boosts economic growth and productivity, advances technology, reduces poverty, and affects the environment. Additionally, inclusive human development is enhanced by globalization in the social, economic, and political domains (Asongu & Nwachukwu, 2017; Asongu & Odhiambo, 2020a; Jain and Mohapatra, 2023a; Jain and Mohapatra, 2023b). Furthermore, trade liberalization is crucial for achieving economic growth (Frankel & Romer, 1999). In this study, it is anticipated that globalization through trade openness (trade) and foreign direct investments (FDI) will have a positive impact on sustainable development.

Trade openness, sustainable development, and its three aspects of sustainability (economic, social, and environmental) are generally addressed in isolation from each other. Determining the link between them is not easy, given the wide-ranging effects of each issue and their mutual connection. The study tries to bridge this gap by empirically examining the link between trade openness and sustainable development in the context of emerging economies. The chapter is organized into two parts. The first part empirically analyzes the relationship, and the second part summarizes the study's findings.

5.2 Econometric Analysis of Trade and Sustainable Development

The present section is further divided into two segments. The first segment describes the data and model specification utilized in the study. The second segment discusses the empirical results of the analysis.

5.2.1 Data and Model Specifications

A sample of 19 emerging countries, namely Argentina, Brazil, Chile, China, Columbia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Philippines, Poland, Russia, Saudi Arabia, South Africa, Turkey, and Thailand, for the period 1996-2020 is employed owing to data availability. The sample is selected based on the classification done by the International Monetary Fund (IMF) (Duttagupta and Pazarbasioglu, 2021). The dependent variable in the study is the Sustainable

Development Index (SDI) constructed by Hickel (2020), which indicates the effectiveness of economies in achieving sustainable human development (SHD). The index is determined by taking the product of two indices: the HDI (human development index) and the EII (ecological impact index). The EII takes into account the degree to which the material footprint and CO_2 emissions from consumption-based activities exceed per capita shares of planetary boundaries, whereas the HDI is calculated as the geometric mean of indices of education (EI), life expectancy (LEI), and modified income (MII). The SDI, HDI, and EII calculations are shown in models (5.1.1), (5.1.2), and (5.1.3), respectively.

$$SDI_{it} = \frac{Human\ Development\ Index_{it}}{Ecological\ Impact\ Index_{it}} \tag{5.1.1}$$

$$HDI_{it} = \sqrt[3]{EI * LEI * MII} \tag{5.1.2}$$

$$EII_{it} = 1 + \frac{e^{AO} - e^{1}}{e^{4} - e^{1}} \tag{5.1.3}$$

where AO stands for average overshoot, defined as the ratio of material footprint and each emission value to the corresponding planetary boundaries per capita. The independent and control variables are selected based on existing literature (Asongu & Odhiambo 2020; Chien et al. 2021; Verma et al. 2022; Nchofoung and Asongu 2022). Trade openness (TO) is the independent variable which is measured through the sum of exports and imports of goods and services measured as a share of gross domestic product (GDP). The other variables include foreign direct investment (FDI), institutional quality (IQ), renewable energy consumption (REC), GDP per capita (GDPPC), and innovations (INNOV). The integration of developing nations into the globalization process that underpins the global economy is widely attributed to FDI. Principal component analysis (PCA) is employed to construct the single composite index for institutional quality, including control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability. The data is gathered from world development indicators (WDI), world governance indicators (WGI), and Hickel (2020).

The idea to construct the following model is taken from Verma et al. (2022), Din et al. (2021), and Nchofoung and Asongu (2022). Prefix L denotes that the variables are transformed in their logarithmic form.

$$LSDI_{it} = \alpha_{it} + \beta_1 LTO_{it} + \beta_2 LFDI_{it} + \beta_3 IQ_{it} + \beta_4 LGDPPC_{it} + \beta_5 LREC_{it} + \varepsilon_{it} \quad (5.1.4)$$

5.2.2 Empirical Results

Before proceeding to estimate the coefficients, the study attempts to test for slope homogeneity and CSD since it is a panel data study. Table 5.1 indicates the presence of slope heterogeneity in the data. Table 5.2 and Table 5.3 present the CSD test for variables and models, respectively. It depicts the existence of CSD both for variables and models. The null hypothesis of cross-section independence is rejected, as represented in both tables.

Table 5.1 Slope Homogeneity Test

	Statistics
Delta	12.229***
$Delta_{Adj.}$	14.978***

*Source: Authors' Computation. Notes: This table reports slope homogeneity test results. *** denotes statistical significance at 1% level.*

Table 5.2 Cross-section Dependence Test for Variables

Variables	**CSD-test**
LSDI	3.54***
LTO	14.59***
LFDI	3.91***
LREC	2.93***
LGDPPC	56.47***
LIQ	-2.16**
LINNOV	29.07***

*Source: Authors' Computation. Notes: This table reports panel cross-section dependence test results. ***, ** denote statistical significance at 1%, and 5% levels, respectively.*

Table 5.3 Cross-section Dependence Test for Model

CSD test	Statistics
Pesaran Test	5.703***
Frees Test	6.344
Friedman Test	52.798***

Source: Authors' Computation.
Notes: This table reports CSD test results for the model.
**** denotes statistical significance at 1% level.*

After testing for CSD and slope heterogeneity, we applied first-generation and second-generation panel unit root tests. Table 5.4 reports the results of panel unit root tests: the IPS (Im-Pesaran-Shin) test and the Pesaran ADF (Augmented Dickey-Fuller) test. It is observed from Table 5.4 that all the variables are stationary at first difference except LFDI when conducting the IPS test. LFDI is stationary at a level across the tests. LGDPPC is stationary at the level using the Pesaran ADF test. Moreover, the results shown in Table 5.5 confirm the long-run relationship between the variables across all tests. There is a co-integrating relationship between the variables in the study.

Table 5.4 Panel Unit Root Test

Variables	IPS test (z-t-tilde bar)	Pesaran ADF test
LSDI	3.482	-1.103
ΔLSDI	-9.685***	-4.023***
LTO	-0.976	-1.806
ΔLTO	-10.313***	-4.155***
LFDI	-5.793***	-2.713***
LREC	2.325	-1.750
ΔLREC	-9.372***	-4.292***
LGDPPC	3.341	-2.368***
ΔLGDPPC	-7.919***	-4.157***
LIQ	2.405	-1.148
ΔLIQ	-9.293***	-3.661***
LINNOV	1.236	-2.327***
ΔLINNOV	-10.859***	-4.847***

Source: Authors' Computation. Notes: This table reports panel unit root test results.
****, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.*

Table 5.5 Panel Co-integration Test Results

Pedroni Co-integration test		**Westerlund Co-integration Test**	
	Statistics		***Z-value***
Modified Phillips-Perron t	5.565***	Gt	2.947***
Phillips-Perron t	-1.568**	Ga	4.174***
Augmented Dickey-Fuller t	-1.320*	Pt	-5.239***
		Pa	0.512***

*Source: Authors' Computation. Notes: This table reports panel co-integration test results. ***, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.*

The study further employed the fixed-effect regression approach suggested by the Hausman test and the DK standard error test to find the estimates. Table 5.6 reports the main findings of the study. It reveals how trade openness is related to SDI in emerging economies. Trade openness has a significant positive relationship with SDI across all tests. It depicts that sustainable human development rises with an increase in the degree of trade openness. Trade provides better work opportunities and products at lower cost to consumers and promotes inclusive economic growth and reduction in poverty that contributes to sustainable development.

The results are consistent with those of previous studies such as Hamdi and Hakimi (2021), Verma et al. (2022), and Musah (2023). Table 5.6 also reveals that renewable energy consumption is having a favorable impact on SDI. Renewable energy is a critical factor for sustainable development, as found by other studies such as Spaiser et al. (2019), Swain and Karimu (2020), Chen et al. (2022), and Guney (2023). REC mitigates the environmental emissions and prevents the environment from degradation. The impact of FDI is positive on SDI but significant only while using the DK test approach. It implies that foreign investors play an essential role in sustainable development. The results are aligned with Izadi and Madirimov (2023) and Aust et al. (2020).

Furthermore, the results for the coefficient of GDP per capita are significant in both tests, indicating economic growth is an essential factor in promoting sustainable development. The results further reveal that institutional quality and innovations have a significant negative impact on SDI, as evidenced by Musah (2023). This inverse relationship may be explained by the fact that most emerging economies seem to have weak institutions. Thus, emerging economies need to focus more on the quality of institutions. In addition, each indicator of institutional quality is different and vital and has a different impact on sustainable human development that needs to be discussed. Moreover, sustainable innovations that promote the quality of the environment, such as renewable energy, are required for the sustainable development of a nation. Appropriate policies will soon be necessary to close the gap between environmental and economic prosperity (Adrangi and Kerr, 2022).

Table 5.6 Estimation of Coefficients

Variables	Fixed-effects regression	Driscoll-Kraay standard error test
LTO	0.011* (0.023)	0.025*** (0.007)
LFDI	0.001 (0.004)	0.003* (0.002)
LREC	0.135*** (0.018)	0.073*** (0.007)
LGDPPC	0.021** (0.010)	0.063*** (0.005)
LIQ	-0.825*** (0.313)	-0.979*** (0.210)
LINNOV	-0.013* (0.007)	-0.021*** (0.004)
Constant	2.032*** (0.756)	1.204** (0.501)

Source: Authors' Computation. Notes: This table reports panel regression results. Standard errors are in parentheses ().
****, **, * denote statistical significance at 1%, 5%, and 10% levels, respectively.*

5.3 Summary and Findings

The present chapter of the study is a pioneering attempt to examine the link between trade and overall sustainable development in 19 emerging economies. The study used the data for the period 1996-2020 as per data availability. To estimate the relationship, the study employed techniques robust to serial correlation, such as the second-generation panel unit root test, co-integration test, DK standard error test, and fixed-effect regression, to test the robustness. The findings reveal that trade openness has a favorable impact on sustainable development. Trade openness affects sustainable human growth in many ways. It can boost economic growth, living standards, and technology, but distributional, social, and environmental impacts must be considered. Moreover, FDI, economic growth, and renewable energy consumption also have positive implications for sustainable development. In contrast, innovations and institutional quality have adverse impact on SDI.

The next chapter is devoted to the third objective of the thesis. It deals with the examination of trade on major economic and social SDGs for emerging economies.

Chapter 6. Trade and Economic & Social Sustainability

6.1 Introduction

This chapter explicitly analyzes the role of trade on major issues related to the economic and social dimensions of sustainable development of the emerging economies for the period 1991-2020. As discussed in Chapter 2, The goals of economic and social sustainability through trade are to guarantee the present and future well-being of human societies and the planet. Trade has revolutionized the availability of goods for low-income households by granting them unprecedented access to goods and services. The improvement of general working conditions and income levels are also influenced by trade. Social sustainability mainly focuses on the welfare of people and communities. Social sustainability can be improved by economic policies that encourage inclusive growth and lessen inequality because they give everyone in society better access to opportunities and resources. Prioritizing social policies in the areas of education, healthcare, and social protection helps to ensure a skilled and healthy labor force as well as lower levels of poverty and inequality, all of which can promote long-term, sustainable economic growth.

The present study seeks to employ different approaches to analyse trade openness and its role in achieving major economic and social SDGs. In the first place, the relationship between trade openness and growth-inequality-poverty (GIP triangle) is examined together. Secondly, the relationship between trade openness and income inequality is studied. Thirdly, the relationship between trade openness and unemployment is examined. The fourth section provides the summary and findings of this chapter.

6.2 Econometric Analysis of Trade and GIP Triangle

The first approach addresses the three goals of SDGs, namely SDG:1 (no poverty), SDG:8 (decent work and economic growth), and SDG:10 (reduced inequalities) simultaneously. These three goals are closely related to each other. Further, Bourguignon gave the relationship between growth, inequality, and poverty the name GIP (Growth-Inequality-Poverty) triangle in 2004. It contributes to the existing literature in the following ways. First, the study prepared a new panel data set for 18 emerging countries over a long period from 1991 to 2020 using several sources. Second, previous studies have examined the relationship between developing and developed countries. However, this study tests the hypotheses, especially for emerging countries, focusing on the structural and socio-economic differences between countries. Third, most studies have done a bivariate analysis using trade with other variables (growth, inequality, or poverty). This study analyses the multivariate panel data set by employing trade, growth, inequality, and poverty together.

This section is further divided into two sub-sections. The first section describes the data and model specification used for the analysis of trade and GIP triangle. The second section presents the empirical findings from the analysis.

6.2.1 Data and Model Specifications

The present study covers the data for the panel of 18 emerging countries for the period 1991-2020. The data was obtained from World Development Indicators (World Bank) and Standardized World Income Inequality Database (SWIID) by Solt (2020). Following the model specifications by Dhrifi (2015), Hassan et al. (2015), and Anser et al. (2020) in the context of financial development, environmental degradation, and crime, respectively, the present study uses the following model specifications to examine the long-run relationship between inclusive development (Growth-Inequality-Poverty) and trade openness.

$$LGDP_{it} = \alpha_0 + \beta_1 LPOV_{it} + \beta_2 GINI_{it} + \beta_3 TRADE_{it} + \varepsilon_{it} \quad (6.1.1)$$

$$GINI_{it} = \alpha_0 + \beta_1 LGDP_{it} + \beta_2 LPOV_{it} + \beta_3 TRADE_{it} + \varepsilon_{it} \quad (6.1.2)$$

$$LPOV_{it} = \alpha_0 + \beta_1 LGDP_{it} + \beta_2 GINI_{it} + \beta_3 TRADE_{it} + \varepsilon_{it} \quad (6.1.3)$$

$$TRADE_{it} = \alpha_0 + \beta_1 LGDP_{it} + \beta_2 LPOV_{it} + \beta_3 GINI_{it} + \varepsilon_{it} \quad (6.1.4)$$

LGDP is gross domestic product per capita measured at the current US$, which is a proxy for economic growth. Poverty is a complex phenomenon to measure. The World Bank measures poverty in terms of basic consumption needs. Therefore, the study uses household final consumption expenditure (HCE) to measure poverty because consumption expenditure is frequently more accurately reported and steady among the poor than income (Datt and Ravallion 1992; Quartey 2005; Odhiambo 2009, 2010a; Mohapatra and Giri 2021). Furthermore, according to Adams (2004), growth only helps poor people in developing nations when it is measured in terms of average income or consumption. It is represented as LPOV in the models. GINI refers to the Gini coefficient, which is a measure of income inequality. TRADE represents trade and is measured as a percentage of GDP. The prefix L shows the logarithmic transformation of the variables.

6.2.2 Empirical Results

This section represents the results from the empirical estimation. Table 6.1 presents the descriptive statistics and pairwise correlation matrix. Table 6.1(a) shows that LPOV has a minimum value of 5.783 and a maximum value of 9.145, with a mean and standard deviation of 8.005 and 0.702, respectively. GINI has a minimum value of 26 and a maximum value of 79.9, having a standard deviation of 9.072 with a mean value of 8.005. The minimum value of TRADE is 13.753, and the maximum value is 9.145, with a standard deviation of 40.120 and a mean value of 63.015. LGDP has a minimum value of 5.708 and a maximum value of 9.728. Table 6.1(b) reveals the estimates of pairwise correlation. It shows that trade has a positive and low degree of correlation with growth and poverty and a negative and low link with inequality.

Table 6.1 Descriptive Statistics of Variables & Pairwise Correlation

Table 6.1(a): Descriptive Statistics of Variables

Variables	*Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
LPOV	540	8.005	0.702	5.783	9.145
GINI	540	43.106	9.072	26	79.9
TRADE	540	63.015	40.120	13.753	220.406
LGDP	540	8.275	0.914	5.708	9.728

Table 6.1(b): Pairwise Correlation

	LGDP	**TRADE**	**GINI**	**LPOV**
LGDP	1.000			
TRADE	0.238*** (0.000)	1.000		
GINI	0.140*** (0.000)	-0.278*** (0.000)	1.000	
LPOV	0.913*** (0.000)	0.149*** (0.000)	0.195*** (0.000)	1.000

*Note: *** Reject H_0 if p-value < 0.01; Values in parentheses are p-values.*
Source: Authors' computation

Table 6.2 Cross-section Dependence Test

Variable	**CSD test**	**p-value**
LGDP	55.92***	0.000
LPOV	7.01***	0.000
GINI	7.85***	0.000
TRADE	18.42***	0.000

*Source: Authors' computation. Note: ***Reject H_0 if p-value < 0.01*

Since the study employs panel data, the cross-sectional dependence of variables has also been checked. Table 6.2 displays the result of the test. It shows that all the variables are cross-sectional dependent. Before the estimation of the ARDL model, it must be ensured that the variables under consideration are not integrated at order two. Thus, to test the stationarity properties of the variables, the study uses the Levin-Lin-Chu, Breitung, and Im-Pesaran-Shin unit root tests. The results of the test are presented in Table 6.3.

Table 6.3 Unit Root Test Result

Variables	LLC t-stat	Breitung t-stat	IPS W-stat
LGDP	-2.595*** (0.004)	5.479 (1.000)	0.704 (0.759)
ΔLGDP		-10.348*** (0.000)	-8.987*** (0.000)
LPOV	-3.108*** (0.000)	9.588 (1.000)	1.785 (0.962)
ΔLPOV		-4.187*** (0.000)	-5.896*** (0.000)
GINI	-1.357* (0.087)	-3.485*** (0.002)	-5.432*** (0.000)
ΔGINI			
TRADE	-2.806*** (0.002)	0.688 (0.754)	-1.457** (0.072)
ΔTRADE		-9.411*** (0.000)	

Source: Authors' computation

*Note: ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10*

Table 6.3 presents that all the variables are stationary at level while using the LLC test. In addition to the LLC test, the results of the Breitung and IPS tests show that none of the variables are stationary at the level. There is evidence of a mixed order of integration among variables. For instance, GINI is stationary at level I(0) in all three tests, and LGDP, LPOV, and TRADE are stationary at the first difference I(1). Hence, we ensured that no variable was integrated for an order higher than 1, which is a prerequisite for the ARDL approach. The next step is to examine the long-run relationship among the variables and the nexus between trade and the GIP triangle using the ARDL approach.

In order to estimate the models (6.1.1), (6.1.2), (6.1.3), and (6.1.4), the study utilized PMG, MG, and DFE estimators. The Hausman test is essential to select between the three estimators. Table 6.4 represents the long-run coefficients estimated using the

PMG-ARDL method since the Hausman test favors the PMG estimator in the models. The results of MG and DFE estimators and the Hausman test are displayed in Appendix A.

Table 6.4 Estimated Long Run Coefficients (PMG)

Regressors	Model (6.1.1)	Model (6.1.2)	Model (6.1.3)	Model (6.1.4)
LGDP		0.223 (0.718)	-0.139 (0.323)	-4.504 (2.806)
LPOV	1.505*** (0.046)	-8.823*** (1.338)		-2.759 (5.769)
GINI	0.000 (0.006)		-0.002 (0.051)	-1.228*** (0.301)
TRADE	0.006*** (0.001)	-0.039*** (0.009)	-0.243*** (0.022)	

*Source: Authors' computation, Note: ***Reject H_0 if p-value < 0.01, Standard errors in parentheses ()*

The findings of Table 6.4 show the presence of a long-run relationship in all four models considered in the study. LGDP is the dependent variable in model (6.1.1). Trade and poverty, which is represented through household final consumption expenditure, have a positive and significant impact on economic growth, whereas the coefficient of inequality is not significant. This implies that when poverty (HCE) decreases (increases), it will promote the economic growth of emerging countries. Sakyi et al. (2015a) and Shahbaz (2012) support the positive relationship between trade and growth. Model (6.1.2) has Gini as a dependent variable. Poverty and trade negatively and significantly impact income inequality. This implies that if HCE (poverty) is increasing (decreasing) by 1 percent, then income inequality is decreasing by 8.82 percent. The Coefficient of trade depicts the negative and significant relationship with income inequality. If trade is increasing by 1 percent, then income inequality will reduce by 0.03 percent. The results partially support the Kuznets' hypothesis that inequality will rise insignificantly at the initial stage of GDP growth. However, the study is not taking into account the square of GDP. The dependent variable in Model (6.1.3) is poverty (HCE). The coefficient between poverty and trade is negative and significant. If trade increases by 1 percent, HCE (poverty) will reduce (increase) by 0.24 percent. This shows that trade is poverty increasing. The impact of income inequality and GDP on HCE (poverty) is negative (positive), but the coefficients are insignificant. Model (6.1.4) has trade as a dependent variable. Trade is negatively affected by growth, poverty, and income inequality. However, the coefficient of GDP and poverty is insignificant. Conclusively, the effect of trade on the GIP triangle can be summarized as follows:

1. Trade positively and significantly promotes economic growth,
2. It helps in reducing income inequality and;
3. It has a negative impact on poverty since poverty is increasing in emerging countries.

Table 6.5 Estimated Short Run Coefficients (PMG)

Regressors	**Model (6.1.1)**	**Model (6.1.2)**	**Model (6.1.3)**	**Model (6.1.4)**
LGDP		-2.894** (1.235)	-3.088*** (1.112)	-8.468** (3.983)
LPOV	1.866*** (0.221)	10.909** (4.856)		22.696** (9.641)
LGINI	-0.003 (0.003)		0.071** (0.036)	0.225 (0.161)
LTRADE	-0.008*** (0.002)	-0.042 (0.036)	-0.063*** (0.024)	
Constant	-0.664*** (0.069)	64.287*** (12.575)	17.075*** (3.303)	32.947*** (12.479)
Error correction term (ECT)	-0.157*** (0.017)	-0.551*** (0.101)	-0.233*** (0.047)	-0.197** (0.078)

*Source: Authors' computation, Note: ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10, Standard errors in parentheses ()*

In the short-run, trade has an adverse and significant impact on growth and (HCE) poverty, as depicted in Table 6.5. This implies that with the rise in trade, GDP reduces, HCE (poverty) also reduces (rises), but income inequality deteriorates in the short run for emerging countries. The ECT is significant for all the models and ranges from 0.15 to 0.55, implying that 15 to 55 percent of the deviation of the short-run from the long-run level is adjusted in the next year.

Finally, the study employs the Dumitrescu-Hurlin panel causality test to find the causal relationship among variables. It can be observed from Table 6.6 that each variable has bidirectional causality with the other three variables. For instance, trade and growth have a bidirectional causality between them. Trade and inequality also affect each other, and trade impacts poverty and vice-versa.

Table 6.6 Dumitrescu Hurlin Causality Test Result

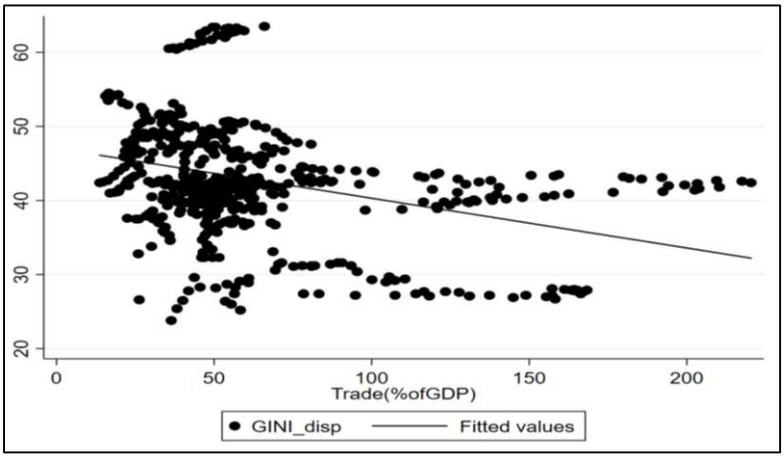
Causality	Z bar-statistics	Z-bar tilde statistics
GINI → LGDP	4.855***	3.987***
LGDP → GINI	18.303***	15.632***
LPOV → LGDP	2.460**	1.914**
LGDP → LPOV	5.156***	4.248***
TRADE → LGDP	6.633***	5.528***
LGDP → TRADE	5.701***	4.720***
LPOV → GINI	25.674***	22.015***
GINI → LPOV	2.243**	1.726*
TRADE → GINI	17.174***	14.654***
GINI → TRADE	7.625***	6.387***
TRADE → LPOV	2.672***	2.097**
LPOV → TRADE	7.436***	6.222***

*Source: Authors' computation, Note: ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10.*

6.3 Econometric Analysis of Trade and Income Inequality (SDG:10)

From the second approach, the study tries to answer some important research questions that need to be addressed. Firstly, does trade impact income inequality in EEs? Secondly, is there a non-linear relationship between trade and income inequality similar to the inverted "U-shaped" Kuznets Curve (KC)? Thirdly, if it exists, what is the turning point? Finally, are the same policy suggestions applicable to each emerging economy? Accordingly, the objectives of the present study have been set as follows: first, to investigate the relationship between trade and income inequality (SDG:10) under the KC hypothesis for emerging countries from 1991 to 2020. Second, to estimate the turning point for the inverted "U-shaped" trade-led KC. Third, to provide some directions for achieving SDG:10 for emerging countries based on key findings. Towards this end, the study employs the latest econometric methods to deal with issues like cross-sectional dependence (CSD) that may arise in the panel framework. To the best of our knowledge, the present study is the first attempt that explicitly extends the analysis of the impact of trade openness on income inequality under the KC framework in light of the Agenda 2030 (A plan of action for people, planet and prosperity to shift the world onto the sustainable path by 2030) with the main focus on achieving SDG:10, i.e. reducing income inequality. Figure 6.1 represents the linear trend between income inequality measured by the Gini coefficient and trade as a percent of GDP for emerging economies. As portrayed, the trend is declining, implying that income inequality falls with the increase in trade openness. Moreover, SDGs sturdily focus on the role of trade in fostering sustainable development and highlight the WTO's potential contribution to the 2030 agenda. The WTO rules attempt to mitigate the impact of existing inequities through the principle of special and differential treatment for emerging countries (WTO, 2018).

Figure 6.1 Trend Analysis of Income Inequality



Source: Authors' computation

The section is further divided into two sub-sections. The first section elucidates the data and model specification used for the analysis. The second section presents the empirical findings from the study.

6.3.1 Data and Model Specifications

The present section elucidates the data and model specifications used in the study to examine the role of trade openness in addressing SDG:10 for the period of 1991-2020 for 18 emerging countries.

Table 6.7 Description of Data

Variable (Symbol)	Proxy	Definition	Data Source
Income Inequality (Gini)	Gini coefficient	Measures the extent to which the distribution of income or consumption among individuals or households within an economy deviates from a perfectly equal distribution. (0 perfect equality to 1 perfect inequality)	SWIID
Trade (trade)	Trade openness (percent of GDP)	A sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI, World Bank
Foreign direct investment (FDI)	FDI inflows (percent of GDP)	Net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors are divided by GDP.	WDI, World Bank
Economic growth (GDP)	GDP per capita (current US$)	It is gross domestic product divided by midyear population. Data are in current U.S. dollars.	WDI, World Bank
Investment (GFCF)	Gross fixed capital formation (percent of GDP)	It includes land improvements, plant, machinery, and equipment purchases, and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.	WDI, World Bank
ICT (internet)	Internet Usage (percent of the population)	Internet users are individuals who have used the internet (from any location) in the last three months.	WDI, World Bank
Human capital (HCI)	Human capital index	The HCI calculates the contributions of health and education to worker productivity. The final index score ranges from zero to one and measures the productivity as a future worker of a child born today relative to the benchmark of full health and complete education.	PWT9

The study includes the Gini coefficient as an indicator of income inequality as a dependent variable. GDP per capita and trade openness are the independent variables, whereas human capital index (HCI), foreign direct investment (FDI), and gross fixed capital formation (GFCF) are control variables. Table 6.7 represents the description of the data. Internet usage as a proxy for ICT is used because advancement in ICT impacts income inequality by providing access to more resources, information, and markets (Wavermann et al. 2005; United Nations 2013; Bauer 2018). FDI inflows have been selected as they may impact inequality in two ways: either through generating employment opportunities, transferring skills and technology, increasing workers' wages and thereby reducing inequality, or by widening the wage gap between rich and poor and growing inequalities (Aitken et al. 1996; Xu et al. 2021; Rezk et al. 2022). GFCF is used as a proxy for investment, as it is essential to promote economic growth and employment (Kuznets 1973). In the Harrod-Domar model, the relationship between saving ratio and capital formation with income growth rate is positive (Ali et al. 2012; Akobeng 2017; Abbas et al. 2020). Additionally, boosting the population's well-being has a beneficial effect on disparity (Purba et al. 2019).

Investment in human capital leads to greater efficiency and productivity of the workers. Many governments also spend on education to reduce educational inequality and thus the degree of income disparity (Lee and Lee 2018; Castello-Climent and Domenech 2021). Therefore, the study uses HCI as an independent variable, among others. Our model is a log-log model in which all the variables are transformed in the natural logarithm. The original Kuznets curve explains how economic growth affects income disparity that is empirically described as follows (Desbordes and Verardi, 2012):

$$Gini_{it} = \beta_0 + \beta_1 GDPPC_{it} + \beta_2 GDPPC_{it}^2 + T_t + \varepsilon_{it} \quad (6.2.1)$$

Where T_t shows the time-specific effect, ε_{it} is an error term, GDPPC denotes GDP per capita, and $GDPPC^2$ is the square of GDPPC. However, the original Kuznets curve has been examined by many researchers, as described above. Our study focuses on the relationship between trade openness and income inequality following the model specifications used in the validation of the Kuznets Curve (Desbordes and Verardi, 2012) and in some other studies (Jalil, 2012; Raza and Shah, 2017; Topuz and Dagdemir, 2020; Ghosh and Mitra, 2021; Shafiullah et al., 2021; Barnes, 2022). The model considered in this study is different from the model (6.2.1). In model (6.2.2), the Gini coefficient is defined as a function of GDP per capita, trade openness, a square of trade openness, HCI, FDI, internet use by population, and GFCF. This can be written as:

$$Ln\_Gini = f(Ln\_trade, Ln\_trade^2, Ln\_GDP, Ln\_HCI, Ln\_FDI, Ln\_internet, Ln\_GFCF) \quad (6.2.2)$$

Through model (6.2.2), we can highlight the role of trade openness on income inequality and the interrelationship between inequality and other factors. Model (6.2.2) can be rewritten as (Jalil 2012; Topuz and Dagdemir 2020):

$$Ln\_Gini = \beta_0 + \beta_1 Ln\_trade_{it} + \beta_2 Ln\_trade_{it}^2 + \beta_3 Ln\_GDP_{it} + \beta_4 Ln\_HCI_{it} + \beta_5 Ln\_FDI_{it} + \beta_6 Ln\_internet_{it} + \beta_7 Ln\_GFCF_{it} + \varepsilon_{it} \quad (6.2.3)$$

Model (6.2.3) reveals the trade-led KC hypothesis. However, five possibilities may arise in linear and non-linear forms explaining the relationship between trade and income inequality.

a. If $\beta_1 = \beta_2 = 0$; no relationship
b. If $\beta_1 > 0$, $\beta_2 = 0$; Positive and linear relation
c. If $\beta_1 < 0$, $\beta_2 = 0$; Negative and linear relation
d. If $\beta_1 > 0$, $\beta_2 < 0$; Inverted 'U-shaped' relation: a typical case of Kuznets hypothesis
e. If $\beta_1 < 0$, $\beta_2 > 0$; 'U-shaped' relation

Threshold estimation following (Boubellouta and Brandt 2021):

$$^{-\beta_1}/_{2} \times \beta_2 \quad (6.2.4)$$

In the nonlinear relationship (cases d and e), a turning point arises from which the relationship's direction (positive or negative) changes. Notably, in our trade-led KC, the threshold is the level of trade where income inequality no longer increases with the further increase in trade. The threshold can be estimated using model (6.2.4), where β_1 and β_2 are the same coefficients as in model (6.2.3).

6.3.2 Empirical Results

This section shows the empirical findings observed from the above-mentioned model specification. Table 6.8(a) of summary statistics of our panel dataset shows that the average value of income inequality and trade is around 3.74 and 3.99, respectively, for the panel of emerging countries under consideration. The mean value of VIF, an estimate of multi-collinearity between variables, is 1.76, which is not an issue of concern in our regression analysis.

The study estimated the CSD for the variables in the model, which is the first stage of our empirical analysis. The results are reported in Table 6.8(b). The null hypothesis in all four CSD tests is that there is no CSD in variables. It is clear from Table 6.8(b) that all four estimated statistics reject the null hypothesis at a 1 percent level of significance for all variables, indicating that variables are cross-sectionally dependent.

Table 6.8(c) reports the results of the CSD test for the model used in the study. Breusch-Pagan LM and Pesaran scaled LM estimates reject the null hypothesis at a 1 percent level of significance, whereas Pesaran CSD statistics fail to reject the H_0. Thus, it shows the evidence for the existence of CSD.

Table 6.8 Summary Statistics & Cross-section Dependence Test

Table 6.8(a): Summary Statistics				
Variable	***Mean***	***Std. Dev.***	***Min***	***Max***
Ln_Gini	3.7382	0.1919	3.1696	4.1510
Ln_trade	3.9881	0.5423	2.6212	5.3954
Ln_trade^2	16.1992	4.4678	6.8710	29.1111
Ln_HCI	0.9005	0.1864	0.3645	1.2484
Ln_internet	1.6429	2.8464	-9.8604	4.4948
Ln_FDI	3.7800	0.1953	-0.00001	5.2694
Ln_GDP	8.2794	0.9127	5.7076	9.7252
Ln_GFCF	3.1194	0.2635	2.2567	3.7959

Table 6.8(b): Cross-section Dependence Test for Each Variable				
Variable	***Breusch-Pagan LM***	***Pesaran Scaled LM***	***Bias-corrected scaled LM***	***Pesaran CSD***
Ln_Gini	2522.397*** (0.0000)	135.4494*** (0.0000)	135.1391*** (0.0000)	4.236202*** (0.0000)
Ln_GDP	3559.744*** (0.0000)	194.7506*** (0.0000)	194.4402*** (0.0000)	59.22275*** (0.0000)
Ln_trade	1240.503*** (0.0000)	62.16839*** (0.0000)	61.85804*** (0.0000)	20.99492*** (0.0000)
Ln_trade^2	1221.377*** (0.0000)	61.07504*** (0.0000)	60.76470*** (0.0000)	20.43962*** (0.0000)
Ln_HCI	4337.729*** (0.0000)	239.2250*** (0.0000)	238.9147*** (0.0000)	65.78798*** (0.0000)
Ln_internet	3447.363*** (0.0000)	188.3262*** (0.0000)	188.0159*** (0.0000)	58.40675*** (0.0000)
Ln_FDI	405.5228*** (0.0000)	14.43577*** (0.0000)	14.12542*** (0.0000)	6.954835*** (0.0000)
Ln_GFCF	699.2394*** (0.0000)	31.22643*** (0.0000)	30.91608*** (0.0000)	4.604896*** (0.0000)

Table 6.8(c): Cross-section Dependence Test in Model		
Test	***Statistics***	***P-value***
Breusch-Pagan LM	1445.262***	0.0000
Pesaran scaled LM	73.87372***	0.0000
Pesaran CSD	1.000804	0.3169

*Source: Authors' computation. Note: ***Reject H_0 if p-value < 0.01*

After finding the presence of a common correlation, our next step is to check for stationarity by employing Pesaran's CIPS and CADF unit root approach. The null hypothesis in both tests assumes that all series are non-stationary. Table 6.9 shows the results of panel unit root methods. Both the test statistics show the same results, thus offering robust evidence for the test of stationarity. Ln_Gini, Ln_GDP, Ln_trade, Ln_trade^{2,} and Ln_GFCF fail to reject the testable hypothesis and are found to be stationary at first difference. Furthermore, Ln_HCI, Ln_internet, and Ln_FDI reject the null hypothesis at 1 percent significance level and depict the absence of unit root at level form i.e. the variables are I(0).

Table 6.9 Panel Unit Root Tests

Variables	CIPS		CADF	
	I(0)	***I(1)***	***I(0)***	***I(1)***
Ln_Gini	-0.092	-2.371***	-0.092	-2.371***
Ln_GDP	-1.980	-4.766***	-1.980	-4.766***
Ln_trade	-1.959	-4.684***	-1.959	-4.684***
Ln_trade^2	-1.912	-4.655***	-1.912	-4.655***
Ln_HCI	-2.624***	-1.368	-2.624***	-1.368
Ln_internet	-5.011***	-4.942***	-5.011***	-4.942***
Ln_FDI	-2.724***	-5.527***	-2.724***	-5.527***
Ln_GFCF	-2.002	-4.209***	-2.002	-4.209***

*Source: Authors' computation. Note: ***Reject H_0 if p-value < 0.01*

Table 6.10 Panel Co-integration Tests

Kao cointegration test		
	Statistics	**p-value**
Modified Dickey-Fuller t	-1.5242	0.0637*
Dickey-Fuller t	-2.4586	0.0070***
Augmented Dickey-Fuller t	-0.7678	0.2213
Unadjusted Modified Dickey-Fuller t	0.8248	0.2047
Unadjusted Dickey-Fuller t	-1.2969	0.0973*
Pedroni cointegration test		
Modified Phillips-Perron t	5.9603	0.0000***
Phillips-Perron t	2.5394	0.0056***
Augmented Dickey-Fuller t	2.7685	0.0028***
Westerlund cointegration test		
Variance ratio	1.3545	0.0878*

*Source: Authors' computation. Note: ***Reject H_0 if p-value < 0.01, *Reject H_0 if p-value < 0.10*

Since the variables under study are both I(0) and I(1), thus we use the Kao, Pedroni, and Westerlund cointegration tests. The results are presented in Table 6.10. It is noted from Table 6.10 that the test statistics reject the null hypothesis and indicate the long-run relationship among the used variables.

In the next step towards the estimation of long-run elasticities, we employed the CCE and DCCE mean group estimators. Column (a) and (b) of Table 6.11 display the results of coefficients of CCE and DCCE estimator where the dependent variables are Ln_Gini.

Table 6.11 Long-run Elasticity Estimates

Variables	**CCE**		**DCCE**		**Driscoll-Kraay SE**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	-1.3880 (1.0009)	0.166	-1.4974 (1.3517)	0.268	3.8016*** (0.2978)	0.000
Ln_GDP	0.0089 (0.0063)	0.154	0.0053 (0.0042)	0.207	0.0581*** (0.0134)	0.000
Ln_trade	0.8504* (0.4683)	0.069	0.5256* (0.3188)	0.099	0.2727*** (0.0952)	0.008
Ln_trade^2	-0.1127* (0.0634)	0.076	-0.0692* (0.0402)	0.085	-0.0386*** (0.0117)	0.003
Ln_HCI	-0.1179 (0.2621)	0.653	-0.5574 (0.3953)	0.159	-0.7721*** (0.0256)	0.000
Ln_internet	0.00002 (0.0023)	0.993	-0.0022 (0.0027)	0.418	0.0131*** (0.0021)	0.000
Ln_FDI	0.0242* (0.0131)	0.066	0.0076 (0.0178)	0.666	0.0156 (0.0356)	0.665
Ln_GFCF	-0.0083 (0.0073)	0.256	-0.0181* (0.0091)	0.049	-0.1255*** (0.0256)	0.000
Root MSE	0.01		0.01			
Threshold	3.7728		3.7976		3.5323	

*Source: Authors' computation. Note: *Reject H_0 if p-value < 0.10, ***Reject H_0 if p-value < 0.01, Standard errors are displayed in parentheses.*

The responsiveness of income inequality with respect to GDP per capita is positive in both CCE and DCCE estimators. The effect of GFCF on inequality is negative but statistically insignificant under the CCE estimator but negative and significant under the DCCE estimator. This implies that a 1 percent increase in Ln_GFCF decreases the inequality by 0.018 percent other things being constant.

The effect of trade openness on income inequality is positive and significant at a 10 percent level under both estimators. A 1 percent increase in trade openness leads to a 0.8504 percent increase in income inequality ceteris paribus. The results further indicate that the coefficient of the square of trade openness (Ln_trade^2) is negative and significant at a 10 percent level. This indicates that assuming the effect of other variables is constant, a 1 percent increase in Ln_trade^2 decreases the income inequality by 0.1127 percent. This implies that trade openness initially increases income inequality, while on a higher level of trade openness it significantly deteriorates income inequality. Therefore, the results confirmed the inverted 'U-shaped' relationship between trade and income inequality, indicating the presence of the trade-led KC for the panel of emerging countries from 1991 to 2020. The results are in line with the findings of Jalil (2012) and Dobson and Ramlogan (2009).

The validity of the trade-led Kuznets hypothesis can be further provided by estimating the threshold point. The turning point was estimated using the coefficients from all three approaches i.e. CCE, DCCE, and Driscoll-Kraay standard errors. The estimated optimum point occurs between 3.5 percent and 4 percent of GDP. Thus, income inequality initially increases along with trade for emerging countries, but when trade as a percentage of GDP approaches a level of about 4 percent, income inequality starts declining with further increases in trade. This suggests that expansion of trade leads to deterioration in income inequality and further on the path to achieving SDG:10. From this analysis, we can infer that Hungary, Poland, and Russia are on the increasing part of the curve, indicating that the three nations are facing rising inequalities in their nations. Additionally, the value of the Gini coefficient shows that income inequality is decreasing with the increase in trade openness in South Africa. Furthermore, the values of the Gini coefficient for the remaining countries lie between the estimated range of threshold. To check for robustness, the paper employed the Driscoll-Kraay standard errors test (Driscoll and Kraay 1998). When the time dimension is large, Driscoll-Kraay standard errors are resilient to extremely generic kinds of cross-sectional (panel) and temporal dependency.

The results are reported in column (c) of Table 6.11. The estimates support the previous results of the CCE and DCCE estimator, confirming the trade-led KC for the selected panel.

The results of the Dumitrescu-Hurlin causality test are reported in Table 6.12, explaining the direction of causation between the variables. The results support the bi-directional causality between trade openness and inequality, GFCF and inequality, economic growth and inequality, FDI and inequality, internet usage and inequality, and HCI and inequality across the panel.

Table 6.12 Dumitrescu-Hurlin Causality Test

Null Hypothesis	**Z bar-statistic**	**p-value**
Ln_trade does not Granger-cause Ln_GINI.	26.5394***	0.0000
Ln_GINI does not Granger-cause Ln_trade.	8.1772***	0.0000
Ln_GFCF does not Granger-cause Ln_GINI.	11.6377***	0.0000
Ln_GINI does not Granger-cause Ln_GFCF	4.0150***	0.0000
Ln_GDP does not Granger-cause Ln_GINI.	22.4942***	0.0000
Ln_GINI does not Granger-cause Ln_GDP	8.5240***	0.0000
Ln_FDI does not Granger-cause Ln_GINI	3.3432***	0.0008
Ln_GINI does not Granger-cause Ln_FDI	1.8349*	0.0665
Ln_internet does not Granger-cause Ln_GINI.	29.6729**	0.0000
Ln_GINI does not Granger-cause Ln_internet	9.2820***	0.0000
Ln_HCI does not Granger-cause Ln_GINI	27.9328***	0.0000
Ln_GINI does not Granger-cause Ln_HCI	40.8453***	0.0000

*Source: Authors' computation. Note: ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10*

From the above results, we conclude some interesting findings as follows:

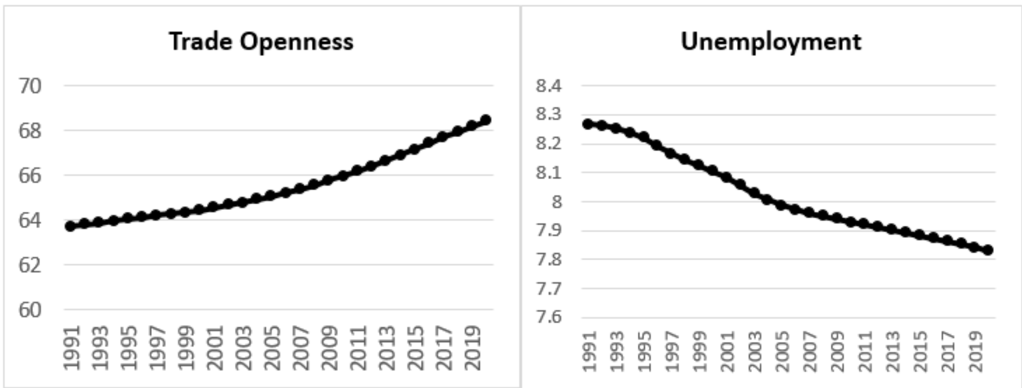
1. The study is able to establish a trade-led Kuznets curve i.e. inverted 'U-shaped' association between trade and income inequality in emerging countries.
2. GFCF ↔ Inequality
3. GDP per Capita ↔ Inequality
4. FDI ↔ Inequality
5. Internet usage ↔ Inequality
6. HCI ↔ Inequality

6.4 Econometric Analysis of Trade and Unemployment

The third approach addresses the issue of unemployment addressing SDG:8. Trade openness fosters economic growth by expanding the market size and optimally utilizing the resources, thereby creating new job opportunities in a country. On the one side, more open countries face higher economic growth, which reduces unemployment and income inequality compared to relatively close countries (Felbermayr et al., 2011; Onifade et al., 2020; Ali et al., 2022; Jain and Mohapatra, 2023a, b). On the other side, trade openness may also work in the opposite direction. With the increase in trade openness, infant industries in the domestic country are not able to compete with the efficient foreign industries, thereby increasing unemployment (Madanizadeh and Pilvar, 2019).

As evident from Figure 6.2, there is a continuous upward trend in trade openness while there is a constant decline in the unemployment rate in emerging economies, as defined by IMF (2021). Given the inextricable link between trade openness and unemployment, the major research question that needs to be addressed is how effective trade openness is in reducing unemployment in emerging economies.

Figure 6.2 Trend Analysis of Trade Openness and Unemployment



Source: Authors' Computation

The present section is categorized into two divisions. Firstly, data and model specification is described and secondly, empirical results of the analysis are discussed.

6.4.1 Data and Model Specifications

Panel data is used from 1991 to 2020 to estimate the effect of trade openness on unemployment for 20 emerging economies, namely Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkiye, United Arab Emirates. Data for the variables unemployment (lunemp), total natural resource rent (ltnrr), trade openness (ltrade), economic growth (lgdppc), and inflation (linflation) are collected from World Development Indicators (WDI), World Bank. The prefix l indicates the logarithmic transformation of the variables.

Table 6.13 Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
lunemp	1.831	0.731	-1.386	3.505
lgdppc	8.444	1.023	5.708	10.755
ltnrr	1.360	1.278	-1.968	4.015
ltrade	4.036	0.550	2.621	5.395
linflation	3.287	0.601	0	7.722

Source: Authors' Computation

Table 6.13 represents the descriptive statistics of the variables. The mean and standard deviation values of lunemp are 1.831 and 0.731, respectively. There is a narrow variation in the observations of total natural resources rent as indicated by the value of the standard deviation of ltnrr, which is 1.278. the standard deviation of trade openness is 0.550. The present study attempts to investigate the nexus between trade openness and unemployment. The following model (6.3.1) analyzes the impact of trade openness on unemployment.

$$lunemp_{it} = \beta_0 + \beta_1 lgdppc_{it} + \beta_2 ltnrr_{it} + \beta_3 ltrade_{it} + \beta_4 linflation_{it} + \varepsilon_{it} \quad (6.3.1)$$

6.4.2 Empirical Results

After specifying the models, it is required to check slope homogeneity and cross-section dependence (CSD) in panel data. Table 6.14 reports the results of the slope homogeneity test. It depicts that heterogeneity is present in all three models.

Table 6.14 Slope Homogeneity Test Results

	Delta	Delta adj.	p-value
Model (6.3.1)	17.576***	19.659***	0.000

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 6.15 reports the findings of the CSD test. The outcome suggests that all the variables are cross-sectional dependent. Furthermore, Table 6.16 reveals the outcome of the CADF unit root test. The results indicate that the variables are stationary at level and first difference. A combination of I(0) and I(1) variables exists.

Table 6.15 Cross-section Dependence Test

Variables	CSD-test	p-value
lunemp	4.93***	0.000
lgdppc	53.26***	0.000
ltnrr	40.04***	0.000
ltrade	24.79***	0.000
linflation	23.49***	0.000

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 6.16 CADF Unit Root Test

Variables	At Level	First Difference
lunemp	-1.529	-3.860***
lgdppc	-1.794	-3.434***
ltnrr	-1.876	-5.357***
ltrade	-2.056*	
linflation	-3.523***	

Source: Authors' Computation;
*Note: ***, *presents significance levels at 1 and 10 percentages, respectively.*

After assessing the unit root properties and cross-section dependence among variables, the article estimated the short-run and long-run association between trade openness and unemployment. Tables 6.17 and 6.18 report the short-run and long-run estimates of CS-ARDL estimation, respectively.

Table 6.17 CS-ARDL: Short-Run Estimates

Variables	Model (6.3.1)
lgdppc	-1.112** (0.456)
ltnrr	0.006* (0.049)
ltrade	-0.329*** (0.076)
linflation	-0.034 (0.047)
ECT(-1)	-0.665*** (0.147)

Source: Authors' Computation. Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5 and 1 percent, respectively.*

Table 6.18 CS-ARDL: Long-Run Estimates

Variables	Model (6.3.1)
lgdppc	-3.412** (1.471)
ltnrr	-0.074* (0.094)
ltrade	-0.388** (0.155)
linflation	0.088 (0.140)

Source: Authors' Computation; Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5 and 1 percent, respectively.*

In Model (6.3.1), economic growth positively impacts unemployment in the short and long run. When economic growth increases, the level of unemployment decreases, which is a good sign for an economy. It is also observed that trade openness has a significant and negative impact on unemployment in emerging economies. Trade openness in emerging countries leads to a reduction in unemployment by 38.8 percent in the long run. The study found the support from Céline et al. (2016). However, in the short run, total natural resources rents affect unemployment positively (Scherzer, 2015) while negatively in the long run. The results between unemployment and NRR match with the results of Fattah (2017) only in the short run but not in the long run.

Afterward, we ran the DH Non-causality test to test for the causality. Table 6.19 represents the results of the DH approach. The bi-directional relationship is evident between unemployment (lunemp), trade openness (ltrade), and NRR (ltnrr), as the coefficients are significant at a 1 percent level. Furthermore, a uni-directional relationship from NRR (ltnrr) to trade openness has been found.

Table 6.19 Dumitrescu-Hurlin Granger Non-causality Test

Causality	**Z-bar statistics**	**Remarks**
Ltrade → lunemp	4.599***	Bi-directional relationship between lunemp and ltrade
Lunemp → ltrade	5.723***	
ltnrr → lunemp	6.285***	Bi-directional relationship between lunemp and ltnrr
lunemp → ltnrr	5.712***	
ltrade → ltnrr	0.815	Uni-directional relationship from ltnrr to ltrade
ltnrr → ltrade	3.361***	

Source: Authors' Computation; Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5, and 1 percent, respectively.*

6.5 Summary and Findings

The present chapter of the study assesses the economic and social sustainability through trade openness for emerging economies owing to data availability. The analysis is carried out for the period of 1991-2020. The study is divided into three parts. First, it examines the dynamic linkage between trade openness and growth, inequality, and poverty considering the GIP triangle. Second, the role of trade openness in income inequality particularly using the Kuznets Curve (KC) framework is assessed. Third, the impact of trade openness on unemployment is investigated.

International trade is recognized as an engine for inclusive economic growth and reduction of poverty and inequality and a critical tool for achieving the SDGs. The first section of the study examines the role of trade in GIP triangle addressing SDG:8, SDG:1, and SDG:10, which is an issue of paramount importance today for emerging countries, considering the time from 1991 to 2020. Given the cross and multi-directional causalities, the link between trade and the GIP triangle seems more complex. The study applies the panel ARDL approach to examine the association between trade and the GIP triangle for 18 emerging countries. The empirical results indicate that trade encourages economic growth and significantly deteriorates income inequality in the long run for emerging countries. In contrast, trade has a significant adverse impact on growth in the short run. Trade increases the level of poverty measured by HCE, but income inequality deteriorates in emerging countries.

Moreover, it is observed from the causality test that there is a feedback relationship among the variables. As a contribution to the growing literature on the development impacts of trade, this study introduces the indirect effects of trade on poverty reduction and income inequality. The implications for poverty reduction depend on the level of trade protection a country imposes. The impact of trade policies is determined by many factors, such as differences in endowments, the extent of imperfect competition, economic policies, and frictions in factor markets. To maximize the effectiveness of a trade policy, it must be complementary and implemented in tandem with trade reforms. A comprehensive strategy is needed to end poverty.

The second section of the study adds to the existing body of literature by investigating the non-linear relationship between trade and income inequality in a panel framework for EEs to address goal 10 of SDGs. It also examines the trade-led KC for emerging countries during 1991–2020. To this end, the study employed CCE and DCCE approaches for long-term estimates. The robustness of the results was also checked using the Driscoll–Kraay standard errors approach. The empirical results of the study confirm the inverted "U-shaped" relationship between trade openness and income inequality, providing evidence for the trade-led KC. The coefficient of trade openness is significant and positive, and the square of trade openness has a negative sign. The findings of the study are in line with Jalil (2012) and Dobson and Ramlogan (2009). The findings indicate that trade significantly impacts income inequality, providing opportunities for further research as well as important insights for regulators and policymakers who plan and execute trade policies.

The third section of the study evaluates the nexus between trade openness and unemployment for 20 emerging economies from 1991 to 2020. As emerging economies strive to establish themselves on the international stage, they must navigate the intricate relationship between trade, economic growth, and job creation. The study employed the second-generation models since CSD and slope heterogeneity were present in the data. Moreover, the CS-ARDL model is utilized to test the intricate relationship in the short and long run. The analysis shows a reduction in unemployment due to increased trade openness and NRR in the long run.

After addressing the economic and social pillars of sustainable development, in the next chapter, the thesis analyses the third pillar of sustainable development that is environmental sustainability.

Chapter 7. Trade and Environmental Sustainability

7.1 Introduction

As the previous chapter has discussed the impact of trade on economic and social sustainability, the present chapter mainly focuses on the analysis of the impact of trade on environmental sustainability. Environmental sustainability is a key to a sustainable future. According to the United Nations Environment Program (UNEP, 2020), "environmental sustainability involves making choices that ensure an equal, if not better, way of life for future generations". In other words, it is the practice of responsibly interacting with the planet. Environmental sustainability enhances human well-being without unduly compromising the planet's life-sustaining ecosystems. It involves striking a balance between consumerist human society and the natural world. This can be achieved by living in a way that doesn't waste or unnecessarily deplete natural resources (Arora, 2018).

Environmental sustainability is crucial, given the quantity of resources we use daily, including food, energy, and manufactured goods. Increased agricultural and manufacturing due to rapid population growth have increased greenhouse gas (GHG) emissions, unsustainable energy consumption, and deforestation. This puts more pressure on the sustainability of the environment. Being an important pillar of sustainability, it has a significant positive impact on human health and the health of other species. It reduces carbon footprints internationally and dependence on fossil fuels and other destructive energy practices. Sustainability can lengthen life expectancy and narrow the wealth and poverty gap by promoting healthier living conditions and improved healthcare. In order to address the industrial aspect of waste and pollution, sustainable development promotes more ethical manufacturing and production (Moldan et al., 2012; Dong and Hauschild, 2017; Arora, 2018).

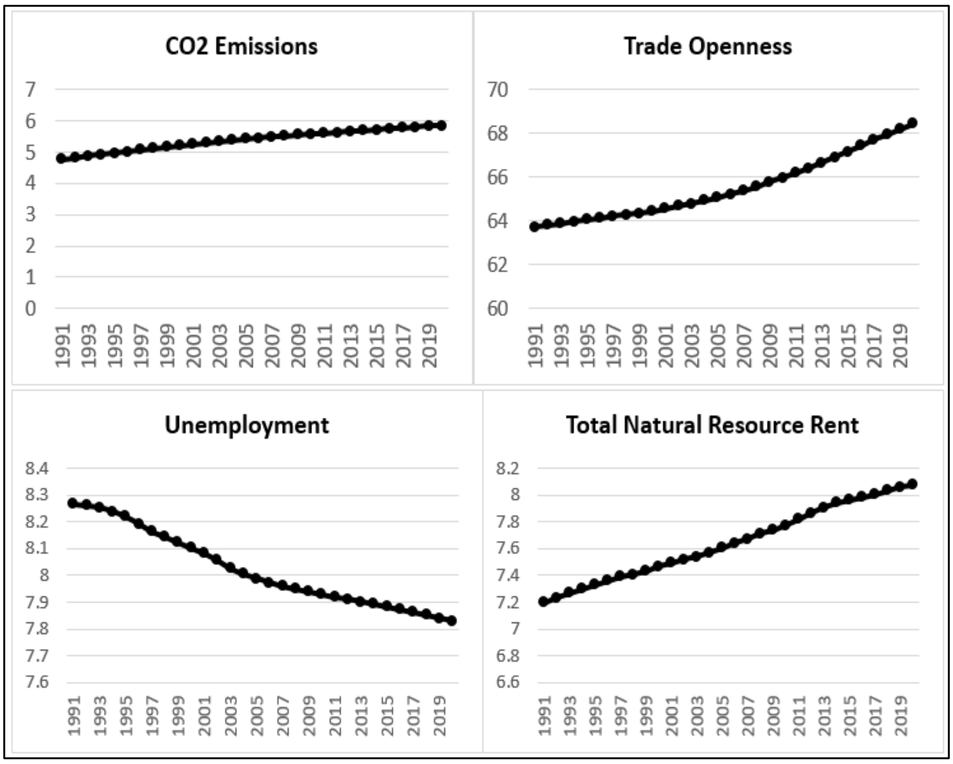
Trade promotes growth and development in a country (Zahonogo, 2016). Trade in goods and services leads to the growing inter-dependencies between production and consumption across countries. Strong trade relationships among countries boost the country's production and standard of living of the people, hence facilitating poverty reduction and economic growth (Tipping and Wolfe, 2016; WTO, 2020; Zafar et al., 2020). Although international trade provides a growth impetus among countries, its implications on environmental sustainability are becoming a growing concern through increasing pollution and depleting natural resources. However, as trade has expanded, questions about its impacts on the environment and, more generally, about the ability of nature to withstand the environmental effects of economic activity have also been raised.

The present study attempts to study the effect of trade openness on environmental sustainability for emerging economies over the period 1991-2020. To measure the environmental sustainability, the study uses the two alternative approaches. First, a single indicator approach is used to investigate the long-run impact of trade openness on CO_2 emissions along with the total natural resources rent (NRR). Second, the composite indicators approach is used in which seven indicators of environmental sustainability, namely, natural resources rent (NRR), renewable freshwater resources (RWR), water productivity (WP), air pollution (AP), CO_2 emissions per gross domestic product (GDP) (CO_2), the energy intensity of primary energy (EI), and the use of renewable energy (REC), is used to construct the Composite Environmental Sustainability Index (CESI). Further, the index is used to assess the impact of trade on CESI.

7.2 Econometric Analysis of Trade and CO_2 Emissions

From the above discussion, it is clear that trade openness and natural resources rent (NRR) play a vital role in addressing the issues of environmental pollution. Thus, the significance of the present study is to delve into the complex web of factors that contribute to the above challenges, examine their interrelationships, and emphasize the urgent need for holistic approaches that promote economic prosperity and environmental stewardship in emerging economies.

Figure 7.1 Diagrammatic Representation of the Variables



Source: Authors' Computation

As evident from Figure 7.1, there is a continuous upward trend in trade openness, CO_2 emissions, as well as total natural resource rent in 20 emerging economies as defined by IMF (2021). Moreover, CO_2 emissions (upward) and unemployment (downward) shows the opposite trend to each other that gives an idea of Environment Philips Curve (EPC). The EPC shows the trade-off between unemployment and environment degradation (Kashem and Rahman 2021; Shastri et al. 2022). As emerging economies strive to establish themselves on the international stage, they must navigate the intricate relationship between economic growth and the sustainable use of natural resources.

Given the inextricable link between trade openness and natural resource rent on environmental quality, specific research questions need to be addressed. The major research questions are as follows: first, does trade openness contribute to environmental degradation in emerging economies? If so, what is the magnitude? Second, does natural resource rent contribute to environmental degradation? If so, to what extent? Finally, does EPC exist for emerging economies? The two major challenges that the present research focuses on are preventing environmental degradation (SDG:13) and sustainable use of natural resources (SDG:12) in the context of emerging economies.

The current section is further categorized into two parts. The first section explains the data and model specification employed in the study. The second section presents the empirical findings of the study.

7.2.1 Data and Model Specifications

In this section, models and data characteristics are summarized. Panel data is used from 1991 to 2020 to estimate the effect of trade openness and NRR on CO_2 emissions for 20 emerging economies, namely Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkiye, United Arab Emirates. Data for the variables CO_2 emissions (lCO_2), unemployment (lunemp), total natural resource rent (ltnrr), trade openness (ltrade), economic growth (lgdppc), use of renewable energy (lrec), innovation (linnov), population growth (PG), and foreign direct investment (FDI) are collected from World Development Indicators (WDI), World Bank. Financial development (FD) data is obtained from the International Monetary Fund (IMF) database. The prefix l indicates the logarithmic transformation of the variables.

The present study attempts to investigate the nexus between trade openness, CO_2 emissions, unemployment, and total natural resource rents. The following are the models specified to analyse the nexus. Model (7.1.1) tests for the existence of the EPC in the case of emerging economies by looking at the impact of unemployment on CO_2 emissions. Further, model (7.1.2) illustrates the effect of trade openness, NRR, and unemployment on CO_2 emissions.

$$lCO2_{it} = \beta_0 + \beta_1 lunemp_{it} + \beta_2 lgdppc_{it} + \beta_3 lrec_{it} + \beta_4 PG_{it} + \beta_5 FDI_{it} + \varepsilon_{it} \quad (7.1.1)$$

$$lCO2_{it} = \beta_0 + \beta_1 lunemp_{it} + \beta_2 lgdppc_{it} + \beta_3 lrec_{it} + \beta_4 ltrade_{it} + \beta_5 ltnrr_{it} + \beta_6 FD_{it} + \beta_7 linnov_{it} + \varepsilon_{it} \quad (7.1.2)$$

7.2.2 Empirical Results

In this section, the outcome of the empirical investigation is discussed. Table 7.1 represents the descriptive statistics of the variables.

Table 7.1 Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
lCO_2	1.375	0.863	-0.445	3.458
lunemp	1.831	0.731	-1.386	3.505
lgdppc	8.444	1.023	5.708	10.755
ltnrr	1.360	1.278	-1.968	4.015
ltrade	4.036	0.550	2.621	5.395
lrec	1.987	2.027	-4.605	4.068
FD	0.416	0.134	0.114	0.797
linnov	8.188	2.246	0	14.248
PG	1.440	1.530	-1.044	15.177
FDI	2.897	6.668	-40.086	106.594

Source: Authors' Computation

The Mean and Standard deviation of the lCO_2 are 1.375 and 0.863, respectively, depicting narrow variation in observations from the mean. The mean and standard deviation values of lunemp are 1.831 and 0.731, respectively. There is a narrow variation in the observations of total natural resources rent as indicated by the value of the standard deviation of ltnrr, which is 1.278. the standard deviation of trade openness is 0.550. The results also suggest little variation in renewable energy consumption in the sample countries. Table 7.2 reports the results of the slope homogeneity test. It depicts that heterogeneity is present in all two models. Table 7.3 reports the findings of the CSD test. The outcome suggests that all the variables are cross-sectional dependent. Furthermore,

Table 7.2 Slope Homogeneity Test Results

	Delta	Delta adj.	p-value
Model (7.1.1)	23.759***	27.162***	0.000
Model (7.1.2)	19.307***	23.332***	0.000

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 7.3 Cross-section Dependence Test

Variables	CSD-test	p-value
lCO_2	20.36***	0.000
lunemp	4.93***	0.000
lgdppc	53.26***	0.000
ltnrr	40.04***	0.000
ltrade	24.79***	0.000
lrec	16.23***	0.000
FD	39.26***	0.000
linnov	25.49***	0.000
PG	30.99***	0.000
FDI	7.51***	0.000

*Source: Authors' Computation; Note: *** presents a significance level at 1 percent.*

Table 7.4 reveals the outcome of the CADF unit root test. The results suggest that the variables are stationary at level and first difference. A combination of I(0) and I(1) variables exists.

Table 7.4 CADF Unit Root Test

Variables	At Level	First Difference
lCO_2	-1.716	-4.316***
lunemp	-1.529	-3.860***
lgdppc	-1.794	-3.434***
ltnrr	-1.876	-5.357***
ltrade	-2.056*	
lrec	-2.305***	
FD	-2.635***	
linnov	-2.789***	
PG	-1.992	-2.642***
FDI	-2.642***	

*Source: Authors' Computation; Note: ***, *presents significance levels at 1% and 10 %, respectively.*

Table 7.5 CS-ARDL: Short-Run Estimates

Variables	Model (7.1.1)	Model (7.1.2)
lunemp	-0.035* (0.019)	0.059** (0.024)
lgdppc	0.356*** (0.106)	0.250** (0.117)
lrec	-0.284*** (0.060)	-0.363*** (0.070)
PG	-0.032 (0.040)	
FDI	0.040 (0.002)	
ltnrr		-0.002* (0.023)
ltrade		-0.027* (0.035)
FD		0.068 (0.128)
linnov		-0.009 (0.014)
ECT(-1)	-0.866*** (0.038)	-0.821*** (0.041)

Source: Authors' Computation; Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5, and 1 percent, respectively.*

After assessing the unit root properties and cross-section dependence among variables, the article estimated the short-run and long-run association between trade openness, total natural resources rent, unemployment, and CO_2 emissions. Tables 7.5 and

7.6 report the short-run and long-run estimates of CS-ARDL estimation, respectively. The dependent variable in model (7.1.1) is carbon emissions (lCO_2). It unveils the existence of EPC in emerging economies.

The estimates indicate that there is a negative and significant relationship between unemployment and CO_2 emissions in the short and long run. A 1 percent increase in unemployment reduces the level of CO_2 emissions by 3.5 percent in the short run, while it will reduce by 4.4 percent in the long run. This implies that the environmental quality will improve at the cost of rising unemployment and vice-versa. This is referred to as the trade-off between unemployment and CO_2 emissions. Economic growth and renewable energy consumption reveal the positive and negative impact on CO_2 emissions, respectively, in both the short and long run.

Table 7.6 CS-ARDL: Long-Run Estimates

Variables	**Model (7.1.1)**	**Model (7.1.2)**
lunemp	-0.044* (0.023)	-0.082** (0.036)
lgdppc	0.389*** (0.129)	0.282** (0.129)
lrec	-0.330*** (0.075)	-0.499*** (0.142)
PG	-0.039 (0.050)	
FDI	0.052 (0.002)	
ltnrr		-0.019* (0.034)
ltrade		-0.040* (0.062)
FD		0.139 (0.170)
linnov		-0.015 (0.018)

Source: Authors' Computation; Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5 and 1 percent, respectively.*

Model (7.1.2) evaluates the impact of NRR, trade openness, and unemployment on CO_2 emissions for emerging economies. The impact of unemployment on CO_2 emissions turns negative in the long run from positive in the short run, depicting the trade-off between them. The impact of ltrade, ltnrr, and lrec on CO_2 emissions is negative in the short and long run. This indicates that opening up the economy for foreign countries decreases CO_2 emissions and improves the quality of the environment. Additionally, an increase in total NRR reduces the CO_2 emissions.

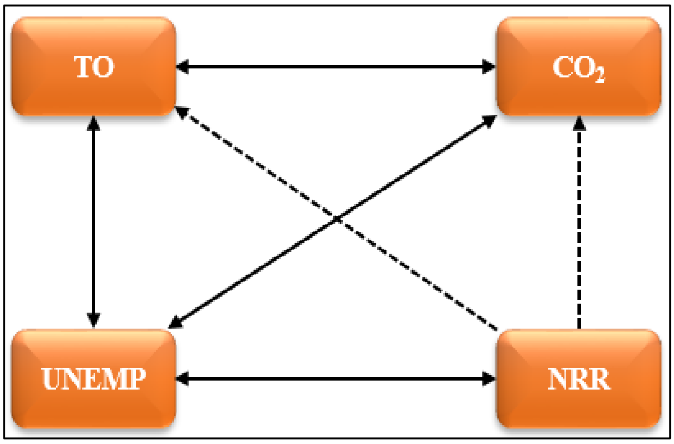
Afterward, the Dumitrescu-Hurlin (DH) Non-causality test is used to test for the causality. Table 7.7 represents the results of the DH approach. The bi-directional relationship is evident between unemployment (lunemp), CO_2 emissions (lCO_2), trade openness (ltrade), and Total NRR (ltnrr), as the coefficients are significant at a 1 percent level. It depicts that any policy changes in unemployment and trade openness can affect the level of CO_2 emissions. Furthermore, a uni-directional relationship between NRR (ltnrr), trade openness, and CO_2 emissions has been found. Figure 7.2 graphically represents the results of the DH granger non-causality test.

Table 7.7 Dumitrescu-Hurlin Granger Non-causality Test

Causality	**Z-bar statistics**	**Remarks**
lunemp → lCO_2	4.817***	Bi-directional relationship between lunemp and lCO_2
lCO_2 → lunemp	4.015***	
ltrade → lunemp	4.599***	Bi-directional relationship Between lunemp and ltrade
lunemp → ltrade	5.723***	
ltnrr → lunemp	6.285***	Bi-directional relationship Between lunemp and ltnrr
lunemp → ltnrr	5.712***	
ltnrr → lCO_2	4.950***	Unidirectional relationship from ltnrr to lCO_2
lCO_2 → ltnrr	1.131	
ltrade → ltnrr	0.815	Unidirectional relationship from ltnrr to ltrade
ltnrr → ltrade	3.361***	
ltrade → lCO_2	12.127***	Bi-directional relationship Between lCO_2 and ltrade
lCO_2 → ltrade	2.519**	

Source: Authors' Computation; Note: Standard errors are in parentheses.
, **, and * show significance levels at 10, 5 and 1 percent, respectively.*

Figure 7.2 Graphical Representation of the Causality Test



Note: The bold lines show the bi-directional causality, whereas dotted lines show the uni-directional causality between the variables. Source: Authors' Computation

7.3 Econometric Analysis of Trade and Composite Environmental Sustainability

This section of the chapter seeks to empirically analyze the relationship between trade openness and composite environmental sustainability. Accordingly, this section is further classified into two parts. The first section elucidates the construction of composite environmental sustainability index (CESI). While, the second section analyzes the impact of trade and its components (trade openness, direction and composition) on CESI.

7.3.1 Construction of Composite Environmental Sustainability Index (CESI)

The present section of the study contributes to the literature by constructing a composite index of environmental sustainability by choosing the seven indicators of the most importance based on the data availability. The index also addresses the five SDGs namely, SDG:6, SDG:7, SDG:9, SDG:11, and SDG:12. To the best of the authors' knowledge, environmental sustainability has not been discussed in the literature using the composite indicators approach and addressing more than one SDG. Hence, the CESI has not been created for any country. Furthermore, the study uses a recently developed principal component analysis (PCA) approach for index construction.

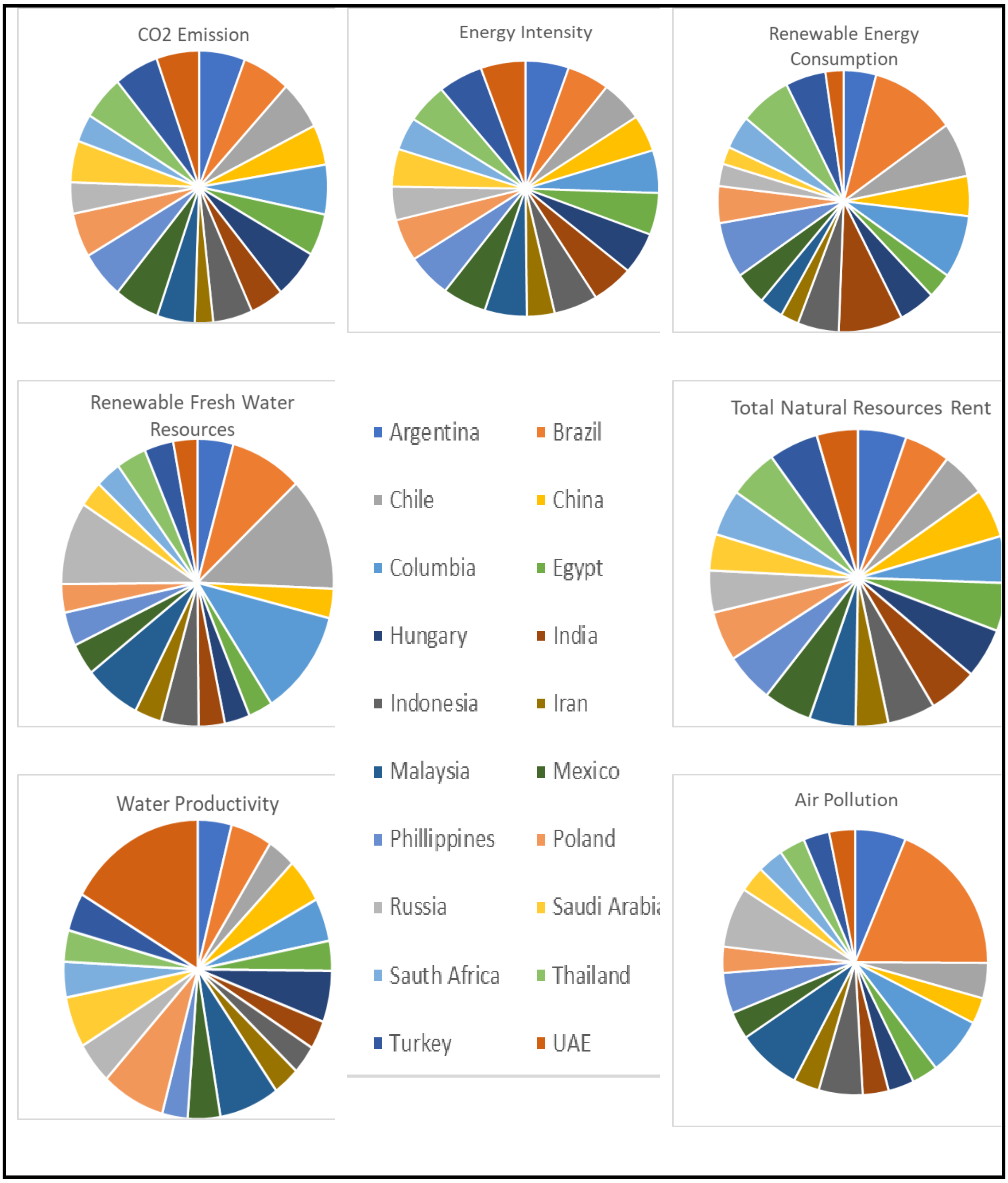
Thus, the section is further classified into three parts. The first section explains the data used in the analysis. It defines the indicators of the index. The second section presents the empirical analysis of the results. The third section deals with the discussion of the findings.

7.3.1.1 Description of Data

The environmental sustainability index (ESI) was formulated by World Economic Forum (WEF) jointly with the Yale Centre for Environmental Law and Policy (YCELP) and the Centre for International Earth Science Information Network (CIESIN) of Columbia University. However, the ESI is not very clear due to the terminology used for it. For example, environmental performance index (EPI) was previously called ESI (Fischer et al., 2022). However, these two terms have different meanings and understandings in the literature. The EPI only tracks and compares the countries based on their performance in environmental indicators. In contrast, the ESI measures the overall progress of nations toward environmental sustainability for the present as well as for future generations. The index constructed in this study is the Composite Environmental Sustainability Index (CESI).

For the construction of CESI, the study uses the indicators defined by ADB for environmental sustainability in constructing IGGI (Figure 7.3). This includes- natural resources rent (NRR), renewable freshwater resources (RWR), water productivity (WP), air pollution (AP), CO_2 emissions per GDP (CO_2), the energy intensity of primary energy (EI), and the use of renewable energy (REC). However, CESI under this study does not include some aspects of environmental sustainability such as water quality, waste management, land productivity, and bio-diversity protection because of data unavailability. World Development Indicators (WDI), World Bank; Human Progress, World Bank; International Energy Agency (2021), and World Energy Balances are the data sources for these indicators. Table 7.8 describes the data in detail. The present study constructs the CESI for 20 emerging countries for the period 1991-2020. It also highlights the indicators' relationship to environmental sustainability and the SDGs addressed by these indicators. The detailed methodology particular to the construction of CESI is described in Appendix B.

Figure 7.3 Graphical Representation of the Indicators



Source: Authors' Computation

Table 7.8 Description of Indicators and Data Sources

Indicator	Definition	Data Source	Relation to environmental sustainability	Mapping SDGs (Jha et al., 2018)
Natural resources rent (% of GDP)	Total revenue generated from extracting natural resources.	WDI, World Bank	Negative	SDG12: responsible consumption and production
Renewable internal freshwater resources per capita	Internal renewable resources in the country	Human Progress, World Bank	Positive	SDG6: clean water and sanitation
Water Productivity	Efficiency by which each country uses its water resources	Human Progress, World Bank	Positive	SDG6: clean water and sanitation
Air Pollution	Percent of the population exposed to ambient concentrations of PM2.5	WDI, World Bank	Negative	SDG11: sustainable cities and communities
CO_2 emission per GDP	CO_2 emissions from the burning of fossil fuels and the manufacture of cement.	WDI, World Bank	Negative	SDG9: Industry, innovation, and infrastructure
Energy Intensity	Energy used to produce one unit of economic output	International Energy Agency (2021), World Energy Balances	Negative	SDG7: affordable and clean energy
Use of renewable energy consumption	Share of renewable energy in total final energy consumption.	WDI, World Bank	Positive	SDG7: affordable and clean energy

7.3.1.2 Empirical Results

Table 7.9 depicts the calculated principal components and the variance explained by those components. We obtain a total of three principal components using Kaiser's (1960) guideline of retaining factors with eigenvalues greater than one. Furthermore, for the preparation of index weights, Varimax rotation is used to get component loadings. The factor loadings are presented in Table 7.10. Seven indicator variables are divided into three components based on the absolute value of their loadings.

Table 7.9 Total Variance Explained

Component No.	Components	Eigenvalue	Proportion	Cumulative
1	CO_2 Emissions	2.40	0.34	0.34
2	Energy intensity	1.63	0.23	0.57
3	Use of renewable energy	1.18	0.16	0.74
4	Renewable freshwater resources	0.73	0.10	0.84
5	Natural resources rent	0.55	0.07	0.92
6	Water productivity	0.42	0.06	0.98
7	Air pollution	0.07	0.01	1.00

Source: Authors' computation

Table 7.10 Rotated Component Matrix

Component No.	Components	Component Loadings		
		1	2	3
1	CO_2 Emissions	0.67		
2	Energy intensity	0.68		
3	Use of renewable energy		0.53	
4	Renewable freshwater resources			0.62
5	Natural resources rent		0.58	
6	Water productivity		-0.60	
7	Air pollution			0.71

Source: Authors' computation

Table 7.11 Description of CESI Components and Indicators Based on PCA

Components	Indicators
PC1	CO_2 Emissions Energy intensity
PC2	Use of renewable energy Natural resources rent Water productivity
PC3	Renewable freshwater resources Air pollution

Source: Authors' computation

Table 7.11 shows the principal components, which are a blend of indicators from various CESI sub-indices. For instance, the first component (PC1) includes indicator 1 and indicator 2, i.e., CO_2 emissions and energy intensity, respectively. The second component (PC2) covers indicators 3, 5, and 6, which are the use of renewable energy, natural resources rent, and water productivity, respectively. The third component (PC3) includes 4 and 7, i.e., renewable freshwater resources and air pollution.

Based on the results of Table 7.10, the CESI is constructed using the arithmetic mean of all indicators shown in Table 7.11. Weights are calculated using the absolute value of factor loading of the respective variable and the proportion of variance explained by the component in which the respective variable falls. Following this, the calculation of the weighted mean provides the final index value for environmental sustainability for each country and the given time period in the dataset. The value of CESI lies in the range 1-6, where 1 represents the worst condition, and 6 indicates the best state of environmental sustainability. Table 7.12 presents the Composite Environmental Sustainability Index (CESI) value in 2020 for each emerging country used in the study.

Table 7.12 CESI Values for Emerging Countries in 2020

S. No.	Countries	CESI	CESI Robust	S. No.	Countries	CESI	CESI Robust
1	Iran	2.02	2.02	11	Turkey	3.36	3.35
2	South Africa	2.62	2.66	12	Hungary	3.38	3.38
3	Saudi Arabia	2.83	2.77	13	Poland	3.39	3.41
4	Egypt	3.05	3.01	14	Argentina	3.50	3.44
5	China	3.08	3.12	15	Philippines	3.52	3.51
6	India	3.14	3.22	16	United Arab Emirates	3.57	3.60
7	Russia	3.18	3.12	17	Malaysia	3.59	3.52
8	Thailand	3.26	3.29	18	Chile	3.89	3.84
9	Mexico	3.29	3.25	19	Columbia	4.19	4.14
10	Indonesia	3.35	3.32	20	Brazil	4.80	4.70

Source: Authors' computation

7.3.1.3 Robustness Test

This section tests the robustness of the weighting method used in PCA for index construction. An indicator's weight in an index represents its relative significance or contribution to the index. There are various weighting approaches used in the literature, such as through factor analysis, PCA, and eliciting expert opinion. Since the index constructed in the present study is not readily available in the previous literature, equal weighting is used for the robustness check. All indicators are given the same weight for aggregation in the equal weighting method (Bandura, 2008; OECD, 2008; Greco et al., 2019). In the current study, seven indicators are used for CESI construction, each given an equal weight of 1. Table 7.12 shows the CESI values calculated from the equal weighting method for robustness. The resulting values of the index are almost the same. Hence, our index is robust.

7.3.1.4 Discussion

This section of this chapter is devoted to the discussion of the findings. Overall, the CESI values in Table 7.12 show that the index lies between 2 and 4.8 for the 20 emerging countries considered in the study. It depicts a diverse picture of environmental sustainability among emerging countries. Figure 7.4 shows the trend of CESI values from 1991 to 2020. The bottom three countries whose CESI is very low compared to others are Iran, South Africa, and Saudi Arabia. The trend of the CESI of Iran, as shown in figure 7.4, is declining and hovering around 2 to 2.5. South Africa's trend of CESI was increasing initially, but after 2015 it shows a negative trend. However, the value of CESI for Saudi Arabia varies during 1991-2020.

The issues restricting Iran's environmental quality are inadequate infrastructure and policies. Corruption in Iran, even in the fossil fuel sector hampers the implementation of policies. Iran is the seventh-highest GHG emitter in the world. It has significant oil, gas, and renewable energy sources, but sanctions have impeded its capacity to convert to clean energy. Therefore, Iran cannot participate in international conferences and regional research projects. When sanctions are withdrawn, Iran will be able to purchase environmental improvement items, have easier access to higher-grade refined gasoline, and collaborate with climate change and management specialists to assist government agencies in developing and implementing policies (Mulhern, 2020; Huntington and Doggart, 2020). The per capita CO_2 emissions from fossil fuels in South Africa are the highest among African nations, almost double the global average.

Moreover, its per capita GHG emission is also high. Extreme weather events are becoming more frequent and severe in South Africa. Furthermore, the country's reliance on coal for energy increases GHG emissions (D'Souza et al., 2022). The objective of South Africa to become carbon-neutral by the middle of the century calls for a dramatic economic change supported by a business-friendly climate, a labour market that facilitates job creation, and more excellent governance and transparency. A more effective price signal to reduce greenhouse gas emissions would be provided by carbon taxes, which are currently too low when allowances and exemptions are taken into account.

Additionally, a better design of carbon taxes would free up policy space to support low-income households, vulnerable workers, and regions (Qu, 2022). The biggest oil exporter in the world, Saudi Arabia, has not typically been linked with environmentally friendly practices. For many years, its oil exports have fuelled the expansion of the world economy. It exported 13.3% of the world's oil in 2019, which also meant that it significantly impacted global warming. Saudi Arabia is one of the worst countries in the world for CO_2 emissions per person due to its heavy domestic oil use. Saudi Arabia's government has been forced to focus more on environmental sustainability as a way to diversify its economy due to the country's excessive reliance on oil at a time when nations are trying to minimize fossil fuel usage and carbon emissions. Saudi Arabia has expanded investment and government resources to put the kingdom on a more environmentally sustainable footing since the announcement of its national reform programme, "Vision 2030," five years ago. It has done this by investing in renewable energy, particularly solar power, launching campaigns to minimize household energy and oil use, and pushing carbon/capture storage technologies to enable continued use of oil without harming the environment (Neve, 2021).

However, Brazil, Columbia, and Chile are CESI's top three highest scorers in 2020. Brazil's CESI was initially increasing since 2009, but after 2018 it is almost stagnant around the score of 4.8. Brazil is the world's 13th highest emitter of greenhouse gases. Because of their responsibilities to the Amazon Rainforest, they are uniquely positioned regarding the climate problem. Mangroves, coral reefs, and coastal habitats are also threatened if climate change is not addressed. Brazil is also plagued by mosquito-borne disease and extreme weather events, which may be exacerbated by climate change.

According to data from 2010, Brazil had cut Amazon deforestation rates by more than 70%, the lowest level in more than 20 years. Brazil has almost met its target of reducing Amazon deforestation 80 percent by 2020 over 2005 levels, which would help the South American country reach its voluntary goal of cutting greenhouse gas emissions by at least 36 percent below business-as-usual levels by 2020. Although there was little deforestation in the Amazon region between 2010 and 2018, evidence indicates that after 2019, the rate began to rise significantly. Despite all of these initiatives, the issue of deforestation and illegal logging have persisted as major problems throughout the nation (Escobar, 2019).

Columbia's CESI score started increasing after 2011, from 3.97 to 4.25 in 2017, but in the last three years, it declined to 4.19 in 2020. The nation is becoming more susceptible to landslides, flooding, and water shortages, which have an impact on key infrastructure, human health, and agricultural production. Colombia pledged to reduce greenhouse gas emissions by 51 percent in 2030 (compared to the baseline scenario) and work toward becoming carbon neutral by 2050 when it released its updated Nationally Determined Contributions (NDC) to the United Nations Framework Convention on Climate Change in December 2020. Colombia has since made several significant moves to put its aspirations into practice.

Like developing a local green bond market to finance green projects, adopting national green taxonomy, developing infrastructure projects for sustainability, and ESG (environmental, social, governance) integration for the financial sector. Chile's CESI score is the 3rd highest, but the trend has been declining over time. Chile is One of the Latin American nations with the highest levels of economic development. The GDP of the nation has more than doubled over the past 20 years, which has aided in raising the standard of living for its people. However, there are various challenges in reducing the negative environmental impact, such as air pollution, water pollution, soil contamination, climate change, and threats to biodiversity. Chile has initiated a national climate commitment known as Nationally Determined Contribution (NDC) and more steps towards environmental sustainability (Leprince-Ringuet, 2020; Bucher and Winter, 2020).

Figure 7.4 Trend of Estimated CESI Values

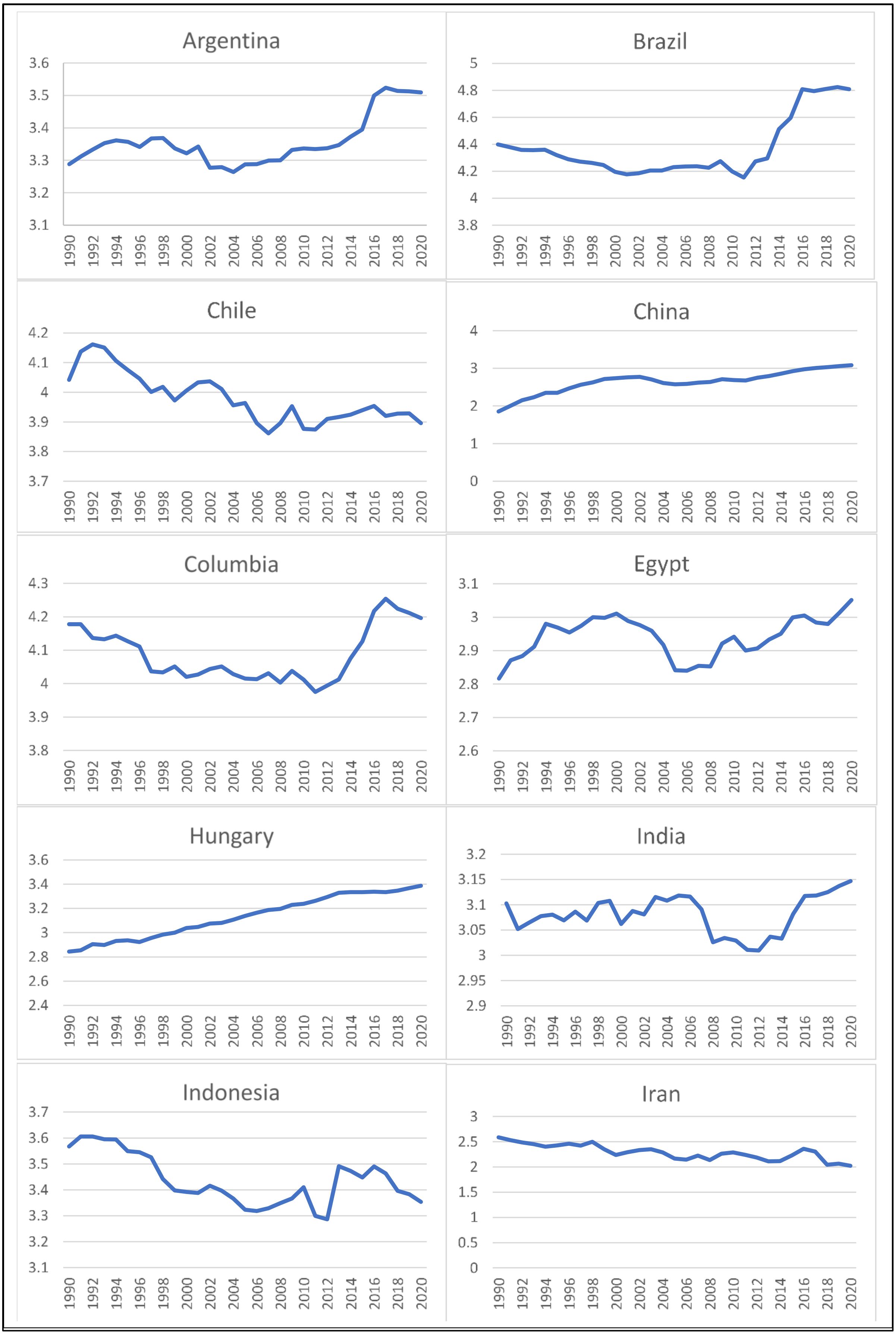
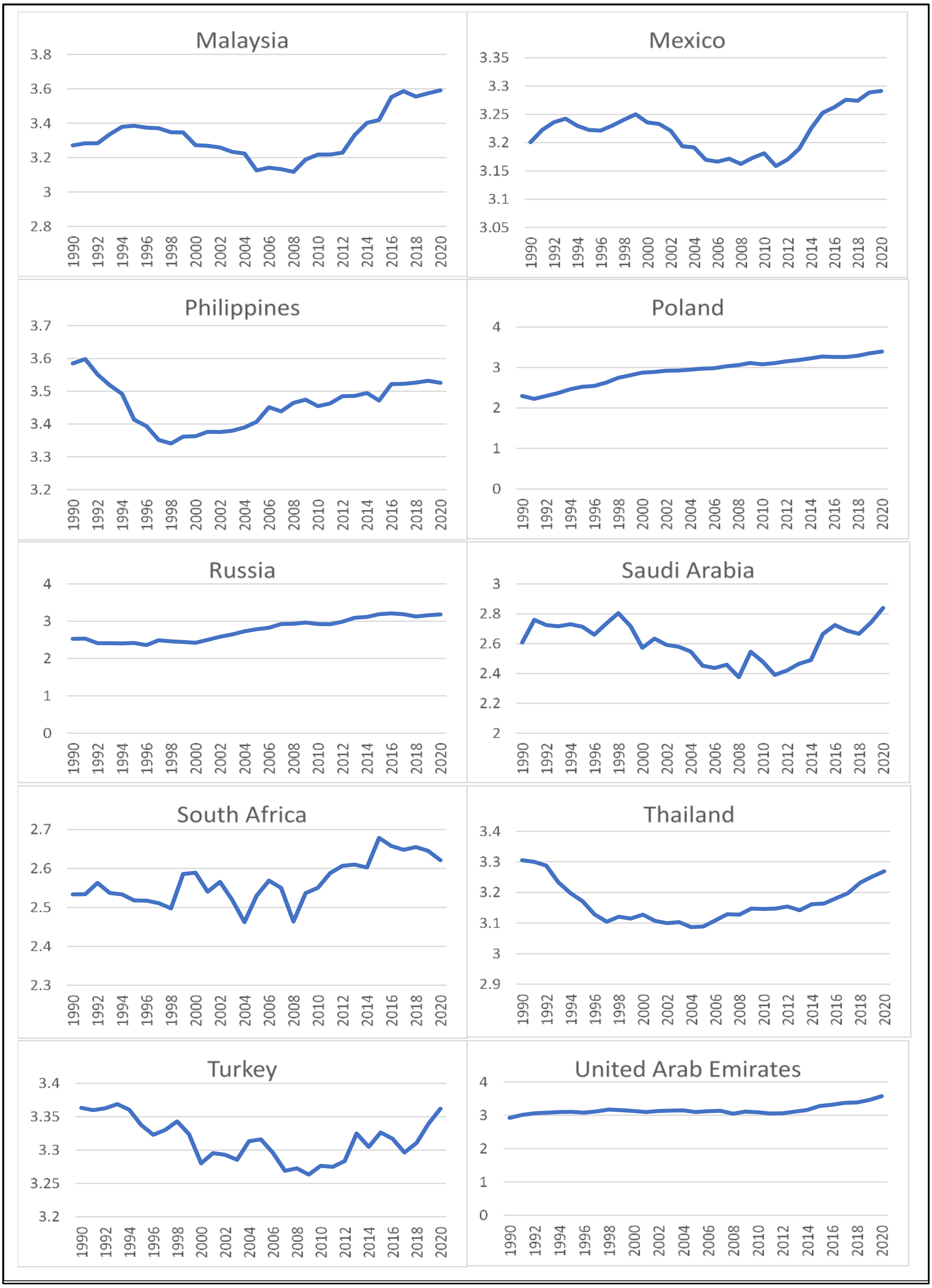


Figure 7.4 Trend of Estimated CESI Values (cont.)



Source: Authors' computation

7.3.2 Impact of Trade on CESI

The present section examines the causal link between components of international trade and environmental sustainability using the composite indicators approach for emerging countries for which there has been no empirical investigation to date. Moreover, the present research aims to address some critical research questions. For instance, is trade openness good or bad for environmental sustainability? Can trade and environmental policies be combined to maximize benefits and minimize environmental costs? To address these questions, the present study utilizes a new approach (composite index) to measure environmental sustainability. The novel contribution of the study is also evident in assessing the effect of components of trade on environmental sustainability while suggesting policy implications to optimize trade and its cost to the environment in emerging economies.

This section is divided into two segments. The first segment provides data and model specifications. The second segment presents the empirical results of the study.

7.3.2.1 Data and Model Specifications

After constructing CESI, the study intends to explore the link between trade and environmental sustainability. Model (7.2.1) is the baseline model. For the detailed analysis of the role of trade, the study uses the disaggregated trade analysis as shown in model (7.2.2) and model (7.2.3). The three models can be written as follows:

$$CESI_{it} = \alpha_1 + \beta_1 ltrade_{it} + \beta_2 lGDP_{it} + \beta_3 lFDI_{it} + \beta_4 lIN_{it} + \beta_5 lURB_{it} + \varepsilon_{it} \quad (7.2.1)$$

$$CESI_{it} = \alpha_1 + \beta_1 lTG_{it} + \beta_2 lTS_{it} + \beta_3 lGDP_{it} + \beta_4 lFDI_{it} + \beta_5 lIN_{it} + \beta_6 lURB_{it} + \varepsilon_{it} \quad (7.2.2)$$

$$CESI_{it} = \alpha_1 + \beta_1 lEX_{it} + \beta_2 lIM_{it} + \beta_3 lGDP_{it} + \beta_4 lFDI_{it} + \beta_5 lIN_{it} + \beta_6 lURB_{it} + \varepsilon_{it} \quad (7.2.3)$$

In model (7.2.1), trade openness (ltrade) is measured by the trade of goods and services as a percent of GDP. In model (7.2.2), trade is disaggregated into merchandise trade and trade in services. It has been seen that the most active area of global trade over the past 20 years has been the trade in services, which has grown faster than goods trade. Since their percentage of global service exports increased from a quarter to a one-third over this time. Developing nations and emerging economies have contributed more significantly in this field. Moreover, trade in services and merchandise trade impacts the environment differently (WTO, 2015). Merchandise trade and services trade are measured by trade in goods (lTG) and trade in services (lTS) as a percentage of GDP in the model (7.2.2). In the model (7.2.3), the study tries to focus on the effect of exports (lEX) and imports (lIM) of goods and services measured as a percentage of GDP on environmental sustainability. Since the direction of trade should also be considered for environmental sustainability, that may result in a pollution haven or halo hypothesis.

Table 7.13 Description of Data

Variables	Description	Symbols	Data Source
Environmental Sustainability	Index	CESI	Authors' calculation
Trade Openness	Trade (% of GDP)	ltrade	WDI, World Bank
Trade in goods	Merchandise trade (% of GDP)	lTG	WDI, World Bank
Trade in services	Trade in services (% of GDP)	lTS	WDI, World Bank
Exports	Exports of goods and services (% of GDP)	lEX	WDI, World Bank
Imports	Imports of goods and services (% of GDP)	lIM	WDI, World Bank
Income	GDP per capita (current US$)	lGDP	WDI, World Bank
Innovations	Patent application	lIN	WDI, World Bank
Investment flows	Foreign direct investment, net inflow (% of GDP)	lFDI	WDI, World Bank
Financial development	Domestic credit to private sector (% of GDP)	lFD	WDI, World Bank
Institutional Quality	Index	INST	Authors' calculation
Urbanization	Urban Population	lURB	WDI, World Bank

Various control variables are also included in the model specifications. GDP per capita (lGDP) is the indicator of income. FDI inflow (FDI) is taken as the indicator of investment flows, expressing the importance of investment. Innovation (lIN) is considered here and measured by patent applications (Muhammad et al., 2020). This variable has been employed as a crucial measure in numerous investigations. According to specific research, innovation lowers carbon emissions. lURB is the urban population. The prefix l indicates that the variables are transformed in their logarithmic form. Authors have constructed the Index of CESI. The data for other variables are gathered from World Development Indicators (WDI), World Bank. Table 7.13 presents the variables and their description in detail. Table 7.14 summarizes the data and shows the descriptive statistics for all variables. Column 1 shows the variables' names. Columns 2, 3, and 4 provide the value of the mean, standard deviation, maximum, and minimum, respectively.

Table 7.14 Descriptive Statistics of the Variables

Variables	Mean	Standard Deviation	Maximum	Minimum
CESI	3.190	0.532	1.853	4.823
ltrade	4.024	0.559	2.621	5.395
lTG	3.852	0.607	2.367	5.258
lTS	2.306	0.615	0.720	3.530
lEX	3.339	0.599	1.886	4.798
lIM	3.310	0.539	1.532	4.611
lGDP	8.423	1.031	5.708	10.755
lFDI	0.561	1.188	-6.081	4.691
lIN	6.906	1.932	2.772	14.147
INST	0.041	0.550	-1.119	1.436
lFD	3.802	0.676	2.270	5.208
lURB	17.519	1.189	14.222	20.580

Source: Authors' Computation

7.3.2.2 Empirical Results

Table 7.15 reports the CSD test results. There is enough evidence to reject the null hypothesis of cross-section independence. Thus, there is CSD in all three models. Toward the goal of testing the properties of stationarity, table 7.16 presents the panel unit root test results. The IPS test results depict that ltrade, lTS, lEX, lIM, FDI, lURB are stationary at a level while CESI, lTG, lGDP, lIN are stationary at first difference. According to the Fisher-type test ltrade, lTS, lEX, lIM, FDI, lURB are stationary at level, whereas CESI, lTG, lGDP, lIN are stationary at first difference. The results of Pesaran CADF tests are slightly different. lGDP, FDI, and lIN are stationary at level while others variables are stationary at first difference.

Table 7.15 Results of Cross-sectional Dependence Test

Test	Model (7.2.1)	Model (7.2.2)	Model (7.2.3)
Pesaran	16.208***	22.001***	21.738***
Frees	7.208	3.662*	3.720*
Friedman	113.217***	191.872***	185.544***

*Source: Authors' Computation; Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

Table 7.16 Results of Panel Unit Root Test

Variables	Im-Pesaran-Shin Test		Fisher-type Test		Pesaran CADF Test	
	Level	*1st Difference*	*Level*	*1st Difference*	*Level*	*1st Difference*
CESI	2.41	-11.36***	27.43	373.65***	-1.91	-4.72***
ltrade	-1.78**		65.39***		-1.95	-4.74***
lTG	-0.35	-12.01***	44.16	416.99***	-1.60	-4.11***
lTS	3.40***		67.65***		-1.92	-4.52***
lEX	-1.56*		62.38**		-1.99	-4.79***
lIM	-3.49***		94.07***		-2.36	-4.58***
lGDP	1.16	-10.09***	25.99	292.90***	-2.11**	
lFDI	-5.70***		154.82***		-2.68***	
lIN	1.07	-12.50***	42.65	554.09***	-2.78***	
lURB	-7.84***		554.58***		-1.39	-1.82

*Source: Authors' Computation; Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$*

Table 7.17 summarizes the findings of panel regression obtained from several model specifications of models (7.2.1), (7.2.2), and (7.2.3). These findings can be used to make several observations.

Table 7.17 Fixed-effect Regression Estimates

Variables	Model (7.2.1)		Model (7.2.2)		Model (7.2.3)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
ltrade	-0.123*** (0.033)	0.000				
lTG			-0.185*** (0.030)	0.000		
lTS			0.118*** (0.034)	0.001		
lEX					-0.112*** (0.042)	0.009
lIM					0.008 (0.057)	0.883
lGDP	0.086*** (0.019)	0.000	0.114*** (0.019)	0.000	0.084*** (0.019)	0.000
lFDI	-0.028*** (0.007)	0.000	-0.019*** (0.007)	0.009	-0.029*** (0.007)	0.000
lIN	-0.045*** (0.013)	0.001	0.017 (0.016)	0.278	-0.043*** (0.013)	0.002
lURB	-0.007 (0.083)	0.924	-0.243*** (0.086)	0.005	-0.018 (0.083)	0.828
Constant	2.766** (1.357)	0.042	6.420*** (1.398)	0.000	2.818** (1.360)	0.039
Results of the Hausman Test						
	Chi-square stat.	P-value	Chi-square stat.	P-value	Chi-square stat.	P-value
	23.53***	0.001	20.14***	0.009	23.20***	0.003

Source: Authors' Computation; Note: Standard errors are robust to heteroscedasticity as shown in parentheses.
**** $p < 0.01$, ** $p < 0.05$*

The empirical results of model (7.2.1) show that the trade of goods and services is significant and negatively associated with environmental sustainability, CESI. This indicates that trade is unsustainable for the environment in the near future. The results are consistent with the findings of Orhan et al. (2021) in the case of India and Bernard and Mandal (2016). A study by Orhan et al. (2021) shows that increasing CO_2 emissions and India's openness to trade, energy use, and agriculture reduce environmental sustainability. Bernard and Mandal (2016) also find that trade openness increases CO_2 emissions, thereby deteriorating sustainability. Moreover, FDI and innovation are negatively related to CESI at 1 percent and 5 percent levels. Conversely, income (lGDP) positively and significantly impacts environmental sustainability.

In model (7.2.2), trade has been seen separately as merchandise trade and services trade. Trade in goods is observed to have a negative and statistically significant impact on the CESI at a 1 percent level, whereas trade in services is positively associated with the CESI. This implies that the merchandise trade is more responsible for degrading the environmental quality. Trade in services is not responsible for deteriorating the environment and can improve the environment's quality. The outcome of the study by Chakraborty and Mukherjee (2013) matches the result of the present study. It suggests that trade in primary and manufacturing products leads to environmental degradation. On the contrary, the transition from the primary to industry to services trade of emerging economies is positively associated with environmental quality and sustainability. Moreover, FDI and urbanization also have a negative impact on CESI at a 1 percent level. Rahman et al. (2022) agree that urbanization negatively impacts environmental sustainability. On the other hand, income and innovation are positively linked to environmental sustainability.

Further, trade is bifurcated into exports and imports of goods and services in Model (7.2.3). Exports of goods and services negatively and significantly impact CESI at a 1 percent level. In contrast, imports of goods and services are positively related to CESI but are insignificant. Rahman et al. (2022) support that boosting the trade balance finally leads to environmental sustainability. According to a World Bank study by Low (1992), polluting or dirty sectors and their exports have grown more quickly in poor developing countries than in wealthy industrialized countries (Salvatore 2013). Furthermore, FDI, innovation, and urbanization also negatively impact the environment, but the coefficient of urbanization is insignificant, while GDP positively impacts the environment. The same study by Low (1992) has discovered, however, that as countries grow wealthier, they actively choose more ecologically friendly methods of economic development and grow more concerned with "sustainable development". The study also performed the Driscoll-Kraay standard errors test to support the results of panel OLS regression. The outcome is presented in Table 7.18.

Table 7.18 Results of Driscoll-Kraay Standard Error Test

Variables	Model (7.2.1)	Model (7.2.2)	Model (7.2.3)
ltrade	-0.190*** (0.016)		
lTG		-0.301*** (0.018)	
lTS		0.108*** (0.005)	
lEX			-0.686*** (0.094)
lIM			0.577*** (0.113)
lGDP	0.198*** (0.020)	0.207*** (0.017)	0.221*** (0.020)
lFDI	0.010*** (0.003)	0.009** (0.003)	0.008** (0.002)
lIN	-0.169*** (0.004)	-0.143*** (0.006)	-0.160*** (0.003)
lURB	0.193*** (0.014)	0.171*** (0.012)	0.207*** (0.017)
Constant	0.041 (0.411)	0.328 (0.336)	-0.833 (0.488)

Source: Authors' Computation; Note: Standard errors are robust to heteroscedasticity, shown in parentheses ();
**** $p < 0.01$, ** $p < 0.05$.*

The results from both tests are similar except for FDI and urbanization. Trade openness, trade in goods, and exports of goods and services negatively impact CESI, while trade in services and imports of goods and services positively impact CESI. Moreover, the effect of GDP on CESI or environmental sustainability is positive.

7.4 Summary and Findings

The present chapter of the study examines the impact of trade openness on environmental sustainability in emerging economies for the time period 1991-2020. The study is carried out in two parts using two alternative approaches to measure environmental sustainability. First, the impact of trade openness and natural resource rents on CO_2 emissions (environmental sustainability) is studied. Second, the impact of trade openness on CESI is analysed.

As emerging economies strive to establish themselves on the international stage, they must navigate the intricate relationship between trade, economic growth, job creation, and the sustainable use of natural resources. Thus, the first section of the study evaluates the nexus between trade openness, total natural resource rent, unemployment, and environmental degradation for 20 emerging economies from 1991 to 2020. The CO_2 emissions are used as an indicator of environmental degradation. The study also examines the validity of EPC for emerging economies by looking at the impact of unemployment on CO_2 emissions. The study is a novel attempt to explore the presence of EPC in emerging economies. Moreover, the study contributes to the existing literature by assessing the complex relationship between trade openness, total natural resource rent, unemployment, and CO_2 emissions for emerging economies. According to the results, the Environmental Philips Curve (EPC) is validated in the group of emerging economies, indicating the trade-off between unemployment and CO_2 emissions. Moreover, CO_2 emission decreases when trade openness and NRR rise in the long-run. The improvement in the quality of the environment is also reported due to an increase in renewable energy consumption.

The second section of the study contributes to the literature by examining the impact of trade components on the environmental sustainability of emerging countries over the period 1991-2020. The existing literature does not provide any comprehensive measures for measuring environmental sustainability. Some studies use single indicators such as CO_2 emissions; others have used composite indices such as ecological footprints and EPI in the name of environmental sustainability and thus faced criticism. Therefore, using principal component analysis, the study first constructs a CESI to evaluate environmental sustainability.

The index includes seven important environmental sustainability indicators: CO_2 emissions, energy intensity, use of renewable energy, NRR, WP, RWR, and AP, taken from a recent study by ADB (Jha et al., 2018). The value of CESI lies between 1 and 6, where 1 indicates the worst condition, and 6 indicates the best situation regarding environmental sustainability. The robustness of the index is also checked using the equal weighting approach. The findings of the study suggest that Brazil, Columbia, and Chile were CESI's top three highest scorers in 2020, and the bottom three countries whose CESI is very low compared to others were Iran, South Africa and Saudi Arabia.

The study then examines the detailed impact of trade by utilizing trade and its components in the three different models. The findings of the empirical analysis can be used to infer a number of observations. It is observed that trade openness negatively affects environmental sustainability. The increase in trade openness deteriorates the quality of the environment, which is not sustainable for the future. Moreover, exports of goods and services and merchandise trade negatively impact environmental sustainability more than imports and trade in services. Thus, the question arises: should we restrict trade? Would restricting trade be helpful for the environment? No, not at all. If trade suddenly stopped, countries would have to use their current resources and technology to manufacture everything they consume. This would result in a general loss in efficiency, requiring more resources to create the same output (WTO, 2020). On the other hand, Increased trade can contribute to the efficient management of the environment by fostering economic development, social welfare, and growth.

After addressing all the objectives of the thesis, the next and last chapter provides the conclusion and policy implications of the thesis. It also includes the limitations and future scope of the study.

Chapter 8. Conclusion and Policy Implications

8.1 Summary and Conclusion

It is evident from recent events that economic integration is becoming more widespread worldwide. It is nearly hard to survive in the global economy without economic integration (Tahir et al. 2018). One way of economic integration is to open the economy to international trade. Economic integration is growing because higher growth rates are associated with more liberalized regimes (more trade openness). Economic growth is rightfully viewed as the ultimate objective of all economic activity because it matters (Baldwin and Forslid, 1998). The advantages of trade liberalization are readily apparent and generally acknowledged by scholars and policymakers (Tahir and Azid, 2015).

Countries have found that integration into the global economy is a potent way to encourage economic development, growth, and poverty eradication. After implementing the Agenda 2030 or sustainable development goals (SDGs), research interest is diverted from development to sustainable development. There has been much discussion about the role that international trade plays in sustainable development both in developed and emerging economies. Opening up the economy with the world creates new markets, technology, and investment accessible to countries, particularly developing countries, making their development sustainable. For all these reasons, international trade plays a vital role in achieving sustainable development goals in the 2030 Agenda (Helble and Shephered, 2017).

Emerging countries face many development challenges, such as unemployment, rising population, and burden on natural resources. Therefore, emerging countries require a framework that goes beyond GDP growth to address the challenges. The framework for achieving sustainable development goals is important for emerging countries. International trade strengthens the growth and development of emerging economies. The thesis used the classification by an IMF study, which identifies the 20 economies in the emerging economies category (Dattagupta and Pazarbasioglu, 2021). The impact of trade on sustainable development is not much explored in the case of emerging countries (Hassan et al., 2014; WTO, 2015; Duttagupta and Pazarbasioglu, 2021). Furthermore, Naeher and Narayanan (2020) recommend that sustainability has been grabbing attention in recent years, mainly in developing countries.

In light of this, the objectives of the thesis are fourfold. First, the study aims to identify the determinants of trade. Second, the purpose of the study is to assess the impact of trade on overall sustainable development in emerging economies. Third, the study aims to explore the impact of trade on major economic and social SDGs. Fourth, it attempts to examine the impact of trade on environmental sustainability in emerging economies.

The first objective of the study aims to identify the conventional as well as modern factors that influence international trade, considering both drivers and inhibitors in emerging economies for the period from 1996 to 2020. The study found strong evidence supporting a significant relationship between various determinants and trade openness. A strong and positive relationship is found between economic growth and trade openness. The higher GDP of a country leads to higher trade openness. Similarly, financial development is directly related to high trade openness. The development of the financial system drives the degree of trade openness. Moreover, institutional quality also plays a positive role in trade openness. Better quality of institutions wins over the confidence of consumers and other economic entities in the international space, enhancing trade openness.

The study also illustrates the detrimental impact of the world uncertainty index on the trade openness of emerging economies. Increased uncertainty is not only a topic of conversation in newspaper columns and Twitter feeds but also has significant effects on the integration of emerging economies into the world economy. Similarly, a high exchange rate also leads to a reduction in trade openness. Regular changes in exchange rates typically undermine the trust of importers and exporters, which has a negative impact on trade openness. Additionally, geo-political risk negatively impacts trade openness. Trade openness in emerging economies is vulnerable to the adverse effects of geo-political events. To sum up, economic growth, quality of institutions, and financial development are the major drivers of international trade. However, geo-political risk, world uncertainty index, trade sanctions, and real effective exchange rate are trade inhibitors that lower trade openness.

Toward the second objective, the study first examined the link between trade and overall sustainable development. The findings reveal that trade openness has a favorable impact on sustainable development. Trade openness affects sustainable human growth in many ways. It can boost economic growth, living standards, and technology, but distributional, social, and environmental impacts must be considered. Moreover, FDI, economic growth, and renewable energy consumption also have positive implications for sustainable development. In contrast, innovations and institutional quality have adverse impact on SDI. The Limitation of the study lies in the fact that despite significant efforts to measure sustainability in recent decades, no single indicator reflects the sustainability of a nation in all of its dimensions. As a result, SDI might not be a sufficient index for analyzing sustainable development. Therefore, the study examined the three dimensions of sustainable development separately in the subsequent analysis.

In order to address economic and social sustainability, the study first examined the impact of trade on GIP triangle for emerging countries from 1991 to 2020. The study used economic growth, income inequality, and poverty (GIP triangle). The study undertakes the three SDGs simultaneously, namely SDG:1 (no poverty), SDG:8 (decent work and economic growth), and SDG:10 (reduced inequalities). Thus, Given the cross and multi-directional causalities, the link between trade and the GIP triangle seems more complex. The study applies the panel ARDL approach to examine the association between trade and the GIP triangle.

The empirical results indicate that trade encourages economic growth and significantly deteriorates income inequality in the long run for emerging countries, while in the short run, trade has a significant adverse impact on growth. Trade increases the level of poverty measured by HCE (household consumption expenditure), but income inequality deteriorates in emerging countries. Moreover, it is observed from the causality test that there is a feedback relationship among the variables. As a contribution to the growing literature on the development impacts of trade, this thesis introduces the indirect effects of trade on poverty reduction and income inequality. The implications for poverty reduction depend on the level of trade protection a country imposes. The impact of trade policies is determined by many factors, such as differences in endowments, the extent of imperfect competition, economic policies, and frictions in factor markets. To maximize the effectiveness of a trade policy, it must be complementary and implemented in tandem with trade reforms. A comprehensive strategy is needed to end poverty.

Secondly, the study investigated the non-linear relationship between trade and income inequality in a panel framework for emerging economies. It also examined the trade-led KC (Kuznets Curve) during 1991–2020. Among 17 SDGs, SDG:10 refers to reducing inequalities within and among countries that is an integral part of the process of sustainable development. The empirical results of the study confirm the inverted "U-shaped" relationship between trade openness and income inequality, providing evidence for the trade-led KC. The coefficient of trade openness is significant and has a positive sign, while the square of trade openness has a negative sign. The findings indicate that trade significantly impacts income inequality, providing opportunities for further research as well as important insights for regulators and policymakers who plan and execute trade policies. So far, the relevant trade reforms have helped to lessen income disparity between nations.

Thirdly, the study evaluated the nexus between trade openness and unemployment (SDG:8 i.e. full and productive employment and decent work for all) for emerging economies. As emerging economies strive to establish themselves on the international stage, they must navigate the intricate relationship between trade, economic growth, and job creation. The study employed the second-generation models since CSD and slope heterogeneity were present in the data. Moreover, the CS-ARDL model is utilized to test the intricate relationship in the short and long run. The analysis shows a reduction in unemployment due to increased trade openness and NRR in the long run.

Furthermore, the study addressed the environmental dimension of sustainable development. Therefore, the study examined the link between trade and environmental sustainability. Toward this, the study analyzed the nexus between trade openness, total natural resources rent, unemployment, and environmental sustainability using a single indicator, i.e. CO_2 emissions. Thus, the study deals with environment-related SDGs, such as SDG:13 (climate action) and SDG:7 (affordable and clean energy). The CO_2 emission is used as an indicator of environmental degradation. The study also examined the validity of the environmental Philips curve (EPC) for emerging economies by looking at the impact of unemployment on CO_2 emissions. The results show that the environmental

Philips Curve (EPC) is validated in emerging economies, indicating the trade-off between unemployment and CO_2 emissions. Moreover, a rise in TO and NRR decreases CO_2 emissions in the long run. The improvement in the quality of the environment is also reported due to an increase in renewable energy consumption.

However, single indicators do not provide a complete picture of environmental sustainability. The available literature highlights the greater accuracy of composite environmental indices in capturing a country's environmental situation. Therefore, the present study is a major breakthrough that constructed the composite environmental sustainability index (CESI) for emerging countries. The index includes seven important environmental sustainability indicators: CO_2 emissions, energy intensity, use of renewable energy, natural resources rent, water productivity, renewable freshwater resources, and air pollution. To this end, PCA is employed to construct the CESI. It also compares the emerging countries' performance and progress toward environmental sustainability through trend analysis. The value of CESI lies between 1 and 6, where 1 indicates the worst condition, and 6 indicates the best situation regarding environmental sustainability. The findings of the study suggest that Brazil, Columbia, and Chile were CESI's top three highest scorers in 2020, and the bottom three countries whose CESI was very low compared to others were Iran, South Africa, and Saudi Arabia.

Subsequently, the study examined the impact of trade components (trade openness, direction, and composition) on the CESI of emerging countries from 1991 to 2020. The findings of the empirical analysis provide some observations. It is observed that trade openness negatively affects environmental sustainability. The increase in trade openness deteriorates the quality of the environment, which is not sustainable for the future. Moreover, exports of goods and services and merchandise trade negatively impact environmental sustainability more than imports and trade in services.

Thus, the question arises that should we restrict trade? Would restricting trade be helpful for the environment? No, not at all. If trade suddenly stopped, countries would have to use their current resources and technology to manufacture everything they consume. This would result in a general loss in efficiency, requiring more resources to create the same output (WTO, 2020). On the other hand, Increased trade can contribute to the efficient management of the environment by fostering economic development, social welfare, and growth. More importantly, free markets can provide access to new technologies that improve the efficiency of local industrial processes by reducing the need for inputs such as energy, water, and other harmful environmental variables. Similarly, industries may be incentivized to adopt stricter environmental standards by liberalizing trade and investment. A nation's export industry is more subject to environmental regulations imposed by its leading importers as it gets more integrated into the global economy.

8.2 Policy Implications of the Study

The current section of the chapter provides some policy implications for emerging economies based on the empirical results.

1. The results of the analysis of determinants of trade openness highlight that economic growth, financial development, and institutional quality are the promoters of trade openness. Geopolitical risk, world uncertainty index, and real effective exchange rate are the inhibitors of trade openness. The study suggests significant policy implications based on the results. Firstly, the idea that finance is more than just a conduit for economic growth and development is reinforced by the data demonstrating the beneficial impact of financial development on trade. Secondly, better institutions in emerging economies are the key to elaborating international trade. The various emerging economies need to step up their efforts to combat social violence and terrorism, clear

administrative obstacles, uphold the rule of law, enforce contract enforcement, and further liberalize the economy. Thirdly, exchange rate stability must be maintained in order to improve the trade openness, which will have a positive impact on long-term growth prospects. Lastly, managing risks stemming from exogenous factors like geopolitical or economic uncertainty is challenging. Nations can increase the number of trading partners, develop new export markets, and most likely join more free trade agreements or trading blocs to lessen the impact of disruptions brought on by these uncertainties. Therefore, the study suggests that policymakers in emerging economies should take the necessary actions to liberalize their trade regimes through effective macroeconomic management to achieve long-term growth.

2. The analysis of the trade and sustainable development index reveals that trade is a favorable instrument for sustainable development in emerging economies. Policymakers must use trade openness to achieve sustainable human development goals while minimizing risks and challenges using a balanced strategy. Nations must use a comprehensive approach to trade openness to maximize its benefits for sustainable human development. This includes investing in education and skill development to ensure equitable growth, social protection to reduce inequality, and environmental restrictions and incentives to promote sustainable practices.

3. The results of the impact of trade openness on the GIP triangle reveal that trade openness encourages economic growth and deteriorates income inequality in emerging economies in the long-run. However, trade increases the level of poverty. The policy suggestions of this study that should be adopted to promote inclusive and sustainable development are as follows: First, trade openness aids growth. Therefore, growth-oriented policies are crucial for an economy because economic growth has a trickle-down effect that will reach poor people and reduce poverty. Second, economic growth is not

the only objective but a means to achieve human development. This necessitates that the benefits of growth from trade openness should be equitably distributed throughout society. The government should offer social safety nets to workers who suffer from trade liberalization and/or due to a rise in imports. They should provide opportunities for better jobs and support policies requiring social protection in the interim. There is a need to examine the environment in which trade liberalization may occur and consider the institutional and policy setting in which it is necessary to advocate specific policies. A well-organized trade liberalization agenda will aid in achieving SDGs when combined with a sound complementary plan. Trade is undoubtedly not the only aspect at play, but it can play a significant role. The study thus recommends that policymakers should promote broad-based, sustainable growth strategies that aim to reduce poverty, favor equality-induced growth as opposed to inequality-induced growth under suitable conditions, and focus on prudent income distribution, which could help to raise the income of the poor.

4. The analysis of trade openness on income inequality confirms the presence of the inverted 'U-shaped' relationship between trade openness and income inequality, supporting the trade-led Kuznets Curve. Significant policy implications ensue from this exploration. Given the growing disparities within nations, the distributional impacts of trade need to be given top priority. Along with efficiency improvements, trade policy should ensure that marginalized workers, women, youth, and impoverished nations benefit more from global trade. Policies boosting international trade need to be more inclusive to allow access to more individuals, businesses, and nations – especially marginalized – to the advantages provided by global markets.

5. A few policy recommendations are provided for emerging economies based on the observations from the analysis of trade openness and environmental sustainability.

The presence of a trade-off between unemployment and environmental degradation suggests that emerging economies must focus on environment-friendly and job-creating technologies simultaneously to sustain employment and address the challenges of poverty reduction and income inequality. Effective environmental policies and institutional frameworks are needed at local, regional, national, and international levels. Emerging countries, reliant on foreign sources for consumption and production, must adopt stricter environmental rules. These regulations can align with open trading systems, fostering markets for goods exportable to nations with similar standards. Environmental measures should be included while signing bilateral and regional trade agreements. Moreover, developed economies can aid capacity building and encourage stricter environmental legislation in less developed allies. Emerging economies should integrate environmental concerns into trade agreements and adopt green technologies to boost trade while reducing CO_2 emissions. Furthermore, emerging countries should diversify their economy by developing the non-natural resource sectors in the long run. It will reduce unemployment by lessening the effects of the resource curse and reducing reliance on particular industries.

6. Additionally, emerging countries should emphasize on trade of environment-friendly goods and should also promote trade in services. An optimum policy mix between trade and environmental sustainability is needed for emerging economies that will address the issue of promoting trade in a sustainable way. Conserving the environment will reduce disparities between the rich and poor today and between the current and future populations. The thesis provides a comprehensive view for policymakers in the decision-making process to identify and prioritize the risky environmental sustainability indicators to make better and sustainable policies.

8.3 Contribution of the Study

The present study empirically examined the role of trade in achieving sustainable development and its goals in emerging economies. The research is a novel approach to address the various SDGs considering economic, social, and environmental pillars. Since, trade openness has the influential impact on the growth and development of an economy, it is necessary to identify the factors affecting trade openness. The research findings will surely help decision-makers better understand the difficulties pertaining to the aforementioned issue and offer guidance for attaining sustainable development and its goals by 2030.

The study contributes to the existing literature in the following ways:

1. Trade is a complex phenomenon shaped by a wide range of motivating and discouraging factors that collectively mold a nation's stance on international trade. Therefore, it is crucial to comprehend the factors that drive trade openness in emerging economies. Although the existing literature has widely demonstrated the determinants of trade, still the socio-political factors remain obscure in the literature. On the other hand, this study adds significantly to the body of knowledge by identifying the factors that impede the trade.
2. Various international organisations are highlighting trade as a channel to achieve sustainable development goals. Moreover, sustainable development goals are a broader concept and it is the need of an hour that needs to be addressed. Previous studies are inadequate in addressing the role of trade in sustainable development goals. The study focuses on SDGs such as, SDG:1, SDG:8, SDG:10, SDG:12, and SDG:13.
3. Most of the studies have analysed the nexus between trade and GIP (growth, inequality, and poverty) triangle in isolation from each other. This study analyses the multivariate panel data set by employing trade, growth, inequality, and poverty together.

4. This study extended the literature by analysing the role of trade in addressing the SDG:10 of reducing income inequality following the Kuznets curve. The literature often tackled the linear and time-series issues between trade and income inequality. The present study contributed to the literature by extending Kuznets' inverted 'U-shaped' hypothesis in the context of trade. Furthermore, an attempt has been made to estimate the threshold value for the trade-led Kuznets curve.

5. The present study is a major breakthrough that constructed the Composite Environmental Sustainability Index (CESI) for emerging countries using the seven indicators of environment sustainability that are of the most importance, as per the data availability. Moreover, it also addresses the five SDGs, namely, SDG:6, SDG:7, SDG:9, SDG:11, and SDG:12. To the best of the authors' knowledge, environmental sustainability has not been discussed in the literature using the composite indicators approach and addressing more than one SDGs. It also compares the emerging countries' performance and progress toward environmental sustainability through trend analysis.

6. Lastly, to date, no empirical investigation has examined the causal link between components of international trade and environmental sustainability using the composite indicators approach for emerging countries. Moreover, the present research aimed to address some critical research questions. For instance, is trade openness good or bad for environmental sustainability? Can trade and environmental policies be combined to maximize benefits and minimize environmental costs? Moreover, the novel contribution of the study is also evident in assessing the effect of components of trade on environmental sustainability while suggesting policy implications to optimize trade and its cost to the environment in emerging economies.

8.4 Limitations of the Study

The major limitations of the study are as follows:

1. The study covers the time period from 1991 to 2020 and does not account for the structural breaks that may occur during the period under study.
2. Although the study is focused on sustainable development goals (SDGs), it does not emphasize the various targets mentioned in each SDG. It may not give a comprehensive picture of the performance of a particular SDG.
3. The study limits the fact that despite significant efforts to measure sustainability in recent decades, no single indicator reflects the sustainability of a nation in all of its dimensions. As a result, SDI might not be a sufficient index for analysing sustainable development.

8.5 Future Scope of the Study

The thesis provides a good and straightforward overview of the issue. It also provides some direction for future research.

1. Although Sustainable development index (SDI) used in the study accounts for all the three pillars of sustainable development but it is not a sufficient index since it does not cover all the targets underlying in each SDG. Therefore, there is a need for a composite index to represent sustainable development comprehensively. Future studies can focus on the construction of an index that may represent all the SDGs and its targets in a single index.
2. In the previous analysis, the study found institutional quality as a promoter of trade openness and uncertainty as a deterrent to trade openness. It is suggested in the previous literature that improved institutions can lessen the impact of uncertainty. As a

result, an analysis concentrating on the mediating/moderating role of institutions between trade and uncertainty can be conducted.

3. Future research can be done on the methodological front by incorporating structure breaks in the models for empirical analysis. This is required because of the recent fluctuations in the market due to the COVID-19 pandemic and the Russia-Ukrain war that hugely impacted the economies. Thus, it will provide more targeted and effective policies for emerging countries.

4. Moreover, components of environmental sustainability can be analyzed individually and linked with trade. In future work, CESI can be constructed for all developing and developed countries to measure environmental sustainability.

5. The study solely focuses on trade openness. However, the effects might be different for exports and imports. Therefore, a disaggregated analysis of imports and exports can be done.

6. Future research can be extended to a time-series analysis of a particular country for more targeted and country-specific policies.

Appendices

Appendix A

Table A1 Estimated Long Run Coefficients (MG)

Regressors	Model (6.1.1)	Model (6.1.2)	Model (6.1.3)	Model (6.1.4)
LGDP		-7.946	1.794	-20.317
		(6.553)	(1.306)	(15.491)
LPOV	3.524**	9.498		14.412
	(1.492)	(12.262)		(46.001)
GINI	0.160		-0.389**	1.377
	(0.166)		(0.192)	(1.616)
TRADE	0.048	-0.062	-0.292***	
	(0.052)	0.077)	(0.079)	

*Source: Authors' computation, ***Reject H0 if p-value < 0.01, **Reject H0 if p-value < 0.05, *Reject H0 if p-value < 0.10.*

Table A2 Estimated Long Run Coefficients (DFE)

Regressors	Model (6.1.1)	Model (6.1.2)	Model (6.1.3)	Model (6.1.4)
LGDP		-0.625	-0.855	9.501
		(1.167)	(0.611)	(13.349)
LPOV	1.670***	-1.121		-47.538*
	(0.098)	(2.255)		(26.828)
GINI	-0.012		-0.166	00.058
	(0.010)		(0.124)	(1.071)
TRADE	0.002	-0.017	-0.117***	
	(0.001)	(0.016)	(0.022)	

*Source: Authors' computation, ***Reject H0 if p-value < 0.01, **Reject H0 if p-value < 0.05, *Reject H0 if p-value < 0.10.*

Table A3 Estimated Short Run Coefficients (MG)

Regressors	Model (6.1.1)	Model (6.1.2)	Model (6.1.3)	Model (6.1.4)
LGDP		-3.095**	-2.389**	-8.786**
		(1.425)	(1.026)	(4.153)
LPOV	1.632***	6.354		34.757***
	(0.245)	(4.362)		(9.088)
GINI	-0.000		0.104*	0.073
	(0.003)		(0.055)	(0.182)
TRADE	-0.005***	-0.031	-0.035	
	(0.001)	(0.036)	(0.025)	
Constant	-1.326**	67.809***	29.760***	-12.718
	(0.675)	(24.399)	(5.465)	(40.983)
Error correction	-0.249***	-0.846**	-0.387***	-0.375***
term (ECT)	(0.040)	(101	(0.045)	(0.072)

*Source: Authors' computation, Note: ***Reject H0 if p-value < 0.01, **Reject H0 if p-value < 0.05, *Reject H0 if p-value < 0.10.*

Table A4 Estimated Short Run Coefficients (DFE)

Regressors	Model (6.1.1)	Model (6.1.2)	Model (6.1.3)	Model (6.1.4)
LGDP		-1.067	-2.318***	-17.284***
		(1.133)	(0.540)	(2.696)
LPOV	1.963***	5.941		29.036***
	(0.118)	(3.924)		(9.639)
LGINI	0.000		0.018	-0.219**
	(0.001)		(0.027)	(0.111)
LTRADE	-0.004***	-0.028	-0.080***	
	(0.000)	(0.017)	(0.011)	
Constant	-0.759***	27.548***	18.066***	38.118***
	(0.186)	(4.909)	(2.609)	(12.402)
Error correction term (ECT)	-0.158***	-0.473***	-0.220***	-0.102***
	(0.019)	(0.038)	(0.024)	(0.019)

*Source: Authors' computation, ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10.*

Table A5 Results of Hausman Test

Models	PMG v/s MG (p-values)	PMG v/s DFE (p-values)
Model (6.1.1)	0.919	0.995
Model (6.1.2)	0.923	0.993
Model (6.1.3)	0.913	0.873
Model (6.1.4)	0.974	0.942

*Source: Authors' computation, ***Reject H_0 if p-value < 0.01, **Reject H_0 if p-value < 0.05, *Reject H_0 if p-value < 0.10.*

Appendix B

This study uses Composite Index Approach because of its simplicity and advantage ofrecognizing the various components of environmental sustainability. The steps followed in theconstruction of CESI are described below.

(i) The seven indicators used in the CESI are expressed in different units. Therefore, as a first step, indicators are normalized using the min-max approach to maintain consistency in the data. Then the scores are converted to a 1-6 scale where 1 shows the worst condition (environmental unsustainability) and 6 shows the best outcome(environmental sustainability). The formula used for the indicators of positive and negative relationships with environmental sustainability (see table I) are:

Positive Indicator:

$$X_{normalized} = 5 \times \left(\frac{X_i - X_{minimum}}{X_{maximum} - X_{minimum}}\right) + 1$$

Negative Indicator:

$$X_{normalized} = 5 \times \left(\frac{X_i - X_{minimum}}{X_{maximum} - X_{minimum}}\right) + 6$$

(ii) The CESI represented as

$$CESI = \frac{W^1(NRR) + W^2(RWR) + W^3(WP) + W^4(AP) + W^5(CO_2) + W^6(EI) + W^7(REC)}{W^1 + W^2 + W^3 + W^4 + W^5 + W^6 + W^7}$$

Here, W indicates the weights that are applied to every seven components. The PCA is employed for this, and the sample adequacy and data reliability is examined using KMO (Kaiser-Mayer-Olkin) test.

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Prof. Geetilaxmi Mohapatra is currently working as an Associate Professor in the Departmentof Economics and Finance, Birla Institute of Technology and Science (BITS), Pilani. She has received a first-class Master's degree in Economics from Central University of Hyderabad and a doctorate in Environmental Economics from Utkal University, Bhubaneshwar. Her research interests include environmental economics, development economics, and international economics. She has over fifteen years of research and teaching experience in economics at the postgraduate level. She is active in research and consultancy and has authored a number of research papers in national and international journals and conference proceedings.

Brief Biography of the Candidate

Neha Jain is a doctoral candidate in the Department of Economics & Finance at Birla Institute of Technology & Science (BITS), Pilani, India. Her research has appeared in reputed international journals like the Management of Environmental Quality and the International Journal of Emerging Markets. She has also assisted in various finance and economics teaching responsibilities during her PhD journey at BITS Pilani. Before joining Ph.D., she worked as a research associate in an ICSSR-sponsored research project entitled "Measuring the Vulnerability of Agricultural Households to Climate Change in Arid and Semi-Arid Regions of Rajasthan – A Capacity to Adapt Perspective" under Prof. Geetilaxmi Mohapatra at BITS Pilani, Pilani. She has completed her graduation and masters from Banasthali Vidyapith. She cleared the UGC NET (Economics) in 2018. Her research interests lie in international trade, growth and development, and sustainable development issues.

Publications

- Neha J., Geetilaxmi M. & Anushka V., (2024) "Driving human development through ecological impact for emerging economies: the role of trade openness". *Environmental Science and Pollution Research*, [(Springer) indexed in Scopus, H-index: 179, Q1(1.01)] https://doi.org/10.1007/s11356-024-34787-5 .
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Under Review

- Neha J. & Geetilaxmi M. "Impact assessment of components of trade on composite environmental sustainability in emerging economies".
- Neha J. & Geetilaxmi M. "Exploring the unexplored: Drivers and inhibitors of trade openness in emerging economies".

Working Papers

- Neha J. & Geetilaxmi M. "Heterogeneous effects of trade sanctions on bilateral trade flows in emerging economies".
- Neha J. & Geetilaxmi M. "Impact of Trade Openness and Natural Resources Rent on Unemployment and Environmental Degradation with special focus on Environmental Philips Curve: Evidence from Emerging Economies".

Conferences and Workshops

- Presented a Research Paper "Links between trade openness and sustainable development in emerging economies" in the **1st international conference on sustainable energy economics in the Asia-Pacific region** jointly organized by Asia-Pacific Applied Economics Association (APAEA) and Goa Institute of Management, Goa during 12-13 April, 2024.
- Presented a Research paper "Environmental Phillips Curve from Trade Perspective: Empirical Evidence from major Emerging Economies" in **International Conference on Sustainable Development (ICSG) 2022** organized by IIM Bodhgaya on 16-17 September, 2022.
- Participated in one-week national workshop on '**Econometrics for Research in Economics'** held at CUH, Mahendergarh during 25-29 April, 2022.
- Presented a Research paper "A Comparative Analysis of Export-led and Domestic Demand-led Growth Hypotheses in BRICS Economies" in **AIB South Asia Conference 2022** hosted by IIM Vishakhapatnam on 23-25 January, 2022
- Presented a Research Paper "Does ESG disclosure and sustainability influence firm's market value with the mediating effect of financial performance: A case of India" in the 5th Asia conference on business and economic studies (**ACBES 2023**) organized by University of Economics, Vietnam during 16-18 August, 2023.
- Presented a Research Paper "The role of the government in environmental degradation: A case of India" in **Anusandhan 1.0** organized by IIT Mandi during 23-25 June, 2023.
- Presented a Research paper "Determinants of Participation in GVCs: A Global Evidence" in **7th Global Leadership Research Conference 2022** organized by Amity Business School on 16-18 February, 2022