TÜRKİYE CUMHURİYETİ
ADANA ALPARSLAN TÜRKEŞ SCIENCE AND TECHNOLOGY UNIVERSITY

GRADUATE SCHOOL
INTERNATIONAL TRADE AND FINANCE DEPARTMENT

ANALYSIS OF BILATERAL TRADE RELATIONS BETWEEN SOMALIA AND OTHER EAST AFRICAN COMMUNITY COUNTRIES
A PANEL GRAVITY MODEL APPROACH

ABDIRAHMAN MOHAMED ALI
M.A.

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DECLARATION OF CONFORMITY

In this study, which was prepared the thesis guidelines of the institute of graduate school at Adana Alparslan Türkeş Science and Technology University, affirms that all information, documents, evaluations and results have been presented in accordance with scientific ethics and moral principles without resorting to any means or assistance that would be contrary to scientific ethics and traditions. I also confirm that I have properly cited all the sources references in this work and accept all moral and legal consequences if a situation is found contrary to my statement regarding my work.

06/02/2025

[Signature]

ABDIRAHMAN MOHAMED ALI

ÖZET

SOMALİ İLE DİĞER DOĞU AFRİKA TOPLULUĞU ÜLKELERİ ARASINDAKİ İKİLİ TİCARET İLİŞKİLERİNİN ANALİZİ PANEL ÇEKİM MODELİ YAKLAŞIMI

ABDIRAHMAN MOHAMED ALI

Yüksek Lisans, Uluslararası Ticaret ve Finansman Anabilim Dalı

Danışman: Doç. Dr. Fatma Feyza GÜNDÜZ

Şubat 2025, 89 sayfa

Bu araştırmanın amacı, 2015'ten 2022'ye kadar olan dönemlerde Somali ile diğer Doğu Afrika Topluluğu ülkeleri arasındaki ikili ticareti panel çekim modeli ile analiz etmektir. Çalışma, Somali ile ticaret yapan muhatapları arasındaki ticaret dinamiklerini şekillendiren faktörleri ve ilişkileri incelemektedir. Bu çalışma, Somali'nin diğer EAC üye ülkeleriyle ikili toplam ticaretini analiz etmek için rastgele etki methodunu (REM) kullanmıştır. Dünya Bankası ve Global-Economy aracılığı ile toplanan panel veriler kullanılmıştır. Çalışmada bağımlı değişken olarak toplam ticaret kullanılırken, gayri safi yurtiçi hasıla, doğrudan yabancı yatırım, ticaret açıklığı, işsizlik, nüfus ve mesafe bu çalışmanın bağımsız değişkenleridir. Çalışmada kukla değişkenler olarak ortak dil, ortak sınır ve kara sınırı kullanılmıştır. Çalışma, Somali ile ticaret ortağı ülkeler arasındaki Gayri Safi Yurtiçi Hasıla (GSYİH) oranının bağımlı değişken üzerinde istatistiksel olarak anlamlı ve pozitif bir etki gösterdiğini bulmuştur. Ticaret açıklığı oranı bağımlı değişkenle güçlü bir pozitif ilişki göstermektedir, nüfus oranı bağımlı değişkenle istatistiksel olarak anlamlı pozitif korelasyona sahiptir, işsizlik oranı istatistiksel olarak negatif anlamlı bir etki göstermektedir. Doğrudan yabancı yatırımın bağımlı değişken üzerinde istatistiksel olarak anlamlı bir etki göstermediği bulunmuştur. Ayrıca ortak dilin ikili ticaret akışlarını önemli ölçüde kolaylaştırdığı, şaşırtıcı bir şekilde ortak sınırların ikili ticaret akışları üzerinde önemli ve beklenmedik bir olumsuz etki gösterdiği bulunmuştur. Bu bulgu, paylaşılan bir sınırın varlığının ikili ticaretin artmasını garantilemediğini ve sınır ötesi ticaret dinamiklerini etkileyen belirli ekonomik, politik ve kurumsal faktörlerin daha fazla araştırılması gerektiğini öne sürmektedir.

Anahtar Kelimeler:Somali, Doğu Afrika Topluluğu Ülkeleri, Panel Çekim Modeli, İkili Ticaret

ABSTRACT

ANALYSIS OF BILATERAL TRADE RELATIONS BETWEEN SOMALIA AND OTHER EAST AFRICAN COMMUNITY COUNTRIES A PANEL GRAVITY MODEL APPROACH

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The aim of this study is to examine the bilateral trade between Somalia and other East African Community (EAC) nations from 2015 to 2022 using the panel gravity model approach. The study investigates the factors and relationships that influence trade patterns between Somalia and its trade partners. The random effects method (REM) was employed to analyze Somalia's bilateral total trade with other EAC member states. Data was collected from the World Bank and Global Economy databases. Total trade was the dependent variable, while independent variables included gross domestic product, foreign direct ınvestment, trade openness, unemployment, population, and distance. Dummy variables such as common language, common border, and land border were also included in the analysis. The study found that the Gross Domestic Product (GDP) ratio between Somalia and its trading partners has a significant and positive impact on bilateral trade. The trade openness ratio also exhibited a strong positive relationship with trade, while the population ratio was positively correlated with the dependent variable, and the unemployment rate had a statistically significant negative effect. It was found that foreign direct ınvestment did not have a significant effect on bilateral trade. The presence of a common language was shown to significantly enhance bilateral trade flows. However, surprisingly, the existence of common borders had a significant negative impact on trade flows. This suggests that shared borders do not necessarily lead to increased trade, and highlights the need for further exploration of the economic, political, and institutional factors that shape cross-border trade dynamics.

Keywords: Somalia, East African Community Countries, Panel Gravity Model, Bilateral Trade

DEDICATION

to my family

ACKNOWLEDGEMENT

With deep reverence and utmost gratitude, I firstly acknowledge Almighty Allah, whose boundless wisdom and grace have made this journey possibleI offer my sincere heartfelt and praise to Him for granting me the strength and perseverance to undertake this journey. Peace and blessings be upon the Prophet Muhammad (PBUH), whose teachings continue to guide and inspire my pursuit of knowledge and truth.

I am truly thankful to the individuals whose invaluable contributions, guidance, and encouragement have been integral to the realization of this study. While it is impossible to individually acknowledge everyone who has offered support, there are a few individuals whose contributions meritspecial recognition.

I am immensely appriciative of my beloved parents, whose constant encouragement, support and prayers have been a source of strength and motivation throughout my academic journey. Their sacrifices and steadfast belief in my potential have been instrumental in my success.

I extend my heart felt gratitude to my esteemed supervisor, Assoc. Prof. Dr. Fatma Feyza GÜNDÜZ, for her exceptional mentorship, insightful critiques, and unwavering commitment throughout this process. Her intellectual guidance and meticulous review of this work have been indispensable in ensuring the academic rigorandquality of this research.

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1. INTRODUCTION

Economic integration signifies the systematic removal of barriers that constrain economic transactions between two or more economies. These barriers, often delineated by geographical boundaries, restrict the seamless flow of goods, labor, and capital. The process of economic integration seeks systematically dismantling impediments to cross-border economic activities, particularly focusing on enhancing the facilitation of trade, optimizing the mobility of labor, fostering fluid capital movement, and promoting efficient service transactions (Pelkmans, 2009).

This progression unfolds through a structured framework. From a free trade area to a customs union, foolowed by a common market, the economic union, and, ultimately, full economic integration. Each stage represents a distinct level of collaboration and harmonization within the international economic framework, with specific features signaling advancements in trade, regulatory alignment, factor mobility, policy coordination, and overall economic integration (Tebekew, 2014).

In recent decades, there has been a notable shift in global trade dynamics, with a diminishing emphasis on multilateral trade negotiations and a pronounced focus on Preferential Trade Agreements (PTAs). The pace of progress in multilateral trade talks under the framework of (WTO) has been sluggish, while the number of PTA has surged. As of the conclusion of 2019, the WTO reported the existence of 301 active PTAs, marking a more than five-fold increase since the early 1990s. This trend has seen widespread participation from both developed and developing nations in PTA negotiations. It is noteworthy that virtually all nations worldwide are presently members of at least one PTA. Consequently, the volume of international trade regulated by PTA policies has experienced substantial growth. Consequently, a comprehensive study by the United Nations Conference on Trade and Development, highlighted that approximately 50 percent of global trade in many countries is now conducted under some form of Preferential Trade Agreement (UNCTAD, 2015).

In 1967, the inaugural East African Community (EAC) was first established, signifying a collaborative initiative among Uganda, Kenya, and Tanzania to promote cooperation in economic and social domains. However, this initial accord faltered in 1977. Subsequently, the EAC agreement was reaffirmed in November 1999, with Kenya, Tanzania, and Uganda as signatories. The renewed agreement, effective from June 2000, outlined a comprehensive integration process encompassing trade, economics, and politics. Acknowledging regional integration as a crucial component of their development strategy, these nations sought to strengthen trade and investment linkages. In 2007, Rwanda and Burundi acceded to the organization, augmenting its membership. South Sudan achieved full membership status in 2016, followed by the Democratic Republic of Congo (DRC) in 2022, becoming the seventh member (Hassan and Mohamed, 2022).

In the contemporary business landscape, the concept of regional integration is widely recognized as a potent driver of societal and economic progress. Both advanced economies and those in developmental stages embrace strategies and endeavors aimed at fostering regional integration, with the aim of attaining collective economic, social, and political advancements. Somalia has submitted and applied for membership in the EAC. Subsequently, in August 2022, the president of Somalia appointed a special envoy to the EAC, who has made notable strides within a brief timeframe. And in June 6th, 2023, the Summit of EAC Heads of States endorsed the report regarding Somalia's candidacy. Somali’s application is being discussed in subsequent meeting, with a final decision expected by november 2023 (Bassey et al., 2024).

The bilateral trade relations between Somalia and other (EAC) member states is a dynamic subject that holds significant implications for regional economic integration, development, and diplomatic ties. Somalia, situated in the Horn of Africa, has been striving to rebuild its economy and strengthen international trade partnerships since the end of the challenges posed by internal conflicts. Examining the trade dynamics between Somalia and the EAC member states provides valuable insights into the economic interdependence and cooperation within the East African region. Somalia, with its strategic location along the Indian Ocean and red sea, plays a crucial role in the maritime trade routes connecting the Middle East, Asia, and Africa. The East African Community, comprised of 8 member states—Somalia, Rwanda, South Sudan, Kenya, Tanzania, Burundi, DR Congo and Uganda promotes economic integration and cooperation among its members.

Analyzing the bilateral trade relations between Somalia and the EAC nations involves considering factors such as trade volume, balance, trends, and the impact of policies and agreements. Historically, Somalia has faced challenges in establishing stable economic relations due to internal conflicts, but recent efforts towards political stabilization and economic recovery have created an environment conducive to regional cooperation. The EAC, with its diverse economies and industries, offers Somalia opportunities for trade diversification and collaboration. Understanding the historical context of diplomatic ties and trade agreements between Somalia and individual EAC countries is essential for a comprehensive analysis. The role of regional organizations, such as the Common Market for Eastern and Southern Africa (COMESA) and the Intergovernmental Authority on Development (IGAD), in shaping trade policies and fostering collaboration can also be explored (Kamaludin, 2023).

Additionally, analysis of trade infrastructure development, barriers, and regulatory frameworks is cretical to undrestanding the challenges and opportunities that exist in the economic relationship between Somalia and the EAC member states. This analysis can shed light on the potential for increased trade, investment, and shared economic benefits, ultimately contributing to the broader goals in East Africa.

1.1. Research Problem of the Study

Africa faces entrenched challenges of poverty, limited global trade participation, and sluggish development in human capital and infrastructure. External pressures compound these issues, necessitating successful Regional Economic Integration (REI). REIs, as crucial building blocks, facilitate inter-country economic and trade integration, serving as instruments for harmonizing financial institutions and trade organizations. This imperative is not only crucial for addressing immediate hurdles but aligns with the policies required for Africa to thrive in the processes of globalization and integration into the world economy. The success of REI is pivotal for Africa's competitiveness in the global arena, transcending economic and trade dimensions to encompass broader areas of development.

Prior studies have extensively examined the broader trade dynamics within the East African region, underscoring the pivotal role of regional partnerships. However, specific insights into Somalia's bilateral trade within the EAC remain limited. This study analyzes the potential economic and competitive impact of Somalia's accession to EAC. It aims to assess the

advantages and disadvantages that Somalia may experience in both the short and long term as a result of its integration into the regional block.

The aim of this study is to analyze the Bilateral Trade exchanges between Somalia and Other counties withing the East African Community Countries (EAC).

1.2. The Importance of the Study

This study aims to evaluate the empirical implications of regional economic integration on analytical methodologies, focusing on the economic, trade, and institutional facets of Somalia and East African Community (EAC) member states. The research employs a robust empirical methodology, emphasizing model specification, data description, and variables selection, particularly exploring advancements in the gravity model to address trade strength in Somalia's partnerships in EAC.

Despite limited empirical exploration, the study strategically employs gravity modeling to analyze economic relationships, centering on bilateral total trade as dependent variable with Gross Domestic Product GDPi (GDPj), Foreign Direct Investment FDIi (FDIj), Trade Openness TOi (TOj), Unemployment UNEMi (UNEMj), Population POPi (POPj) and Distance between DIS(i,j) as crucial independent variables. Common-language (COMLANij), common-borders (COMMONBORDERSij) and landlockness (LANDLOCKNESSij) as dummy variables of the study. By investigating the intricate dynamics of economic interactions, the study seeks to enhance the empirical knowledge of regional economic integration within the East African region.

1.3. The Specific Goals of the Study

The upcoming specific goals are envisaged to be addressed throughout the duration of this study.

a. To analyze the impact of key economic indicators, such as GDP and FDI, on the bilateral trade relationships between Somalia and East African Community (EAC) member nations.

b. To examine the influence of trade openness and population size on the trade volumes between Somalia and its EAC counterparts.

c. To investigate the effect of labor market factors, particularly unemployment rates, on trade dynamics within the EAC region.

d. To evaluate the effect of geographical distance in shaping trade flows between Somalia and other EAC member states.

e. To offer evidence-based policy recommendations aimed at fostering Somalia's trade growth and enhancing regional collaboration within the EAC framework.

1.4. The Limitations of the Study

The results of this study are benefiting for policymakers to enhance economic cooperation and stimulate sustainable growth in the region. Furthermore, the findings of the study will provide research based and up to data to future researchers and academicians about Bilateral Trade Relations between Somalia and Other East African Community Countries; thus contributing to the body knowledge about subject under investigation.

Economic collaboration refers to the process in which neighboring countries come together to form a regional grouping or alliance. The main objective of regional collaboration is to enhance economic, political, and social cooperation among member states, leading to shared benefits and mutual development. This process can cover a wide range of areas and take various forms, often involving the establishment of regional organizations, agreements, and institutions (Balassa, 1987).

However, this research investigates only regional integration and bilateral trade between Somalia and other EAC member states. In undertaking this, the study seeks to investigate critical themes in macroeconomic and trade policies, focusing on intra-regional trade relations between Somalia and the East African Community (EAC) member states. The study employs a gravity model estimation procedure to assess the bilateral relations between Somalia and its EAC member nations. The data utilized for this analysis covers from 2015 to 2022, encompassing all selected variables and providing a comprehensive overview of the bilateral trade dynamics during this period. In order to derive meaningful insights, a panel regression is conducted using the random effect method REM. Selecting this period has been determined by the availability of a comprehensive and consistent dataset for all relevant countries, thereby ensuring the robustness and accuracy of the analysis of bilateral trade relations between Somalia and the member states within EAC.

1.5. Regional Integration of EAC

Recent Updates on EAC

The East African Community (EAC) as a prominent regional intergovernmental organization in Eastern part of the continent, comprising eight member nations: Somalia, Tanzania, Kenya, Rwanda, Burundi, Uganda, South Sudan and the Democratic Republic of the Congo (DRC). The core mission of the EAC is to foster regional collaboration and integration across a broad spectrum of sectors, including trade, infrastructure development, investment, and socioeconomic progress (Njenga, 2018).

Its overarching goal is to promote collaborative efforts in the economic, political, social, and cultural spheres among its constituent nations. Fundamental principles guiding the EAC's objectives include mutual trust, political commitment, and sovereign equality, as well as the promotion of peaceful coexistence, conflict resolution through nonviolent means, and adherence to the values of smooth governance, democracy, rule of law, accountability, transparency, gender equality and the human rights protection. The equal distribution of benefits and the pursuit of cooperation for mutual advantage are central to the framework established in Article 6 in EAC Treaty. The EAC represents a population of approximately 283.7 million people, with more than 30% residing in urban areas. Spanning an area of 4.8 million square kilometers, the region has a combined Gross Domestic Product (GDP) of roughly US$ 305.3 billion (Kaahwa, 2017).

Over recent years, the EAC has made considerable progress in its journey toward forming an economic union, beginning with the establishment of a preferential trade area (PTA) in 1993, followed by the formation of a free trade area (FTA) in 1996. As a growing regional economic bloc, the EAC is continuously enhancing cooperation among its member states to maximize mutual benefits across political, economic and social dimensions (Kimeu, 2020).

A major milestone was achieved in 2005 when the EAC Partner States reaffirmed their commitment to integration by establishing a Customs Union, as stipulated under Article 75 of the EAC Treaty. This agreement paved the way for the facilitation of free trade within the region by eliminating duties on intra-EAC trade, while also implementing a common external tariff

(CET) that standardizes tariffs on imports from non-member countries across all EAC states (Ekutu, 2021).

In 2010, the EAC member goverments formally established the Common Market Protocol, enabling movement of goods, services, capital, and labor unrestricted, within the EAC zone. The full implementation of the common market has been projected for December 2015, this target date was failed to met. Nevertheless, notable progress has been made towards realizing a unified market (Chilangazi and Magasi, 2023).

Furthering its ambitions, the EAC heads of state and government signed and agreed the East African Community Monetary Union Protocol (EAMU) in November 2013, which is aimed at being fully established by 2031. This protocol envisions a harmonized approach to fiscal policy, monetary and exchange rate management, statistical systems, financial market regulation, banking oversight, financial stability, payment systems, and the alignment of accounting and financial standards, thus making easier for greater financial and economic collaboration within the region (NEC, 2023).

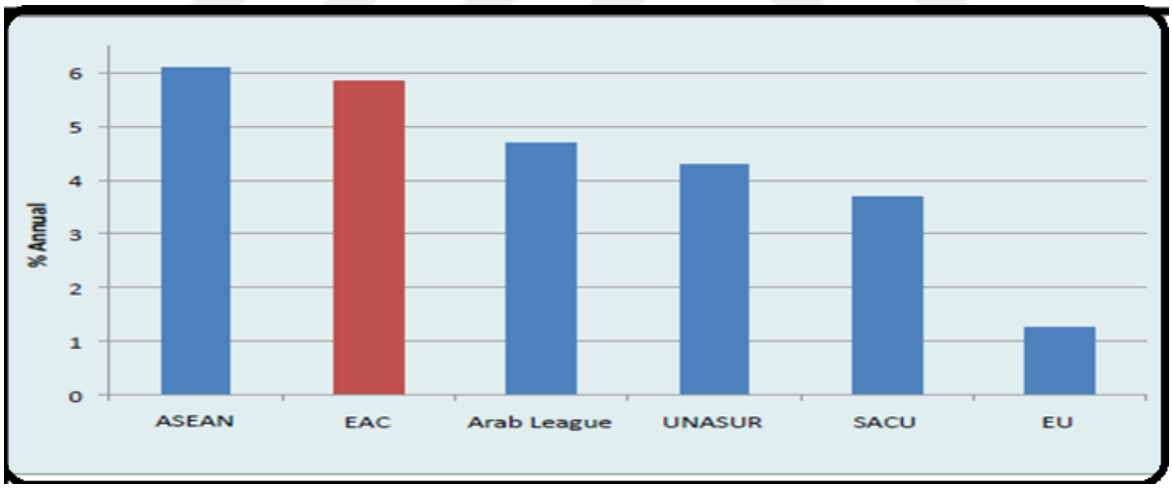

Figure1.1. EAC Average GDP Growth Comparing with other Regional Integrations
Source: (Tebekew, 2014).

In 2003, the combined GDP of the three former East African Community (EAC) member states amounted to $31.4 billion (McIntyre, 2005).

Among them, Kenya boasted the largest economy with a GDP of $14.1 billion, a population of 31.9 million, and a per capita GDP of $445. Tanzania followed with a GDP of $10.3 billion, a population of 35.9 million, and a per capita GDP of $286.6. Uganda had a GDP of $7.0 billion,

a population of 25 million, and a per capita GDP of $280.8. Despite their inherent disparities, these countries exhibit notable commonalities arising from their geographic proximity, shared climate, and intertwined historical contexts. A particularly significant aspect is Uganda's reliance on accessing to maritime ports in Kenya (Mombasa) and Tanzania (Dares-Salaam), given its landlocked status. All three nations are active member states of the World Trade Organization (WTO) and engage in various Regional Trade Agreements (RTAs). Notably, Kenya and Uganda are participants in the Common Market for Eastern and Southern Africa (COMESA), while Tanzania is aligned with the Southern African Development Community (SADC). These countries consider economic integration in the region as a critical component of their development strategies, recognizing it as a key driver of enhanced trade and investment flows. Policymakers anticipate that the implementation of the EAC customs union will significantly enhance intra-regional trade and investment, fostering a competitive environment that boosts the efficiency and global competitiveness of their export sectors. Moreover, activating the EAC common external tariff (CET), which effectively reduces tariff barriers, is expected to further propel these objectives by promoting a more integrated and competitive regional market (Tebekew, 2014).

Macroeconomic Convergence Criteria

Macroeconomic convergence refers to the collective effort of various regional states to attain comparable macroeconomic outcomes, including increase in the economy, inflation rates, budget deficits, and manageable public debt levels. This creteria of macroeconomy is crucial for maintaining the stability within the region, reducing external influences, and protecting excessive volatility, thereby fostering a stable and attractive environment for business and investment (Oloo, 2023).

The Maastricht Treaty of 1992 accepted the primary convergence criteria for the European Union, while Articles 83 and 84 of the treaty confirming the East African Community (EAC) lay down similar requirements for macroeconomic policy coordination and monetary and fiscal policy harmonization within the EAC (Lunogelo and Mbilinyi, 2009).

The Monetary Affairs Committee (MAC) of the EAC, comprising the Governors of Central Banks, convened in Uganda, to devise a strategic framework for expediting the development of a monetary union within the EAC in 2007. The committee established a set of macroeconomic convergence criteria, which were categorized into primary and secondary criteria. The primary criteria consist of four fundamental convergence criteria in which member states must achieve and maintain for three years minimum before being considered eligible to join the monetary union (Binda, 2017).

These criteria include: a ceiling on headline inflation of 8%, a fiscal deficit (including grants) not exceeding 3% of Gross Domestic Product (GDP), a maximum gross public debt of 50% of GDP in Net Present Value terms, and a reserve cover equivalent to 4.5 months of imports (Kuteesa, 2012).

The secondary criteria are aimed at addressing any existing macroeconomic disparities among EAC member states resulting from diverse macroeconomic policies. These include restrictions on core inflation (set at 5%), fiscal deficit (excluding grants, limited to 6% of GDP), and a minimum tax-to-GDP ratio of 25% (Ltaifa et al., 2014).

The ceiling on inflation rate serves as a pivotal macroeconomic convergence criterion within the East African Community (EAC). This criterion mandates that member states maintain headline inflation rates at or below 8.0% for a sustained period, typically three years consecutively, before the settling the monetary unification. Such a ceiling reflects a commitment to price stability, which is fundamental for fostering macroeconomic stability, promoting investment, and sustaining economic growth within the region. By adhering to this convergence criterion, EAC member states aim to mitigate inflationary pressures, enhance economic predictability, and facilitate the smooth functioning of monetary policy mechanisms (Yabu and Kessy, 2015).

Table 1.1. shows that Somalia exhibits relatively favorable performance, with inflation rates generally remaining below the 8.0% threshold until 2022, where a slight deviation occurs with a rate of 6.7%. This suggests a degree of stability in Somalia's inflation environment, albeit with some variability over time. In contrast, Burundi experiences notable inflation volatility, with several years surpassing the 8.0% threshold, notably in 2017, 2020, and 2021. This volatility underscores challenges in maintaining price stability within the economy and underscores the need for more effective monetary policy measures and structural reforms to align with the convergence criteria. Similarly, South Sudan exhibits extreme inflation volatility, characterized by instances of hyperinflation, particularly notable in 2016 and 2017, highlighting profound macroeconomic challenges facing the country. Kenya and Uganda demonstrate relatively stable inflation dynamics overall, with occasional breaches of the 8.0% threshold observed in certain years.

Despite experiencing inflation fluctuations, both countries generally maintain inflation within the target range, indicative of a degree of macroeconomic stability and policy efficacy. Rwanda also contends with inflation volatility, occasionally surpassing the 8.0% threshold, particularly evident in 2016, 2017, and 2021, emphasizing the necessity for effective policy interventions to mitigate inflationary pressures and uphold price stability.

In contrast, Tanzania emerges as a standout performer in maintaining stable inflation dynamics within the target range. With inflation rates consistently below the 8.0% threshold and only sporadic fluctuations observed, Tanzania exhibits a comparatively stable macroeconomic environment among its EAC counterparts. This stability reflects effective monetary policy implementation and prudent fiscal management, contributing to sustained price stability and economic resilience (NEC, 2023).

Table 1.1. EAC Macroeconomic Convergence Criteria for Inflation (target ≤ 8%)

INLATION	2015	2016	2017	2018	2019	2020	2021	2022
Somalia	4.0	2.3	3.4	4.2	4.7	4.1	4.6	6.7
Burundi	5.5	5.6	16.1	-2.8	-0.7	7.3	8.4	18.8
Congo DR	0.8	1.6	3.3	3.6	1.8	3.8	8.2	8.8
Kenya	6.6	6.3	8	4.7	5.2	5.4	6.1	7.7
Rwanda	2.5	7.2	8.3	-0.3	3.9	9.9	-0.4	17.7
South Sudan	52.8	380	189.9	83.5	87.2	29.7	10.5	-6.7
Tanzania	5.6	5.2	5.3	3.5	3.5	3.3	3.7	4.4
Uganda	5.6	5.7	5.2	2.6	2.9	3.3	2.2	7.2

Source: (EAC data portal and CBS, 2022)

Intra-EAC Trade

In 2022, Somalia faced a significant disparity between its import and export values, indicative of a substantial trade imbalance within its economy. The estimated import basket reached approximately US$ 6.4 billion, while exports amounted to only around US$ 697 million. This disparity underscores the considerable gap in Somalia's trade balance, which has widened over the years. Somalia's export portfolio is primarily composed of Sheep and Goats, Gold, Bovine, Other Oily Seeds, and Insect Resins, with key export destinations including Oman, the UAE, Saudi Arabia, India, and Bulgaria. Similar to many Sub-Saharan African nations, Somalia's export base is heavily reliant on a handful of primary commodities, primarily comprising food items, ores, metals, precious stones, and agricultural raw materials. Notably, agricultural products, particularly oil seeds, feature prominently in Somalia's export profile. Moreover, raw hides and skins represent significant exports for Somalia, with live animals alone constituting nearly 60% of the country's total exports. This concentration in export commodities underscores the need for Somalia to diversify its export base and address structural challenges to achieve a more balanced and sustainable trade framework (NEC, 2023).

As shown in Table 1.2. Kenya emerges as a dominant player in intra-EAC trade, consistently recording substantial volumes of both imports and exports throughout the analyzed period. Notably, Kenya's total imports surged from USD 543.96 million in 2020 to USD 865.92 million in 2021 before slightly decreasing to USD 846.88 million in 2022. Similarly, Kenya's total exports witnessed a consistent upward trend, reaching USD 1613.22 million in 2020, and peaking at USD 2058.44 million in 2022. These figures underscore Kenya's pivotal role as a major trading hub within the EAC, driven by its diversified economy and strategic geographical

position. Uganda also features prominently in intra-EAC trade, albeit exhibiting fluctuations in trade volumes over the analyzed years. While Uganda's total imports experienced a slight decline from USD 1651.42 million in 2020 to USD 1070.23 million in 2022, its total exports followed a fluctuating trajectory, reaching USD 1246.04 million in 2020, before peaking at USD 1944.34 million in 2022. These fluctuations may reflect various factors such as changes in domestic demand, external market conditions, and policy dynamics impacting Uganda's trade performance. Tanzania demonstrates relatively stable trade patterns, with both total imports and exports maintaining an upward trajectory over the analyzed period.

Tanzania's total imports increased from USD 335.28 million in 2020 to USD 577.99 million in 2022, while its total exports rose from USD 952.02 million in 2020 to USD 1414.87 million in 2022. This consistent growth underscores Tanzania's role as a significant contributor to intra-EAC trade, driven by its diverse economic sectors and export-oriented industries. Rwanda, Burundi, and South Sudan exhibit varying degrees of trade activity within the EAC, with fluctuations observed in both total imports and exports.

Rwanda's trade volumes show a notable increase in total imports from USD 856.48 million in 2020 to USD 1168.13 million in 2022, accompanied by a corresponding rise in total exports from USD 437.94 million to USD 840.75 million during the same period.

Burundi's trade volumes also display an upward trend, albeit with more moderate growth rates compared to other member states. South Sudan, while showing a substantial increase in total imports from USD 7.90 million in 2020 to USD 439.68 millionin 2022, registers relatively lower levels of total exports, reflecting its status as an emerging player in intra-EAC trade.

Table 1.2. Intra EAC Trade Imports and Exports (in USD million)

COUNTRIES	TOTAL IMPORT			TOTAL EXPORT		
	2020	2021	2022	2020	2021	2022
Burundi	180.30	233.46	273.36	48.22	57.30	55.36
Kenya	543.96	865.92	846.88	1613.22	1974.60	2058.44
Rwanda	856.48	796.04	1168.13	437.94	628.52	840.75
South Sudan	7.90	170.61	439.68	3.69	32.78	3.80
Tanzania	335.28	528.03	577.99	952.02	1368.48	1414.87
Uganda	1651.42	1609.56	1070.23	1246.04	1531.81	1944.34
EAC	3575.33	4203.63	4376.28	4301.14	5593.49	6317.56

Source: eac.opendataforafrica.org

2. LITERATURE

This section is structured around key thematic areas. It addresses the association between Gross Domestic Product (GDP) and total trade, it also investigates the impact of Foreign Direct Investment (FDI) on total trade, the concept of trade openness and its connection to total trade, the linkage between unemployment and total trade. It also focuses on the relationship between population and total trade. A comprehensive summary of the reviewed literature will be concluded at the end of this chapter.

Mwambe et al., (2019) conducted Don Prasad Aldersgate College, Graduate School, Philippines, investigated the implications of the Framework Economic Partnership Agreement (FEPA) on trade between the (EAC) and the European Union (EU) between the period 2000 – 2018. Employing a gravity model estimation, the study analyzed the impact of the interim EPA on trade flows, encompassing exports and imports, between the two trading blocs. Key variables included trade flow data, economic size indicators such as real GDP growth and per capita GDP, and also dummy variables to capture the effects of FEPA and temporal dimensions. The findings indicate that the interim EPA largely failed to deliver substantial benefits to EAC economies, with evidence pointing toward potential trade diversion. Burundi's trade was significantly negatively impacted, while exports from Kenya and Tanzania experienced a positive effect. These results are potentially attributable to structural challenges, including low productive capacities within EAC, the global financial crisis that dembened global consumption demand, the rise of intra-EAC trade, strengthened trade relations with COMESA and SADC, and insufficient supply of goods to meet EU market demands.

Wahyudi and Anggita (2015) employed the gravity method of trade to examine Indonesia's trade dynamics with its top ten export partners. Employing panel regression analysis with a fixed-effects model, the research aimed to uncover the association between key economic variables—namely, Constant Gross Domestic Product (GDP), Per Capita GDP, transportation costs, and the Real Effective Exchange Rate (REER)—and Indonesia’s export performance with these trading partners. The study utilized secondary data, and the methodology included rigorous statistical testing through the Chow test, Hausman test, and classical assumption tests to ensure robustness. The findings of the panel regression analysis revealed that, both collectively and individually, Constant GDP, Per Capita GDP, transportation costs, and REER

significantly influenced Indonesia's export levels. These results underscore the critical role of economic size, purchasing power, logistical efficiency, and currency valuation in shaping Indonesia's bilateral trade outcomes.

Fatima et al., (2019) conducted a comprehensive investigation into the determinants of Pakistan's trade exchanges with its principal trading partners. Utilizing panel data spanning 1995 to 2016, the study incorporated variables including GDP, per capita income, population, and membership in international organizations, sourced from various databases. The analysis employed an augmented gravity model of trade, leveraging fixed and random effects methodologies to examine the relationships. The findings revealed that the product of GDPs, trade-to-GDP ratio, and Pakistan's population significantly and positively influenced bilateral trade with its key partners. Conversely, per capita GDP exhibited a positive effect, while the distance between trading nations and the population of trading partners demonstrated a negative but statistically insignificant impact. Additionally, membership in international trade organizations was found a negative and insignificant influence on Pakistan's bilateral trade. The results suggest that the gravity model of trade theory fails to fully explain Pakistan's trade relationships, with certain variables displaying unexpected negative associations. These findings underscore the complexity of Pakistan's trade dynamics and highlight the need for tailored policy interventions.

Gaillard and de Soyres (2020) in their influential study global trade and GDP co-movement, provided a comprehensive re-examination of the relationship between international trade and GDP synchronization across 135 countries over period 1970 to 2009. Drawing on a robust theoretical framework, the research introduced two critical dimensions of trade linkages: (i) the traditional bilateral trade index and (ii) innovative indices that capture shared exposure to third states, highlighting the importance of similarities in trade network structures. The empirical findings underscored that both dimensions are significant determinants of GDP correlation, revealing an extra mechanism by which economic fluctuations propagate through global trade channels. The study further illuminated the role of trade composition in shaping synchronization patterns, showing that high-income countries exhibit greater GDP co-movement when their trade is concentrated on intermediate inputs, while low-income countries' GDP synchronization is more influenced by trade in final goods. Moreover, the analysis demonstrated that the increasing density of the global trade network has amplified the link

between international trade flows and bilateral GDP co-movement. This phenomenon has driven a marked evolution in the trade co-movement slope over the past two decades, emphasizing the transformative impact of globalization on macroeconomic interdependencies and the structural dynamics of the global economy.

Joram (2015) investigated the influence of regional trade agreements (RTAs) on (FDI) inflows in Eastern African countries, aiming to show up the relative effects of these collaborations and provide policy recommendations. The study found that foreign investment decisions are inherently forward-looking, contingent upon expectations of future returns. Political stability in Eastern African countries was identified as a key determinant of FDI, with foreign investors showing reluctance to engage in politically unstable environments due to the adverse effects on investment returns and the economic value of assets, particularly in times of conflict. This is attributed to the increased volatility of the host economy's exchange rate under political instability. The study concluded that greater political stability within the region enhances FDI inflows. Furthermore, if any individual member state's political risk deviates below the regional average, it may experience an outflow of FDI to other countries within the integration framework. The findings led to the recommendation that RTAs with comprehensive trade and investment provisions attract more FDI, suggesting that negotiations should prioritize such provisions to foster greater investment.

Wang et al., (2010) focused on the determinants of trade exchanges among OECD countries, employing gravity panel data methods to test hypotheses derived from new trade theory, (FDI) theory, and economic growth theory. It extended the traditional gravity approach by incorporating variables like domestic research and development (R&D) stock and inward FDI, in addition to GDP and transportation costs. The data set, covering 19 OECD countries from 1980 to 1998, revealed that market size, domestic R&D stock and inward FDI positively correlated with the trade volume. However, distance between trading partners had a negative effect. These findings provided empirical support for the theoretical constructs of new trade, FDI, and economic growth.

Aizenman and Noy (2005) explored the double-way linkages between (FDI) and international trade, specifically examining the inter-temporal connections between FDI and various categories of trade. The study applied a model to investigate the feedback mechanisms between FDI and trade, particularly in the context of developing countries. Using Geweke's (1982) decomposition method, the authors found that the most significant feedback occurred between FDI and manufacturing trade. The analysis revealed that the majority (81%) of the linear feedback between FDI and trade could be attributed to Granger causality, with 50% of the feedback flowing from FDI gross flows to trade openness and 31% from trade to FDI. The remaining feedback was attributed to simultaneous correlations between the two variables.

Asteriou and Moudatsou (2015) examined the synchronization of business cycles across the enlarged European Union (EU), focusing on the role of bilateral trade and foreign direct investment (FDI) in influencing business cycle (BC) synchronization. The study utilized international data spanning 1998 to 2011, which included the period of the European sovereign debt crisis. The authors found that while international trade significantly contributed to business cycle synchronization, particularly before the 2008 financial crisis, FDI did not have a direct effect on this synchronization. Notably, the synchronization effect was more pronounced for traditional EU countries, highlighting the differential impact of trade and FDI on business cycles within the region.

Alex (2020) uncovered the role of economic collaboration within the East African Community on bilateral trade, with a particular focus on Uganda. Utilizing descriptive statistics and secondary time-series data spanning between periods 1967 to 2020, the study highlighted that EAC integration has positively influenced trade among its member states. Notably, Uganda's export volume increased by USD 14 billion, with intra-EAC trade accounting for 22.4% of total exports, reflecting an annual growth rate of 6.5%. The reduction of tariff barriers, from 26.1% in 1994 to 9.2% in 2011, was instrumental in fostering trade growth. This integration has contributed to significant regional competition, positioning EAC economies as some of the fastest-growing in Sub-Saharan Africa. Additionally, the GDP-share of trade increased significantly, with imports rising from 21% in 2000 to 28% in 2015, while exports grew from 13% to 18% over the same period. These findings suggest that EAC economic integration has had a robust and positive impact on bilateral trade among member states, stimulating both export and import activities.

Mahona and Mjema (2014) explored the determinants of trade between Kenya and Tanzania within the (EAC), employing a gravity model approach. The study sought to explain why trade between these two countries dominates within the EAC. The findings revealed that the economic size (GDP) of EAC member states is a more significant determinant of trade flows than per capita GDP, with both countries' economic size driving trade volume. The negative impact of the distance variable underscored the elevated costs of trading, time-related barriers, and market access difficulties between the nations. In a disaggregated model, the GDP of Tanzania exerted a more substantial influence on trade than that of Kenya, with Tanzania's GDP coefficient exhibiting a higher value. While the GDP of Tanzania's importers had a positive and statistically insignificant effect on trade, Kenya's export trade responded positively and significantly. Furthermore, the study indicated that the population of importing countries plays a significant role in facilitating trade between Tanzania, Kenya, and other EAC members. The negative and significant coefficient for per capita income suggested that both Kenya and Tanzania do not engage in the trade of high-income goods. The distance variable had a greater negative impact on Tanzania's exports than on Kenya's. Additionally, the exchange rate variable demonstrated the importance of price competition, as a depreciation of Tanzania's currency did not enhance exports to the same extent as it did for Kenya. Lastly, the study concluded that trade liberalization and the formation of the EAC bloc have significantly improved trade flows between EAC countries, demonstrating the effectiveness of the regional integration measures in promoting intra-regional trade.

Literature reviewed shows that GDP, FDI, unemployment, trade openness, distance, and population are critical factors in determining trade flows and economic performance. There are varying perspectives among researchers regarding their impact on trade. Some studies emphasize the positive association between GDP and bilateral trade, inconstast others highlight the negative influence of distance due to increased transportation costs. Many researchers focus on the reciprocal influence between FDI and trade, particularly in developing economies, and the positive impact of trade openness in reducing trade barriers and fostering economic growth. The previous studies have largely examined the effects of economic size, political stability, regional trade agreements, and economic integration on these variables, especially for countries like those in the EAC and Organization for Economic Cooperation and Development (OECD). Most results suggest that GDP growth, trade liberalization, and FDI play pivotal roles in enhancing bilateral trade, while distance remains a consistent obstacle. These studies contribute

to the understanding of how regional trade agreements and macroeconomic factors like GDP, FDI, and trade openness can influence global trade patterns, emphasizing the importance of economic stability and liberalization.

3. METHODOLOGY

This chapter is about Analysis of Bilateral Trade exchanges between Somalia and Other East African Community nations through Panel Gravity Model Approach, the chapter gives the theoretical framework which starts by the definition of the study variables, theory adopted and data used along with model which this study uses.

3.1. Definition of theVariables

Total Trade (TT)

Total trade is the cumulative value of goods and services traded between an economy and its international counterparts within a defined timeframe, usually quantified in monetary units. This metric encapsulates exports, denoting goods and services sold to foreign nations, and imports, indicating goods and services acquired from abroad. Total trade serves as a fundamental gauge of a country's economic interaction with the global market. It reflects the extent of a country's commercial activity, influenced by various factors including trade policies, trade partners, and economic circumstances (Helpman et al., 2006).

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) stands as a pivotal factor in the realm of international trade, shaping the landscape of global commerce and economic interactions. A comprehensive indicator of a country's economic output, GDP serves as a fundamental indicator influencing trade dynamics. Nations with robust GDP figures often wield greater purchasing power, driving demand for imports and shaping their trade relationships with other countries. Conversely, countries with lower GDP levels may find themselves more reliant on exports to fuel economic growth and bridge trade imbalances. Moreover, GDP reflects the overall economic health and competitiveness of a nation, influencing its ability to participate in global trade networks. A strong GDP signals a vibrant and productive economy, fostering investor confidence and attracting foreign capital, which in turn can stimulate trade flows. Conversely, stagnant or declining GDP growth may hinder a country's trade performance, impacting its capacity to engage in international commerce and compete in global markets. Furthermore, fluctuations in GDP can have ripple effects across supply chains, affecting trade volumes, pricing dynamics, and market sentiments. Understanding GDP trends is therefore crucial for businesses,

policymakers, and investors seeking to navigate the complexities of global trade (Wang et al., 2010).

Foreign Direct Investment (FDI)

Foreign Direct Investment (FDI) has become a cornerstone of the global economy, particularly in discussions within the realm of international trade. Scholars and experts in trade economics have extensively deliberated on the profound significance of FDI, particularly concerning developing economies. Notably, Mohanty and Sethi (2019) underscored the pivotal role played by foreign capital, specifically FDI, in mitigating the challenges often encountered by developing nations, such as insufficient capital resources. Foreign Direct Investment (FDI) as a cornerstone of international trade, denoting the stright investment made by a company from one nation into tangible assets or enterprises situated in another. This investment approach, distinct from portfolio investment, entails a direct engagement in the operations and management of foreign businesses, often signifying a prolonged commitment to penetrate or expand within foreign markets. In the realm of bilateral trade, FDI assumes a multifaceted role, fostering market access, technological exchange, supply chain integration, and the development of complementary trade patterns between investing and host nations. FDI facilitates the crossborder flow of capital, expertise, and resources, thereby acting as a fundamental driver of economic growth and development. It also plays a crucial role interms of shaping the complex dynamics of international trade and investment, contributing to the deepening of global economic integration and fostering collective prosperity.

Trade Openness (TO)

The impact of trade openness on economic performance has been the subject of ongoing debate among contemporary researchers. However, the findings of these studies have yielded varied conclusions. Some authors, such as (Gwartney et al., 2001, Dollar and Kraay, 2002). Warner (2003) contend that there exists a robust association between openness to global trade and economic performance. Trade openness refers to the level to which an economy embraces participation in international trade. It signifies the degree of external engagement a country maintains in its trade activities. In empirical terms, trade openness is commonly quantified by calculating the ratio of a nation's total exports plus imports to its Gross Domestic Product (GDP). This measurement serves as a fundamental variable extensively utilized in various international macroeconomic investigations. Moreover, trade openness represents howmuch an

economy engages in international trade, reflecting its willingness to participate in global markets.

Conceptually, it embodies a commitment to reducing challenges to trade, such as tariffs, quotas, and regulatory restrictions, in order to facilitate the exchange of goods and services across borders. This openness allows countries to tap into a broader range of opportunities, accessing foreign markets to both export their products and import goods and services they require. By embracing trade openness, economies can benefit from increased competition, efficiency gains, and opportunities for specialization, ultimately leading to economic growth and development. Additionally, trade openness fosters the integration of countries into the global economy, promoting cooperation, innovation, and the diffusion of knowledge and technology. In essence, trade openness serves as a cornerstone of economic policy, shaping the trajectory of international trade relationships and influencing the overall prosperity of nations (Fuji, 2019).

Unemployment Rate (UNEMP)

According to Janoski et al., (2014) unemployment the segment of the labor force who actively seeking employment but is unable to secure work, despite being available for and willing to engage in productive labor.

As shown the below Table 3.1 high unemployment rate in Somalia holds significant implications for bilateral total trade between Somalia and other East African Community (EAC) member states. Firstly, Somalia's high unemployment rate indicates a significant portion of the population lacking steady income and purchasing power. This can dampen domestic demand for goods and services, leading to reduced imports from EAC member states.

Conversely, Somalia's ability to export goods to other EAC countries may also be constrained due to limited domestic production capacity resulting from high unemployment. Furthermore, the unemployment rates of EAC member states themselves can impact bilateral total trade with Somalia.

For countries with lower unemployment rates, such as Tanzania and Uganda, there may be greater domestic consumption and demand for imports, including those from Somalia. This can result in increased bilateral trade volumes, in terms of exports from Somalia and imports to these countries. Conversely, nations with higher unemployment rates, such as Burundi and Rwanda, may experience reduced purchasing power and lower demand for imports, including those from Somalia.

Additionally, high unemployment rates in both Somalia and other EAC member states can hinder economic growth and investment, thereby constraining overall trade volumes. Unemployment contributes to economic instability and can deter foreign investment, which is essential for expanding trade opportunities and fostering economic development. Moreover, unemployment may lead to social unrest and political instability, further impeding trade relations and hindering efforts to improve bilateral total trade between Somalia and other EAC countries.

Addressing unemployment challenges in Somalia and other EAC member states is crucial for enhancing bilateral total trade relations. Policies aimed at promoting job creation, skills development, and entrepreneurship can stimulate economic growth and increase purchasing power, leading to greater demand for imports and boosting bilateral trade volumes. Furthermore, initiatives to improve trade infrastructure, reduce trade barriers, and enhance market access can facilitate smoother trade transactions and contribute to the expansion of bilateral total trade between Somalia and other EAC member states.

Table 3.1. EAC Countries Unemployment Rate, 2015-2022, in Percent %

COUNTRY EAC-members	2015	2016	2017	2018	2019	2020	2021	2022
Somalia	18.88	18.93	18.98	18.87	18.83	19.57	19.93	20.05
Burundi	1.48	1.32	1.17	1.02	0.87	1.03	1.13	1.02
Congo DR	4.46	4.48	4.46	4.43	4.44	5.13	5.11	4.99
Kenya	2.77	2.76	3.52	4.24	5.01	5.62	5.64	5.50
Rwanda	11.83	11.86	11.88	12.1	12.43	13.01	13.31	13.01
South Sudan	12.29	12.33	12.26	12.23	12.20	13.75	13.49	12.98
Tanzania	2.14	2.15	2.17	2.20	2.21	2.78	2.74	2.76
Uganda	2.75	3.18	3.64	3.57	3.55	4.51	4.3	4.28

Source: https://databank.worldbank.org/

Population (POP)

The East African Community which is presently experiencing one of the most rapid population growth rates globally, exacerbating a multitude of socio-economic bariers including healthcare disparities, poverty, environmental degradation, unemployment, and agricultural productivity decline. Statistics indicate that approximately 60% of mortality cases within the region are attributable to water contamination and poor sanitation practices, while 40% are linked to indoor air pollution, with a mere 1% attributed to outdoor air pollution, as outlined in a United Nations report (UN, n.d.). Moreover, projections suggest that Tanzania, Kenya, and Uganda are among the 33 nations anticipated to witness a population surge of at least fivefold by the year 2100 (UNEC, 2023).

Table 3.2. EAC Countries Population Growth, 2015-2022, in Percent %

COUNTRY EAC-member	2015	2016	2017	2018	2019	2020	2021	2022
Somalia	3.36	3.77	3.92	3.61	3.63	3.42	3.15	3.07
Burundi	2.21	1.64	2.31	3.03	3.32	2.91	2.71	2.70
Congo DR	3.39	3.47	3.44	3.27	3.19	3.22	3.22	3.20
Kenya	2.22	2.23	2.20	2.05	2.0	2.03	1.96	1.93
Rwanda	2.39	2.44	2.48	2.44	2.39	2.40	2.37	2.31
South Sudan	-0.17	-1.15	-3.69	-2.47	0.5	1.52	1.34	1.53
Tanzania	3.34	3.48	3.37	3.19	3.02	3.01	3.01	2.96
Uganda	3.09	3.33	3.50	3.40	3.40	3.33	3.21	3.0
Total EAC	19.83	19.21	17.53	18.52	21.45	21.84	20.97	20.7

Source: https://databank.worldbank.org/

According to above Table 3.2. Somalia, the fluctuating population growth rates observed in the country, with a general downward trend after 2016, reflect a complex socio-economic context. Despite challenges such as political instability and security concerns, Somalia's strategic location and abundant resources present trade opportunities.

However, the population's dynamics can affect domestic consumption patterns and market demand, which, in turn, may impact trade flows both domestically and regionally. Efforts to stabilize the country's economy and improve infrastructure can enhance its participation in regional trade activities, potentially contributing to total trade growth within the EAC.

In other EAC countries experiencing rapid population growth, such as Uganda and Tanzania, increased demand for imports to meet growing consumption needs is likely. This heightened demand can create opportunities for exporters within the region and beyond, thus facilitating trade flows and economic integration. Conversely, countries with slower population growth rates or declines, like Kenya, may focus on enhancing export competitiveness to access external markets and offset sluggish domestic demand. Diversifying export products, improving trade infrastructure, and implementing trade facilitation measures are critical strategies for such countries to stimulate trade growth.

Additionally, demographic dynamics influence investment decisions and trade policies within the EAC. Governments may prioritize sectors aligned with demographic trends, such as healthcare, education, and agriculture, to support growing populations and foster sustainable development. Leveraging demographic dividends, particularly the youthful population's potential for innovation and entrepreneurship, can further boost trade prospects within the region.

Distance

The gravity model often represents distance as an inverse measure of trade intensity, where longer distances reduce trade flows. This is based on the assumption that transportation costs and cultural differences increase with distance. However, some studies argue this interpretation oversimplifies the complexities of modern trade, as advancements in technology and logistics reduce the impact of physical distance (Anderson, 2011).

Common Language

A common Language refers to a shared language spoken by people in two countries, either as a native or widely-used second language. It facilitates communication and reduces transaction cost in bilateral trade by making it easier to negotiate contracts, undrestand regulations, and build trust between trading partners. Studies have found that countries sharing a common language tend to trade more with each other because it minimizes misundrestandings and boosts efficiency in trade processes (Melitz, 2008).

Common Border

A common border is the shared boundry between two countries. This geographical proximity can significantly enhance Bilateral Trade by reducing transportation costs, facilitating quicker delivery times, and promoting economic integration. For instance, a study by (Anderson and Van, 2003) highlights that common borders can lower trade barriers, thereby increasing trade valumes between neighboring nations.

Landlockness

Landlockedness is the condition of a country being entirely surrounded by land, lacking direct access to the sea. This geographical disadvantage can significantly impede a nations's trade by increasing transportation costs and creating dependency on neighboring countries' infrastructure and political stability. Landlocked countries often face higher transport costs, which can reduce their trade volumes (Raballand, 2003).

3.2. Gravity Models in Trade

The gravity model one of the widely prevalent and robust frameworks for conducting statistical analyses of bilateral flows between distinct geographic entities. This subsequent section traces the historical development and application of the model, which finds its intellectual origins in Isaac Newton's "Law of Universal Gravitation," first articulated in 1687. Newton's pioneering concept in physics suggested that the gravitational force is directly proportional to the product of their masses and inversely proportional to the square of the distance separating them. This foundational principle, which mathematically is expressed as:

$F_{ijt} = G\ (M_{it}.M_{jt} / D^2_{ij})$ (3.1)

i and j represent country i and country j respectively and t forperiod of time.

F_{ijt} signifies the gravitational force.

M_{it} and M_{jt} for the economic sizes.

D_{ij} means the distance between the two entities.

G is a constant dependent on the units used the measurement for mass and force.

The application of this model to global trade gained significant recognition following the seminal work of (Tinbergen, 1962; Pöyhönen, 1963; Pulliainen, 1963) that showed that a similar mathematical structure could effectively capture the dynamics of trade flows among countries. Since its introduction, numerous empirical studies have employed the gravity model

for investigating key phenomena, such as the trade creation and diversion effects resulting from Regional Trade Agreements (RTAs), including the East African Community (EAC). Contributions to the theoretical development of the model were made by (Anderson, 1979; Helpman, 1987; Bergstrand, 1985; Deardorff, 1998).

Over time, the gravity model has been successfully applied to a variety of areas, including cross-border capital flows by (Kimura and Lee 2006; Ceglowski ,2006), international education by (Sa et al., 2004; Bessey, 2012; Gündüz, 2018) tourism by (Karagöz, 2008; Keum, 2010; Gündüz et al. 2019), and migration flows by (Vogler and Rotte, 2000; Lewer et al., 2008).

In essence, the gravity model posits that the volume between two nations is primarily influenced by their economic size, typically measured by GDP or GNP, and population, as well as the geographical distance separating them. In drawing from Newton's theory, this model suggests that the exchange of trade between two countries is positively correlated with their economic mass and population size, while it is inversely related to the distance. This distance serves as a proxy for transportation and transaction costs. The basic formulation of the gravity model can be mathematically shown as:

$$F_{ijt} = C\ (GDP_{it}.GDP_{jt} / D_{ij}) \qquad (3.2)$$

In the specific equations:
F_{ijt} denotes trade flows between countries i and j
C represents constant term
GDP_{it} gross domestic product for country i, and GDP_{jt} stands for the gross domestic product for country j.
DIS_{ij} represents distance between the capitals of the two trading countries.

In econometric analysis, the gravity model is typically employed in a log-linear form, where the parameters represent the responsiveness of trade exchanges with respect to the estimated variables (Butt 2008).

This transformation allows for a more tractable analysis by linearizing the relationship between the variables, enabling clearer interpretation of how economic size and distance effect trade flows. When applying this approach to the fundamental principles of the model, is expressed as:

$$X_{ijt}=\boldsymbol{\alpha}_0 (GDP_{it})^{\boldsymbol{\alpha}1}(GDP_{jt})^{\boldsymbol{\alpha}2}(DIS_{ij})^{\boldsymbol{\alpha}3} \quad (3.3)$$

In this framework, X_{ijt} denotes the trade flow between countries, which can encompass various forms of trade, including overall trade volume, meantrade exchanges, or specific export and import activities of a given nation. GDP_{it} and GDP_{jt} represent the economic size of the two trading nations, which are commonly quantified using economic economic measures such as economic output (GDP), per capita income (GNP) or population size. Additionally, the variable DIS_{ij} signifies the geographical separation between the trading nations, acting as an indicator for transportation expenses which typically increase with greater distance.

Typically, gravity model is often represented in a logarithmic-linear structure, which facilitates the interpretation of the interpreted parameters as elasticities.
Consequently, equationn(3.3)can be expressed in the following structure:

$$InX_{ijt}=\boldsymbol{\alpha}_0 + \boldsymbol{\alpha}_1 InGDP_{it} + \boldsymbol{\alpha}_2 InGDP_{jt} + \boldsymbol{\alpha}_3 InDIS_{ij} + \boldsymbol{U}_{ij} \quad (3.4)$$

U_{ij} residuals term.

Contemporary studies on approaches for estimating the gravity equation have identified two key challenges associated with the log-linearization of the model, which require further investigation due to the absence of a consensus regarding the optimal resolution. Firstly, omitting global trade resistance factors outlined by (Anderson and Van. 2003), along with unaccounted variations in trade data, can lead to skewed estimations resulting from model inaccuracies.

A common strategy to address this issue involves log-linearizing the model and estimating it through Ordinary Least Squares (OLS) with constant/fixed effects. Nonetheless, the inherent heteroscedasticity in the logarithmic-linear structure leads to increase and suboptimal estimates when applying OLS. Furthermore, logarithms cannot be computed for zero value. Consequently, when zero trade flows are present in the data, these data points must either be excluded or replaced with a small positive value, introducing data selection errors and loss of critical details. Additionally, the expended gravity framework expands the foundation model by incorporating additional factors that explain trade flow between countries. It asserts that trade activities between nations are influenced not only by their production levels (GDP) and geographic distance but also by factors such as population size, trade-related factors, along with dummy variables that encourage or restrict trade relationships between nations (Martinez-Zarzoso and Nowak-Lehmann, 2003).

Unlike cross-sectional and time-series approaches, this study employs a panel data method. The strength of panel data lies in its capacity to merge time-series and cross-sectional datasets, offering enhanced variability, greater degrees of flexibility and reduced collinearity among explanatory factors (Nguyen, 2010).

Over the past ten years, gravity models have been extensively applied to analyze the influence of various policy issues and institutional determinants on bilateral trade flows among countries. These determinants include regional trade organizations, monetory unions, political alliances, and activities in border regions (DeRosa, 2007).

Regional integration effects are typically addressed by deviating from the predicted trade volume of a baseline gravity model and incorporating dummy variables that capture different integration effects. In addition to the core gravity variables, several other factors may either facilitate or obstruct bilateral trade. Consequently, the model is augmented with dummy variables that account for the presence or absence of shared borders and participation in preferential trade accords. To consider the impact of currency fluctuations, the model also includes the Real Exchange Rate between Somalia and its trade partners. Furthermore, time-specific dummy variables are included to account for missing variables that are constant across countries but vary over time, influencing all countries included in the dataset. (Cheng and Wall, 2005) as referenced by (Rahman et al., 2006), argue that incorporating fixed effects is the most

effective way to address heterogeneity in gravity models. While traditional gravity models typically rely on cross-sectional data to estimate trade impacts for a given period, panel data methodology is employed in this study. Panel data, which integrates both time-series and cross-sectional data, provides richer insights than cross-sectional data alone.

The generalized gravity model asserts that the trade volume, including imports and exports, between country pairs is determined by their economic scale (GDP or GNP), per capita income, geographic distance (as a proxy for transportation expenses), along with various dummy variables that either facilitate or hinder commercial between nations. In the context of the East African Community (EAC), which includes Somalia and seven other member states, these factors are crucial in understanding the dynamics of trade within the region.

That is:

$$X_{ijt}=\beta_0 Y_{it}^{\beta 1} Y_{jt}^{\beta 2} Y_{it}^{\beta 3} Y_{jt}^{\beta 4} D_{ij}^{\beta 5} A_{ij}^{\beta 6} U_{ijt} \quad (3.5)$$

In the specified gravity model, where $Y_i Y_j$ represents the GDP or GNP of country i (j), y_i (y_j) denotes the per capita income of country i(j), D_{ij} indicates the distance between the economic centers of the two nations, A_{ij} represents time-invariant dummy variables, U_{ij} is the error term, and $\beta\beta$ s the parameters of the model.

The gravity model is initially stated in multiplicative form, but for estimation purposes, equation (3.5.) can be transformed into a log-linear form as:

$$LX_{ijt}=\beta_0+\beta_1 LY_{it}+\beta_2 LY_{jt}+\beta_3 LY_{it}+\beta_4 LY_{jt}+\beta_5 L\,Dij+\sum \boldsymbol{\delta} hpijht+ U_{ij} \quad (3.6)$$

In the proposed model, the variable L denotes the natural logarithms, while δ represents the coefficients associated with preferential trade dummies, and P_{ijh} signifies the sum of these preferential trade dummy variables. A dummy variable is assigned the value of one when a specific condition is satisfied and zero otherwise.

Beyond the essential gravity variables, the model is further enhanced by incorporating various factors that may either facilitate or hinder trade relations between nations. Specifically, the model includes dummy variables that reflect the presence or absence of a shared border and the existence of a System of Preferences (SOP) scheme and its associated benefits between trading partners. Additionally, to account for the effects of currency fluctuations, the model integrates the Real Exchange Rate between Somalia and its trading partners. Furthermore, country-pairspecific and time-specific dummy variables are included to adjust for unobserved heterogeneity that is constant over time but varies across countries in the sample. This methodology accounts for omitted variables that may affect bilateral trade, as well as common shocks impacting all countries involved (Cheng and Wall, 2005; Rahman et. al, 2006).

These fixed effects are particularly important in controlling for heterogeneity across country pairs, offering more accurate and robust estimates in the gravity model.

So, first and for most, this research employs the gravity model, rooted in Newton's Law of Universal Gravitation, to analyze bilateral trade exchanges, emphasizing both exports and imports. Utilizing panel data methodology, the study explores factors such as GDP, population, geographical distance, and additional variables like trade-related factors within the framework of the East African Community. The log-linearized model aims to estimate elasticities and unravel nuanced insights into the intricate determinants shaping bilateral trade relationships over time.

3.3. The Panel Gravity Models

Panel data involves aggregating observations across multiple time periods for a repeated crosssection of entities such as households, firms, states or countries (Baltagi, 2008),
This method enables the collection of multiple data points for each unit in the sample, as emphasized by (Hsiao,2005).

Panel data analysis is created by bringing together the time series observations of economic units in the form of cross sections. The fact that panel data analysis has both a cross-sectional and time dimension makes it more effective in modeling economic relations; it allows for producing results. Panel data models are expressed as follows (Baltagi, 2005):

$Y_{it} = \alpha + X'_{it}\beta + u_{it}$ t = 1, …, T i = 1, …, N (3.7)

i shows a cross-section dimension such as households, individuals, and firms, it also shows the time-series dimension. Y^{it} is the dependent variable of (i) observation. β is Kx1 and X_{it} represents the itth observation on K explanatory variables. U_{it} is the error term. The error term is considered to have a constant variance and a zero mean. Also, the residual term is uncorrelated with other variables.

Mostly one-way error component is used in panel data analysis as;

$u_{it} = m_i + v_{it}$ (3.8)

where:

mi : indicates the individuals- specific variation of y, vit : indicates the stochastic regression disturbance

Panel data exist in two forms: balanced panel data and unbalanced panel data. In the balanced panel data, for each participant there is an equal amount of time observations (no missing observations). For unbalanced panel data, the number of time observations might be different for some individuals (there are missing observations). It's also a short panel when the number of slices or individual units is more than the count of time periods. When the duration of the panel exceeds the number of sections or individual units, it is called a long panel (Baltagi, 2005):

There are some techniques for performing panel data analysis, such as the pooled least squares method (POLS), fixed effects (FEM) and random effects (REM) models.

Panel data models are divided into five different groups depending on the values of the parameters according to unit and/or time (Hsiao, 2022):

Both constant term and slope parameters are constant model with respect to unit and time:

$Y_{it} = \beta_0 + \sum_{k=1}^{k} \beta_k X_{kit} + \mu_{it}$ t=1,..,T i =1,..., N (3.9)

The model in which the slope parameter is constant and the constant term varies from unit to unit:

$$Y_{it}=\beta_{0i}+\sum_{k=1}^{k}\beta_k X_{kit}+\mu_{it} \qquad t=1,\ldots,T \qquad i=1,...,N \qquad (3.10)$$

The model in which the slope parameter is constant and the constant term varies according to unit and time:

$$Y_{it}=\beta_{0it}+\sum_{k=1}^{k=1}\beta_k X_{kit}+\mu_{it} \qquad i=1,...,N \qquad t=1,\ldots,T \qquad (3.11)$$

Model where all parameters are variable with respect to units but constant with time:

$$Y_{it}=\beta_{0i}+\sum_{k=1}^{k}\beta_{ki} X_{kit}+\mu_{it} \qquad i=1,...,N \qquad t=1,...,T \qquad (3.12)$$

Model in which all parameters vary according to both unit and time:

$$Yit=\beta 0it+\sum_{k=1}^{k}\beta kitXkit+\mu it \qquad i=1,...,N\ t=1,..,T \qquad (3.13)$$

Pooled Least Squares Method (POLS)

The pooled ordinary squares method could be utilized when the combined groups are relatively similar or homogeneous. This is one of the simplest panel-data models, as all parameters are constant (reject any effect of time). In this method, there is no autocorrelation between observations, given the units. Errors across unit and time have constant variance. Error terms are zero mean, constant variance, independent, and uniform distribution.

The estimation of this model is quite simple and its assumptions are similar to those of the classical model. Level differences can be eliminated with "mean-centering." The model can directly use the least squares method on cascading groups.

A large standard error of the model (small T-statistic) may be a warning that the group is not that homogeneous and that a more advanced method such as the random effects model might be more suitable (Johnston and Di Nardo, 1997; Greene, 2003):

$$Y_{it} = \beta 1 X_{it} + \alpha + \mu_{it} \qquad i = 1..., N \qquad t = 1..., T \tag{3.14}$$

where α is the unknown intercept, Y_{it} where i is entity and t = time, acting as the dependent variable, X_{it} indicates the explanatory variable, $\beta 1$ is the slope parameter, μ_{it} is the error term.

In the use of panel data analysis, there are some steps to be followed before the proposed regression framework is applied to determine the function. First, it is necessary to determine which of the pooled OLS, fixed effects, or random effects approaches applied in panel data analysis provide the optimal choice. In this step, the Chow and Hausman diagnostics are applied to identify the most appropriate framework.

Fixed Effect Model

The fixed effects model is employed to analyze the effects of factors that change over time, and it is used to analyze the effects of a country, individual, company, etc. It examines the relationship between predictive and outcome variables within the scope of units, such that each unit exhibits unique characteristics, which may or may not affect the predictive variable. When the fixed effects approach is used, it is assumed that something in particular can affect or influence predictive or outcome variables and must be controlled.

This justifies the assumption of association between the residual term of the unit and its independent variable. The fixed effects model is based on these time-invariant attributes. Thus, the overall influence of the estimators on the outcome factor can be determined. The term "fixed effects" refers to the fact that the parameters for each cross-section do not vary over time (they are time invariant), but only the data set changes (Gujarati and Damodar, 2003).

The unit error term and the constant should not be related because each unit is different. The fixed effects framework is not suitable and a methodology is needed because the results may not be correct when the error terms are related. This forms the basis for the Hausman diagnostic test. The fixed effects model is formulated as (Greene, 2012):

$$Y_{it}= \beta 1X_{it} + \alpha_i + \mu_{it} \qquad t=1,\ldots, T \qquad i=1,\ldots, N \qquad (3.15.)$$

There αi (i=1...N) unknown constant term for each unit (n unit-specific constant unit), Y_{it} is dependent variable, i = unit, t = time, X_{it} is the independent variable, $\beta 1$ is independent variable coefficient, μ_{it} is error term.

Another way to understand the FEM is that binary variables are to use. Thus, the formula of the fixed effects approach is as follows:

$$Y_{it}= \beta 0 + \beta 1X1,_{it} + \cdots + \beta kXk,_{it} + \gamma 2E2 + \cdots + \gamma nEn + u_{it} \qquad (3.16.)$$

Time effects can also be added extends the unit-spacific model to include both time and unitspacific effects.

$$Yit = \beta 0 + \beta 1X1,it + \cdots + \beta kXk,it + \gamma 2E2 + \cdots + \gamma nEn + \sigma 2T2 + \cdots + \sigma 1T1 + uit \qquad (3.17.)$$

i = entity and t = time, Xk,it denotes the presence of independent variables, βk is the coefficient for the independent variables,

u_{it} is the residual term, En is the n entity. $\gamma 2$ is the binary repressors' (entities') coefficient. $\sigma 2$ is binary regressor (units) coefficient, $T1$ denotes time as a categorial variable (dummy) with time period t-1.

The only source of uncertainty under the fixed effect model is sampling or estimation error in the included studies. In the random effects approach, the same sources are valid, and in addition to these reasons, there may be an error due to the variance between studies. Accordingly, the variance, standard error and margin of error values for the combined effect size in the random

effect model will always be larger or wider compared to the fixed effects framework (Borenstein and Higgins, 2013).

Random Effects Model (REM)

In contrast to the fixed effects framework, the random effects model presumes that unit change is random and unrelated to the estimator or independent variable used in the analysis. The principle difference between the fixed and random effects models lies in whether the unobserved unit-specific factor is associated with the regressors, rather than whether these factors are stochastic.

The random effect should be employed if there is reason to think that the unit difference has an influence on the dependent variable. The random effects model has the advantage of permitting the integration of time-invariant variables, which are not accounted for in the fixed effects model (Greene, 2008). In the fixed effect model, these variables were observed with constant terms.

The random effects model is:

$$Y_{it} = \beta 1 X_{it} + \alpha_i + \mu_{it} + \varepsilon_{it} \qquad i = 1,.., N \qquad t = 1,\ldots, T \qquad (3.18.)$$

αi (i=1...N) unknown constant term for each unit, Y_{it} dependent variable, where i = unit, t = time, X_{it} indicates the independent variable, $\beta 1\ is$ independent variable coefficient, As previously stated, the error term consists of two parts: μ_{it}, individual error and ε_{it}, random element that vary both over time and across units. The total of two error terms is the composite error.

The REM assumes that the unit's residual term is not associated with predictive variables, which allows time-invariant factors to contribute as independent variables. In the REM, the individual characteristics of the predictive variables that can or cannot be affected should be specified in detail. The difficulty with this is that certain variables that should be there may not be, resulting in model deviation caused by variables that were overlooked. The random effects model enables us to extrapolate the results beyond the model's sample size (Gujarati, 2004).

Hausman Test

The Hausman test compares the fixed effects and random effects models in questioning the best model for the panel data regression model (Gujarati et. al 2012).The Hausman test is compatible with k degrees of freedom and chi-square distribution (Baltagi, 2008). The Hausman test compares FEM and REM under the null hypothesis that individual effects are not correlated with any regression in the model (Hausman, 1978).

The least squares dummy variable (LSDV) and generalized least squares (GLS) are consistent and biased if the uncorrelated null hypothesis is not violated. Under the null hypothesis, the LSDV and GLS estimates should not vary consistently. To achieve a zero difference, the Hausman test employs the covariance of an efficient estimator (Greene, 2008).

It is more suitable. In the Hausman test, the null hypothesis is based on the absence of correlation between the error term and the independent variables, while the alternative hypothesis is based on the presence of correlation. In case the null hypothesis cannot be rejected, the random effects model will be valid (Tatoglu, 2012).

The Hausman test can be examined directly with the following hypothesis.

$H0$ = Random Effects Model ,

$H1$ = Fixed Effects Model If the p-value is less than (0.05), $H0$ is rejected If the p-value is higher than (0.05), $H0$ is accepted.

Assumptions of the Panel Data Models

There have been two assumptions made in panel data models. Uncorrelated errors and nocorrelation of errors with explanatory variables are explained (Gujarati et. al, 2012):

Uncorrelated errors: It can be seen that errors in each unit can be correlated over time (T) and with (N) clusters that represent units, because errors and any of the clusters can be correlated. So, with this correlation, the ordinary least square estimation acts upon standard errors to be biased and with unbiased parameter estimates. As we need to fit for clustering with full estimates of standard errors, cluster-robust standard errors are likely to be required.

No correlation of error with explanatory variables: It is possible for any correlation of error term with any explanatory variable, but when error is correlated with an explanatory variable, a biased estimate is produced due to the ordinary least square estimator. Here, instrumental variable estimation is likely to be applied.

Advantages of Using Panel Data Models

There are many significant and useful reactions to panel data that we must mention in the following points (Baltagi, 2005):

When compared to time series or cross-section data, panel data offers several advantages. Considering the difference of units that are heterogeneous in panel data, this heterogeneity can be controlled, unlike in time series and cross-section analysis.

Because panel data contains more observations, collinearity in explanatory variables decreases, degrees of freedom increase, and more efficient data means more informative data, which leads to better parameter estimates.

For this and other more exciting reasons, panel data makes it possible for researchers or analysts to study more serious and important economic questions that are probably impossible to focus on the aim of the study by using only cross-section or time series data sets. So researchers and analysts can get better parameter estimates, which results in more precise and unbiased estimates, because more data means more variation and more information can be performed.
Panel data are more accurate and measurable than cross section or time series data alone, and because time-invariant variables can be included in panel data, it is better explained than cross section and time series data.

Panel data sets offer a more effective approach for analyzing dynamic behaviors compared to cross-sectional data. While cross-sectional data allows for estimating the unemployment rate at a specific point in time, repeated cross-sectional data can track how this rate evolves over time. However, only panel data facilitates the estimation of transitions, such as identifying the proportion of individuals who remain unemployed from one period to the next. This ability to capture intertemporal relationships enables a more nuanced understanding of dynamic

processes, making panel data indispensable for studying persistence and changes in economic outcomes.

3.4. Model Development

Utilizing my dataset, we conduct an analysis employing a distinct bilateral gravity model focused on Somalia: (1) Somalia's TTV comparing its EAC member states. In line with methodology established by (Sharma and Chua, 2000) and further refined by (Hassan, 2001), the study's gravity model for Somali's trade dynamics encompasses the bilateral trade flows (aggregate of exports and imports) between Somalia and its trading partners in EAC.

The study utilizes key independent variables such as GDP, FDI along with supplementary variables, to delineate the intricate patterns within this trade framework. So the desired model in this study is as follows:-

$$\ln X_{ijt}=\boldsymbol{\beta}_0+\boldsymbol{\beta}_1\ln(GDP_{it}*GDP_{jt})+\boldsymbol{\beta}_2\ln(FDI_{it}*FDI_{jt})+\boldsymbol{\beta}_3\ln(TO_{it}*TO_{jt})+$$
$$\boldsymbol{\beta}_4\ln(UNEM_{it}*UNEM_{jt})+\boldsymbol{\beta}_5(Distance_{ij})+\boldsymbol{\beta}_6\ln(POP_{it}*POP_{jt})+\boldsymbol{\beta}_7(COMLAN_{ij})$$
$$+\boldsymbol{\beta}_8(Landlockness_{ij})+\boldsymbol{\beta}_9(COMborder_{ij})+U_{ijt}$$

where:
X_{ij}= Total tradebetweenSomalia (i) and partner country (j),
$GDP_i(GDP_j)$ = GrossDomestic Product of country i(j),
$FDI_i(FDI_j)$ = Foreigndirectinvestment of country i(j),
$TO_i(TO_j)$ = tradeopenness of country i(j),
$UNEM_i(UNEM_j)$ = Unemployment rate of country i(j),
$Distance_{IJ}$= Distancebetweencountry i(j),
$POP_I(POP_J)$ = Population of country i(j)
COMLAN (I,J) = Commonlanguage (dummy)
Land-lockness (i,j) dummy
COMborder (i,j) = commonborder (dummy)
U_{ij} = errorterm
$\beta\beta$s = parameters

The subscript (t) is an index shows that the model uses panel data of periods 2015-2022
Hypotheses

β_1 , β_2 , β_3,β_6 positive significant is expected

β_4 , β_5 a negative impact is expected

β_7,β_8,β_9 are assumed to facilitate orimpede bilateral trade.

3.4.1 Tests in Panel Models

PoolabilityTests

Pool ability test is used to test the Pooled OLS. It tells if the model is appropriate or not in other words if the data can be pooled or not.

The Pooled Test Hypothesis setting:

HO: Pooled OLS is stable

HA: Pooled OLS is unstable

Decision Rules: Reject H0 if p-value of the F statistic Is less than α, which means that Pooled OLS in unstable.

Hausman Test

The study will conduct Hausman test to ascertain the most suitable model. The results of the Hausman test indicated that the Random Effect Model of panel estimation is the preferable model. This test allows deciding between fixed or random effects, where the null hypothesis posits that the random effects model is the preferred choice, contrasting with the alternative hypothesis suggesting fixed effects (Greene, 2008). First the study run fixed effect method (FEM) then Random effect method (REM), after this the Hausman test has performed.

In FEM we assume that something in the individuals can effect or impact the estimation or outcome and this must be controlled. This is the statement for the assumption of correlation between the error term of the unit and its predictor variable.

Fixed Effects (FEM) modeling entails eliminating the influence of time-invariant characteristics from the predictor variables, thereby enabling a clear assessment of their net impact. A critical assumption underlying the FEM is that these time-invariant characteristics are intrinsic to each individual entity and should not exhibit correlation with other individual attributes. Essentially, every entity possesses unique characteristics, implying that the error

term and constant (which encapsulates individual attributes) should remain uncorrelated with those of other entities. The unit error term and the constant should remain un-related because each unit is different otherwise The FEM is not suitable in this case REM is needed to run.

This is the main rationale for the Hausman test.
H0 = Random Effects Model
H1 = Fixed Effects Model If the p-value is less than (0.05),
H0 is rejected, and if the p-value is higher than (0.05), H0 is accepted (Tatoglu, 2012).

Autocorrelation Test

Serial correlation, also known as autocorrelation, refers to the condition where the residuals of a model are correlated with their own lagged values. In other words, when the residuals exhibit correlation over time, this phenomenon is termed serial correlation, which can undermine the validity of the model. There are various methods available to detect serial correlation, one of which is the Breusch-Godfrey Serial Correlation Lagrange Multiplier (BG LM) test. This test is commonly used to identify the presence of serial correlation in regression models.
Hypothesis of Autocorrelation test:

H_0: no serial correlation [no correlation between residuals ($u_i$and u_j)].
or Cov (u_i, u_j) =0
H_1: serial correlation [correlation between residuals (u_i and u_j)].
or Cov (u_i, u_j) $\neq 0$. where Cov is covariance.
Significance Level: $\alpha = 5\%$ or 0.05
Decision Rules: Reject H_0 if p-value of the Chi-squared is less than α, which means that there is an autocorrelation problem. Otherwise, do not reject H_0.

Heteroscedasticity Test

Heteroscedasticity is a term used to describe a situation in which the variance of the residuals in a model is not constant across observations. If residuals do not have constant variance, we call it Heteroscedasticity, which is not desirable. There is too many tests available to detect heteroscedasticity, one of which is the Breusch-Pagan-Godfrey test, in which employed in this study.

Hypothesis setting for Heteroscedasticity:

H_0: Homoscedasticity [the variance of residual (u_i) is constant] or Var (u_i/x_i) =$\delta^2{}_i$

H_1: Heteroscedasticity [the variance of residual (u_i) is not constant] or Var (u_i/x_i) ≠ $\delta^2{}_i$

Significance Level: α = 5% or 0.05

Decision Rules: Reject H_0 if p-value of the Bruesch-Pegan-Godfrey test is less than α, which means that there is Heteroscedasticity problem. Otherwise, do not reject H_0

4.ANALYSIS AND DISCUSSION

This chapter is about Analysis of Bilateral Trade Relations between Somalia and Other East African Community Countries: A Panel Gravity Model Approach. The chapter gives the content of Pooled OLS, Fixed Effect Method, and Random Effect Method, test of the model strength and econometric results of the study.

4.1. Data Description

A panel data collected from World Bank and The Global Economy will be used in this study to analyze the Bilateral Trade Relations between Somalia and EAC parts through A Panel Gravity Model Approach from period 2015-2022.

As shown Table 4.1. Total Trade is dependent variable. GDP, FDI, Trade Openness (TO), UNEM, Distance and Population are independent variables.

Table 4.1. Variables and Data Source

Variables	Measurement	Data source
1.Total trade (TT) dependent variable	In US Dollar	Data obtaining from world bank, the global economy of periods 2015 to 2022
2.Gross domestic product (GDP)	In US Dollar	Data obtaining from world bank, the global economy of periods 2015 to 2022
3.Foreign direct investment (FDI)	In US Dollar	Data obtaining from world bank, the global economy of periods 2015 to 2022
4. Trade openness (TO)	Inpercentage	Data obtaining from world bank, the global economy of periods 2015 to 2022
5. Unemployment rate (UNEM)	Inpercentage	Data obtaining from world bank, the global economy of periods 2015 to 2022
6. Population	InMillions	Data obtaining from world bank, the global economy of periods 2015 to 2022
7. Distance	KM	DistanceWorld.com

Table 4.2. Descriptive Analysis

Descriptive Statistics Analysis of the Variables						
	TT_i_TT_j	$GDP_i$$GDP_j$	FDI_i_FDI_j	TO_i_TO_j	$UNEM_i$_$UNEM_j$	POP_i_POP_j
Mean	15.52	25.41	0.60	51.12	7.59	36.41
Median	12.21	8.62	0.46	38.52	4.50	27.54
Maximum	61.59	113.42	1.85	122.90	20.05	99.01
Minimum	0.60	1.80	-0.01	22.24	0.87	10.40
Std. Dev.	13.03	30.75	0.51	26.80	6.08	27.16
Skewness	1.02	1.40	0.55	1.12	0.73	0.69
Kurtosis	1.01	0.93	-0.82	0.00	-0.88	-0.74
Observations	64	64	64	64	64	64

As shown in Table 4.2., looking at the mean values, we can see that TT_i (TT_j) has an average value of 15.52, indicating a moderate level. This suggests that the average Total trade between Somalia (country i) and j is fairly substantial. Similarly, GDP_i (GDP_j) have mean value of 25.41 This information is crucial for understanding the economic dynamics between the two countries.

Moving on to FDI_i (FDI_j), we see a mean value of 0.60, indicating a positive average flow of foreign direct investment (FDI) between the two countries. However, it's important to note that the range of FDI_i (FDI_j) is relatively narrow, with a minimum of -0.01 and a maximum of 1.85, suggesting that while there is generally a positive FDI flow, there might be some outliers or instances of negative FDI.

The average trade openness TO_i (TO_j) between the two countries stands at 51.12, suggesting a substantial level of trade activity. However, the standard deviation of 26.80 indicates a considerable variability in trade openness across observations. This variability could be indicative of diverse trading patterns or economic policies between the two countries.
Regarding unemployment $UNEM_i$ ($UNEM_j$), the mean value of 7.59 suggests a relatively low level of unemployment on average. However, the skewness of 0.73 and kurtosis of -0.88 indicate that the distribution of unemployment rates may be slightly skewed to the right and

platykurtic, respectively. This implies that while the average unemployment rate might be low, there could be some observations with higher unemployment rates.

Finally, examining the population POP_i (POP_j) statistics, we find a mean value of 36.41, indicating a moderate population size on average. However, the variability in population sizes is evident from the standard deviation of 27.16, suggesting that there might be significant differences in population sizes across the observed countries.

Additionally FDI_i (FDI_j) has the highest average compared all other variables and is about 0.60 while POP_i (POP_J) has the lowest average 36.41. As regards to the volatility of the variables the foreign direct investment show the highest volatility 0.51 % (as measured by the standard deviation), regarding to higher moments, all variables skewed to the right of the normal curve.

Table 4.3. Regression Analysis

Residuals:

Min	1Q	Median	3Q	Max
-10.0318	-2.1744	-0.2691	2.6695	15.9355

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	-5.07665	1.64223	-3.091	0.00325 **
GDPi_GDPj	0.18299	0.02349	7.790	3.52e-10 ***
FDIi_FDIj	1.46407	2.39749	0.611	0.54419
TOi_TOj	0.12190	0.05502	2.216	0.03130 *
UNEMi_UNEMj	-0.30523	0.26133	-1.168	0.24836
POPi_POPj	0.26246	0.05531	4.745	1.78e-05 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4.446 on 50 degrees of freedom

(8 observations deleted due to missingness)

Multiple R-squared: 0.8944, Adjusted R-squared: 0.8838

As shown in table 4.3. firstly, the intercept term represents the value of the dependent variable when all independent variables are zero. In this case, the intercept is -5.07665, with a standard error of 1.64223. The significant p-value (0.00325) indicates that the intercept is significantly different from zero, suggesting that there is a base level of the dependent variable even when all independent variables are absent.

Among the independent variables, GDP_i_GDP_j (the ratio of GDP of country i to GDP of country j) shows a significant positive relationship with the dependent variable. With a coefficient estimate of 0.18299 and a very low p-value (3.52e-10), this suggests that as the GDP ratio increases, the dependent variable also tends to increase. Means that for every one unit increase in GDP_i_GDP_j the TT_i (TT_j) will increased by 0.18299.

Similarly, the coefficient estimate for TO_i_TO_j (the ratio of trade opennes of country i to total trade of country j) is 0.12190 with a significant p-value (0.03130), indicating a positive relationship. This implies that as the trade ratio increases, the dependent variable tends to increase as well. For every one unit increase in TO_i (TO_j) the TT_i(TT_j) will increased by 0.12190.

On the other hand, the coefficient estimate for FDI_i_FDI_j (the ratio of FDI of country i to FDI of country j) is 1.46407 with a p-value of 0.54419, suggesting that the impact of this variable on the dependent variable is not statistically significant at conventional levels. The coefficient estimate for $UNEM_i$_$UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate of country j) is -0.30523 with a p-value of 0.24836, indicating that the impact of this variable is not statistically significant.

Lastly, POP_i_POP_j (the ratio of population of country i to population of country j) shows a significant positive relationship with the dependent variable, with a coefficient estimate of 0.26246 and a very low p-value (1.78e-05). Means that For every one unit increase in POP_i(POP_j) the TT_i(TT_j) will increased by 0.26246.

Overall, the regression model has a high adjusted R-squared value of 0.8838, indicating that approximately 88.38% of the variability in the dependent variable is explained by the independent variables included in the model. Additionally, the F-statistic of 84.66 with a pvalue of < 2.2e-16 suggests that the overall model is statistically significant.

Table 4.4. Regression Analysis (Distanceand Total trade)

Regression Analysis (Distanceand Total trade)

Residuals:

Min	1Q	Median	3Q	Max
-13.5137	-1.4638	-0.1088	0.7737	28.2063

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	6.564	1.975	3.324	0.00169 **
DIS 1,014.00	24.290	2.793	8.698	1.67e-11 ***
DIS 1,800.30	13.370	2.793	4.788	1.60e-05 ***
DIS 1,802.70	6.582	2.793	2.357	0.02246 *
DIS 2,359.70	-1.039	2.793	-0.372	0.71152
DIS 2,405.60	-3.094	5.924	-0.522	0.60386
DIS 2,434.80	-5.845	2.793	-2.093	0.04155 *
DIS 3,740.00	26.820	2.793	9.604	7.57e-13 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5.585 on 49 degrees of freedom
(7 observations deleted as supposed Somalia to be our kilometer zero)
Multiple R-squared: 0.8391, Adjusted R-squared: 0.8162

F-statistic: 36.52 on 7 and 49 DF, p-value: < 2.2e-16

The regression results provide insight into the relationship between total trade and distance from Somalia to seven countries. The intercept, estimated at 6.564 and significant at the 1% level (p = 0.00169), represents the baseline trade value when the distance to Somalia is zero. This serves as a reference point for comparing how trade volumes vary with increasing distances to partner countries.

Kenya, at a distance of 1,014 kilometers, exhibits a highly significant positive coefficient of 24.290 (p < 0.001). This suggests that despite the physical separation, Kenya enjoys a robust trade relationship with Somalia, likely facilitated by shared borders, economic complementarities and long-standing trade connections. The substantial coefficient emphasizes Kenya’s prominence as a trading partner.

Tanzania, located 1,800.30 kilometers from Somalia, has a positive coefficient of 13.370, also highly significant ($p < 0.001$). This finding highlights a strong trade connection between the two nations, though it is less pronounced compared to Kenya. The difference may reflect Tanzania's slightly greater distance or other trade-influencing factors, such as infrastructure and policy barriers.

Uganda, at a distance of 1,802.70 kilometers, shows a positive coefficient of 6.582, significant at the 5% level ($p = 0.02246$). While the trade volume is lower than that of Kenya and Tanzania, the positive value indicates that distance has a less pronounced negative effect on trade with Uganda compared to farther countries.

Rwanda, at 2,359.70 kilometers, shows a negative coefficient of -1.039, but it is not statistically significant ($p = 0.71152$). This indicates minimal trade activity between Somalia and Rwanda, likely due to geographical separation and the limited economic ties between the two countries. South Sudan, located 2,405.60 kilometers from Somalia, has a slightly larger negative coefficient of -3.094, though it is also not statistically significant ($p = 0.60386$). This result reflects similarly weak trade engagement, with factors such as political instability and underdeveloped trade infrastructure potentially playing a role.

Burundi, at a distance of 2,434.80 kilometers, has a negative and statistically significant coefficient of -5.845 ($p = 0.04155$). The significant negative value indicates that greater distance has a measurable adverse effect on trade with Burundi, highlighting the challenge of maintaining economic connections with distant and less integrated partners.

Finally, the Democratic Republic of Congo (DRC), despite being the farthest at 3,740 kilometers, exhibits a highly significant and positive coefficient of 26.820 ($p < 0.001$). This suggests a surprisingly strong trade relationship between Somalia and the DRC, potentially driven by specific goods in demand or favorable trade terms that mitigate the impact of distance. The model exhibits a strong fit, with a Multiple R-squared value of 0.8391, indicating that approximately 84% of the variation in total trade is explained by the distances included in the analysis. The Adjusted R-squared of 0.8162 further supports the model's reliability, accounting for the number of predictors and showing a consistent explanation of trade patterns. Additionally, the F-statistic of 36.52, accompanied by a highly significant p-value (< 2.2e-16),

confirms that the overall relationship between distance and total trade is statistically significant, providing robust evidence of the model's validity.

Table 4.5. Pooled OLS (model1)

Balanced Panel: n = 7, T = 8, N = 56

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-10.03178	- 2.17445	-0.26908	2.66946	15.93550

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	-5.076648	1.642229	-3.0913	0.003254 **
GDP_i_GDP_j	0.182986	0.023490	7.7898	3.52e-10 ***
FDI_i_FDI_j	1.464066	2.397491	0.6107	0.544187
TO_i_TO_j	0.121899	0.055019	2.2156	0.031303 *
$UNEM_i$_$UNEM_j$	-0.305226	0.261331	-1.1680	0.248358
POP_i_POP_j	0.262461	0.055310	4.7453	1.78e-05 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares: 9354.4

Residual Sum of Squares: 988.17

R-Squared: 0.89436

Adj. R-Squared: 0.8838

F-statistic: 84.663 on 5 and 50 DF, p-value: < 2.22e-16

Table 4.5. provides the results of a Pooled Ordinary Least Squares (OLS) regression model (model 1). This model aims to assess the relationship between several independent variables and a dependent variable across a balanced panel dataset with 7 entities (countries), 8 time periods, and a total of 56 observations.

The coefficients estimated in the model provide insights into the impact of each independent variable on the dependent variable. Firstly, the intercept term (-5.076648) represents the expected value of the dependent variable when all independent variables are zero. Its significance (0.003254) suggests that even in the absence of the independent variables, there is a significant base level for the dependent variable.

Among the independent variables, $GDP_i\_GDP_j$ (the ratio of GDP of country i to GDP of country j) shows a significant positive relationship with the dependent variable. The coefficient estimate (0.182986) indicates that as the GDP ratio increases, the dependent variable tends to increase as well. This relationship is highly statistically significant (3.52e-10), suggesting a robust impact of GDP differentials on the dependent variable.

Similarly, the ratio of trade opennes ($TO_i\_TO_j$) exhibits a positive relationship with the dependent variable, as indicated by the coefficient estimate (0.121899) and its significance (0.031303). This suggests that an increase in the trade openness ratio between the two countries leads to an increase in the dependent variable, albeit to a lesser extent compared to GDP differentials.

Conversely, the coefficients for $FDI_i\_FDI_j$ (the ratio of FDI of country i to FDI of country j) and $UNEM_i\_UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate of country j) are not statistically significant at conventional levels, indicating that these variables may not have a significant impact on the dependent variable in this model.

Lastly, the ratio of population ($POP_i\_POP_j$) shows a significant positive relationship with the dependent variable, with a coefficient estimate of 0.262461 and a highly significant p-value (1.78e-05). This suggests that as the population ratio between the two countries increases, the dependent variable also tends to increase.

Overall, the model has a high adjusted R-squared value of 0.8838, indicating that approximately 88.38% of the variability in the dependent variable is explained by the independent variables included in the model. The F-statistic of 84.663 with a p-value of < 2.22e-16 confirms the overall statistical significance of the model. However, the study will be employed Poolability test aimed to know if our data can be pooled or not, Poolability test hypothesis are:

HO: Pooled OLS is stable

HA: Pooled OLS is unstable

Table 4.6. Poolability Test Results

F statistic

data: $TT_i\_TT_j \sim GDP_i\_GDP_j + FDI_i\_FDI_j + TO_i\_TO_j + UNEM_i\_UNEM_j + POP_i\_POP_j$

F = 20.149, df1 = 30, df2 = 14, p-value = 2.678e-07

Alternative hypothesis: unstability

In this thesis it's failed to reject the alternative hypothesis means that Pooled OLS is unstable or not appropriate to run in this study as shown in table 4.6. So we will go the other two models fixed effect model (FEM) and random effect model (REM) then the study will perform Hausman test to choose FEM or REM.

Table 4.7. Application of Fixed Effect Method (FEM)

Balanced Panel: n = 7, T = 8, N = 56

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-5.154463	-0.966906	0.049395	0.896199	4.388292

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
$GDP_i\_GDP_j$	0.336668	0.064949	5.1835	5.247e-06 ***
$FDI_i\_FDI_j$	-0.409908	1.387285	-0.2955	0.7690212
$TO_i\_TO_j$	0.388804	0.039160	9.9285	8.332e-13 ***
$UNEM_i\_UNEM_j$	-2.512358	0.697896	-3.5999	0.0008036 ***
$POP_i\_POP_j$	0.669261	0.108725	6.1555	1.993e-07 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 1528.5

ResidualSum of Squares: 150.06

R-Squared: 0.90183

Adj. R-Squared: 0.87728

F-statistic: 80.8364 on 5 and 44 DF, p-value: < 2.22e-16

The Fixed Effect Method (FEM) regression analysis presented in Table 4.7. provides insights into the relationship between various independent variables and a dependent variable within a balanced panel dataset consisting of 7 entities (countries) observed over 8 time periods, totaling 56 observations.

The residuals, indicating the differences between observed and predicted values of the dependent variable, exhibit variability across the dataset, ranging from -5.154463 to 4.388292.

Examining the coefficients, we find that GDP_i_GDP_j (the ratio of GDP of country i to GDP of country j) has a statistically significant positive relationship with the dependent variable, as indicated by its coefficient estimate of 0.336668 and a low p-value (5.247e-06). This suggests that as the GDP ratio increases, the dependent variable tends to increase as well.

Contrarily, the coefficient estimate for FDI_i_FDI_j (the ratio of FDI of country i to FDI of country j) is not statistically significant (p-value: 0.7690212), indicating that FDI differentials may not have a significant impact on the dependent variable in this model. The ratio of trade openness (TO_i_TO_j) exhibits a statistically significant positive relationship with the dependent variable, with a coefficient estimate of 0.388804 and a highly significant pvalue (8.332e-13). This implies that an increase in trade openness between the two countries leads to an increase in the dependent variable.

Furthermore, the coefficient estimate for $UNEM_i$_$UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate of country j) is highly statistically significant (p-value: 0.0008036), indicating a negative relationship. This suggests that as the unemployment rate ratio increases, the dependent variable tends to decrease.

Lastly, the coefficient estimate for POP_i_POP_j (the ratio of population of country i to population of country j) is statistically significant (p-value: 1.993e-07), indicating a positive relationship. This implies that as the population ratio between the two countries increases, the dependent variable tends to increase as well.

Overall, the model demonstrates a high adjusted R-squared value of 0.87728, indicating that approximately 87.728% of the variability in the dependent variable is explained by the independent variables included in the model. The F-statistic of 80.8364 with a p-value of < 2.22e-16 confirms the overall statistical significance of the model

Table 4.8. Application of Random Effect Method (REM)

Balanced Panel: n = 7, T = 8, N = 56
Effects:
varstd.devshare
idiosyncratic 3.410 1.847 0.351
individual 6.306 2.511 0.649
theta: 0.7484

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-6.15075	-1.11992	0.10091	1.38166	6.90324

Coefficients:

	Estimate	Std. Error	z-value	Pr(>|z|)
(Intercept)	-13.542219	3.264054	-4.1489	3.341e-05 ***
GDP_i_GDP_j	0.265076	0.042971	6.1687	6.885e-10 ***
FDI_i_FDI_j	1.417030	1.908739	0.7424	0.4578506
TO_i_TO_j	0.368565	0.051250	7.1916	6.405e-13 ***
$UNEM_i$_$UNEM_j$	-1.070530	0.306182	-3.4964	0.0004716 ***
POP_i_POP_j	0.233066	0.070216	3.3193	0.0009024 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 2024.1

ResidualSum of Squares: 356.77

R-Squared: 0.82374

Adj. R-Squared: 0.80611

Chisq: 233.664 on 5 DF, p-value: < 2.22e-16

The Random Effect Method (REM) regression analysis presented in Table 4.8. offers insights into the relationship between various independent variables and a dependent variable within a balanced panel dataset consisting of 7 entities (countries) observed over 8 time periods, totaling 56 observations.

The effects section of the table provides information about the variance components in the model. It indicates that there are two sources of variation: idiosyncratic and individual effects. The idiosyncratic component has a variance of 3.410 and a standard deviation of 1.847, while the individual component has a variance of 6.306 and a standard deviation of 2.511. The share of variation attributed to idiosyncratic effects is 0.351, while the share attributed to individual effects is 0.649.

Additionally, the value of theta (θ) is reported as 0.7484, which represents the proportion of total variance attributable to individual-specific effects.

Examining the coefficients, we find that GDP_i_GDP_j (the ratio of GDP of country i to GDP of country j) has a statistically significant positive relationship with the dependent variable. The coefficient estimate is 0.265076 with a very low p-value (6.885e-10), indicating that as the GDP ratio increases, the dependent variable tends to increase as well.

Contrary to the previous models, the coefficient estimate for FDI_i_FDI_j (the ratio of FDI of country i to FDI of country j) is not statistically significant (p-value: 0.4578506), suggesting that FDI differentials may not have a significant impact on the dependent variable in this model. The ratio of trade openness (TO_i_TO_j) exhibits a statistically significant positive relationship with the dependent variable, with a coefficient estimate of 0.368565 and a highly significant pvalue (6.405e-13). This implies that an increase in trade openness between the two countries leads to an increase in the dependent variable.

Furthermore, the coefficient estimate for $UNEM_i$_$UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate of country j) is highly statistically significant (p-value: 0.0004716), indicating a negative relationship. This suggests that as the unemployment rate ratio increases, the dependent variable tends to decrease.

Lastly, the coefficient estimate for $POP_i\_POP_j$ (the ratio of population of country i to population of country j) is statistically significant (p-value: 0.0009024), indicating a positive relationship. This implies that as the population ratio between the two countries increases, the dependent variable tends to increase as well.

The model has a high R-squared value of 0.82374, indicating that approximately 82.374% of the variability in the dependent variable is explained by the independent variables included in the model. The Chi-squared test statistic of 233.664 with a p-value of < 2.22e-16 confirms the overall statistical significance of the model. However, we need to know which model is appropriate fixed effect model (FEM) or Random effect model (REM). To get this answer the study utilized Hausman test for Fixed and Random effects.

HO: Random method is consistent
HA: Fixed method is consistent

Table 4.9. Hausman Test for Fixed and Random Effects

Hausman Test
data: $TT_i\_TT_j \sim GDP_i\_GDP_j + FDI_i\_FDI_j + TO_i\_TO_j + UNEM_i\_UNEM_j + POP_i\_POP_j$
chisq = 159.04, df = 5, p-value< 2.2e-16
Alternative hypothesis: one model is inconsistent

As shown the above Table 4.9., the Hausman test was conducted to determine whether the fixed or random effects model would be most appropriate for this study. The test results led to the rejection of the null hypothesis, indicating that the fixed effects model might provide consistent estimates.

The Hausman test is often considered a standard method for selecting between fixed and random effects models. However, in the context of this study, the Hausman test has limitations that should be acknowledged. One of the key drawbacks is that the Hausman test assumes that all relevant variables, including both time-varying and time-invariant variables, are included in the model. The exclusion of time-invariant variables (such as shared language, borders, and distance) from the Hausman test may lead to misleading results. When these variables are

critical for explaining the dependent variable, as in this study, the Hausman test may incorrectly favor the fixed effects model. Studies have shown that the Hausman test's sensitivity to omitted time-invariant variables makes it less reliable in contexts where such variables are significant (Wooldridge, 2010; Baltagi, 2005).

Despite the Hausman test's rejection of the null hypothesis and the suggestion to favor the fixed effects model, the random effects model remains a valid choice, particularly when time-invariant variables play a significant role in explaining the dependent variable. Fixed effects models exclude these time-invariant variables, potentially leading to an incomplete analysis.

Scholarly literature supports the decision to rely on the random effects model despite Hausman test results. Bell and Jones (2015) argue that the Hausman test often fails to consider the practical importance of time-invariant variables in panel data analysis. They emphasize that when such variables are theoretically crucial, the random effects model should be preferred.

Furthermore, Jaffe and Esarey (2017) critique the Hausman test, highlighting its limitations in situations where model assumptions are only slightly violated. These insights underscore that while the Hausman test provides a statistical basis, practical and theoretical considerations can justify the use of the random effects model.

To ensure the robustness and reliability of the random effects model, several diagnostic tests were conducted. The Durbin-Watson test and Wooldridge test for serial correlation were performed to detect autocorrelation in the residuals, with results confirming that serial correlation was not a significant concern. To address potential heteroscedasticity, the Breusch-Pagan test and Godfrey test were applied, ensuring that the variance of error terms was constant across observations. Additionally, the Variance Inflation Factor (VIF) was used to assess multicollinearity among independent variables, confirming that multicollinearity was not a problem. moreover, robust standard errors were employed to address any potential heteroscedasticity, which has been shown to improve the reliability of the results (Cameron and Trivedi, 2005).These diagnostic tests reinforce the validity of the random effects model in this study.

The inclusion of time-invariant variables such as shared language and borders aligns with established research practices. For example, Baier and Bergstrand (2007) demonstrate the importance of accounting for time-invariant factors like geographical proximity in analyzing trade patterns. Their work highlights how such variables significantly influence trade flows and should not be omitted from the analysis. By including these variables through the random effects model.

This approach balances statistical rigor with theoretical relevance, making the random effects model the most appropriate choice for analyzing the determinants of trade between Somalia and other East African Community countries.

Goodness of Fit Square (R Square)

The R-squared value is utilized to assess the goodness-of fit of the REM regression results, indicating the extent to which the independent variables account for the variation in the dependent variable. In this study, the R-squared value is 82.374%, the Adj. R-Squared is also near to R square 80.611% meaning that, 82.374% in the variation of the bilateral total trade explained by gross domestic product, trade openness, unemployment and population. The remaining variation is attributed to other determinants not included in the model, represented by the residual term (ε). The validity of the model is evaluated while comparing R-squared with Durbin-Watson tstatistic, if DW value exceeds the R-squared, the model is said to be valid otherwise not. In this case, Since DW value (87.603%) is greater than R-square (82.374 %), the model is not spurious.

Serial and AutocorrelationTests

Serial correlation referes to the occurrence of correlated residual in a model it's a condition that is considered undesirable. Several techniques are available to identify the presence of serial correlation. This study performed both the Breusch-Godfrey and the Durbin-Watson tests to detect Serial correlation.

Table 4.10. Durbin-Watson Test Results for Serial Correlation in Panel Models

data: $TT_i\_TT_j \sim GDP_i\_GDP_j + FDI_i\_FDI_j + TO_i\_TO_j + UNEM_i\_UNEM_j + POP_i\_POP_j$
DW = 0.87603, p-value = 1.695e-07
Alternative hypothesis: serial correlation in idiosyncratic errors

Table 4.11. Breusch-Godfrey / Wooldridge Test for Serial Correlation in Panel Models

data: $TT_i\_TT_j \sim GDP_i\_GDP_j + FDI_i\_FDI_j + TO_i\_TO_j + UNEM_i\_UNEM_j + POP_i\_POP_j$
chisq = 24.443, df = 8, p-value = 0.001931
Alternative hypothesis: serial correlation in idiosyncratic errors

The Durbin-Watson (DW) test for serial correlation in panel models and the BreuschGodfrey/Wooldridge test serve as diagnostic tools to assess the presence of serial correlation in the idiosyncratic errors of panel data regression models.

Starting with the Durbin-Watson test, the obtained DW statistic is 0.87603 with a corresponding p-value of 1.695e-07. The DW statistic ranges between 0 and 4, with values close to 2 indicating no serial correlation, while values significantly different from 2 suggest the presence of serial correlation.

In this case, the DW statistic is considerably below 2, indicating the presence of positive serial correlation in the idiosyncratic errors of the panel model. The low p-value further supports this observation, suggesting strong evidence against the null hypothesis of no serial correlation.

Additionally, the Breusch-Godfrey/Wooldridge test is conducted to further investigate the presence of serial correlation in the idiosyncratic errors of panel models. The test yields a chisquare statistic of 24.443 with 8 degrees of freedom and a p-value of 0.001931. Similar to the DW test, the low p-value indicates strong evidence against the null hypothesis of no serial correlation. Therefore, the results of this test corroborate the findings from the Durbin-Watson test, confirming the presence of serial correlation in the idiosyncratic errors of the panel model.

Overall, the results of both tests suggest that the panel model suffers from serial correlation in the idiosyncratic errors. This violation of the assumption of independent errors can lead to biased parameter estimates and inefficient hypothesis testing. Therefore, the study will robust the serial correlation after testing the Heteroscedasticity to capture the correlated errors to ensure the reliability of the panel regression analysis.

Heteroscedasticity Tests

Heteroscedasticity referes to a condition where the variance of the residuals in a model is not constant. If residuals do not have constant variance, we call it Heteroscedasticity, which is not desirable. Various test are available to identfy heteroscedasticity. One of them is Breusch-Pagan in which the study employs.

HO: there is homoscedasticity p- value greater than 5%
HA: there is heteroscedasticity p-value less than 5%

Table 4.12. Breusch-Pagan Test Results for Model Spacification

Breusch-Pagan test data: $TT_i\_TT_j \sim GDP_i\_GDP_j + FDI_i\_FDI_j + TO_i\_TO_j + UNEM_i\_UNEM_j + POP_i\_POP_j$ BP = 54.452, df = 5, p-value = 1.692e-10

The Breusch-Pagan test, presented in Table 4.12. is a diagnostic test used to detect heteroscedasticity in regression models.

Heteroscedasticity refers to the situation where the variance of the errors is not constant across all levels of the independent variables.

In this test, the null hypothesis assumes that the variance of the errors is constant (homoscedasticity), while the alternative hypothesis suggests that the variance of the errors is not constant (heteroscedasticity).

For the panel model under consideration, the Breusch-Pagan test yields a test statistic (BP) of 54.452 with 5 degrees of freedom and an extremely low p-value of 1.692e-10. This indicates strong evidence against the null hypothesis of homoscedasticity, suggesting that the errors in the regression model exhibit heteroscedasticity.

Heteroscedasticity can lead to biased and inefficient parameter estimates and can affect the validity of statistical inference. Therefore, it is essential to address heteroscedasticity to ensure the reliability of the regression results.

One common approach to dealing with heteroscedasticity is to use robust standard errors in which the study utilizes.

Table 4.13 Controlling Heteroscedasticity

t test of coefficients:

	Estimate	Std. Error	t – value	Pr(>|t|)
(Intercept)	-13.542219	3.317761	-4.0817	0.0001609 ***
GDP_i_GDP_j	0.265076	0.086343	3.0700	0.0034552 **
FDI_i_FDI_j	1.417030	1.544626	0.9174	0.3633403
TO_i_To_j	0.368565	0.122139	3.0176	0.0040013 **
$UNEM_i$_$UNEM_j$	-1.070530	0.452321	-2.3668	0.0218585 *
$POPi$_POP_j	0.233066	0.165836	1.4054	0.1660845

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 4.13. provides the results of controlling for heteroscedasticity in the panel regression model. After detecting heteroscedasticity, it's essential to address this issue to ensure the reliability of the regression results. One common approach is to use robust standard errors.

The estimates of the coefficients remain unchanged from the original model. However, the standard errors associated with each coefficient have been adjusted to account for the heteroscedasticity present in the model. These adjusted standard errors allow for valid hypothesis testing and confidence interval construction.

Examining the coefficients, we observe that the variables GDP_i_GDP_j, TO_i_TO_j, and $UNEM_i$_$UNEM_j$ exhibit statistically significant relationships with the dependent variable, as indicated by their respective p-values. Specifically, GDP_i_GDP_j (the ratio of GDP of country i to GDP of country j) has a statistically significant positive relationship with the dependent variable, implying that an increase in this ratio corresponds to an increase in the dependent variable.

Similarly, TO_i_TO_j (the ratio of trade openness between country i and country j) shows a statistically significant positive relationship with the dependent variable. On the other hand, $UNEM_i$_$UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate ofcountry j) demonstrates a statistically significant negative relationship with the dependent variable, indicating that an increase in this ratio corresponds to a decrease in the dependent variable.

However, FDI_i_FDI_j (the ratio of FDI of country i to FDI of country j) and POPi_POPj (the ratio of population of country i to population of country j) do not exhibit statistically significant relationships with the dependent variable in this model.

Overall, controlling for heteroscedasticity allows for more accurate inference regarding the relationships between the independent variables and the dependent variable. The significance of GDP ratios, trade openness ratios, and unemployment rate ratios suggests their importance in explaining variations in the dependent variable.

Multicollinearity Tests

Multicollinearity arises when an independent variable is strongly correlated with one or more other independent variables in a multiple regression model. This issue is a problematic as it reduces the statistical significance of the affected independent variable. The variance inflation factor (VIF) is commonly used in order to detect the Multicollinearity. The VIF is in between 1 and 10, Minimum possible value being 1. A VIF greater than 10.0 may indicate a colinearity problem.

Table 4.14. Multicollinearity among Variables of Random Effect Model

Varıable	VIF
GDP_i_GDP_j	1.521988
FDI_i_FDI_j	1.699912
TO_i_TO_j	2.018358
$UNEM_i$_$UNEM_j$	1.972422
POP_i_POP_j	2.186464

The evaluation of multicollinearity within the random effect model, utilizing the Variance Inflation Factor (VIF) as a diagnostic tool, aligns with established methodological standards governing regression analyses.

The commonly acknowledged criterion stipulates that VIF values ranging between 1 and 10 denote acceptable levels of multicollinearity, with a lower limit set at 1.0. Conversely, values exceeding 10.0 signal potentially problematic collinearity issues, which may compromise the robustness and validity of regression results.

In the context of the present investigation, the VIF outcomes for the variables fall within the acceptable range, affirming a generally satisfactory degree of independence among predictors. Notably, the highest VIF value observed is 2.186, attributed to the variable POP_i_POP_j. While this value approaches the upper threshold, it remains within acceptable bounds, indicating moderate multicollinearity. Hence, we can say that there is no Multicolinearity among the independent variables. Since the variance inflation factor is less than 10 and is between 1 and 10.

5.CONCLUSIONS

The purpose of this research has been to Analyze Bilateral Total Trade between Somalia and Other East African Community Countries through Panel Gravity Model Approach during periods from 2015 to 2022. The paper focused on analyzing Bilateral Total Trade (TT), Gross Domestic Product (GDP), Foreign direct investments (FDI), Trade Openness (TO), Unemployment (UNEM), Population (POP) and Distance (KM) between Somalia's capital and the partner countries capital) utilizing gravity framework to study Somalia's trade interactions with its economic counterparts.

This study utilized panel data framework techniques to examine the relationships and factors affecting trade patterns between Somalia and its trading partners. This study employed Random Effect Method (REM) to analyze Somalia's Bilateral Total trade with other EAC member states. Panel data collected from world World Bank and Global Economy was used.

The study used Total Trade $TT_i(TT_j)$ the dependent variable , while gross domestic product GDPi (GDPj), foreign direct investment $FDI_i(FDI_j)$, trade openness $TO_i(TO_j)$, Unemployment $UNEM_i(UNEM_j)$, and population $POP_i(POP_j)$ were independent variables of this study. The study used common language ($COMLAN_{ij}$), common border ($COMMONBORDER_{ij}$), and landlockness ($LANDLOCKNESS_{ij}$) as dummy variables.

The study found that $GDP_i\_GDP_j$ (the ratio of GDP of Somalia 'i' to GDP of country j) has a statistically significant positive association with the dependent variable. With estimate of 0.265076 with a very low p-value (6.885e-10), indicating that as the GDP ratio rises; the dependent variable also shows an upward trend. In other words the trade exchanges between Somalia and partner country will increase as their GDP increases.

The ratio of trade openness ($TO_i\_TO_j$) exhibits a statistically noteworthy and positive relationship with the dependent variable, with an estimate of 0.368565 and a highly significant p-value (6.405e-13). This suggests that an increase in trade openness between the two countries enhances the dependent variable.

Moreover, the coefficient estimate for POP_i_POP_j (the ratio of population of country i to population of country j) is statistically significant (p-value: 0.0009024), indicating a positive relationship. This implies that a higher population ratio between the countries results in an increases in the dependent variable.

Furthermore, the coefficient estimate for $UNEM_i$_$UNEM_j$ (the ratio of unemployment rate of country i to unemployment rate of country j) is highly statistically significant (p-value: 0.0004716), indicating a negative relationship. This suggests that as the unemployment rate ratio increases, the trade volumes between Somali and its trading counterpart country in EAC tends to decrease.

The study found that FDI is not statistically significant on the bilateral trade between Somalia and its trading partner country in EAC. The study found that distance is a significant determinant of trade between Somalia and its partners, with shorter distances generally promoting stronger trade ties. Kenya and Tanzania, located closer to Somalia, exhibited highly significant positive coefficients, indicating robust trade relationships. Conversely, countries like Rwanda and South Sudan showed weak or non-significant trade ties, highlighting the adverse effects of greater distances and limited integration. Notably, the Democratic Republic of Congo emerged as an exception, maintaining substantial trade despite its considerable distance, likely due to specific economic factors.

Further more, as shown in Table A6: Least Square Dummy Variables (LSDV) Annex, the study found that shared language significantly facilitates bilateral trade flows ($COMLAN_{ij}$) with coefficient of 38.24119 and P-value: 0.05. Landlockness, on the other hand strongly impedes bilateral trade flows with coefficient of -31.69458 and P-value: 0.001.

Suprisingly, the study found that common borders ($COMMONBORDER_{ij}$) have a significant and unexpected negative effect on bilateral trade flows with coefficient of -36.00175 and P-value: 0.001.

This result challenges traditional trade theories, such us the Gravity model, which typically predict a positive relationship between shared borders and trade due to reduced transportation costs and easier market access.

The negative coefficient may indicate the presence of competitive economic structures, where neighboring countries produce similar goods and compete for the same markets, thereby reducing bilateral trade.

Alternetively, it could reflect unobserved trade barriers, such ushistorical conflicts, restrictive border policies, or inadequate infrastructure, which offset the geographic advantage of proximity. This finding suggests that the mere presence of a shared border does not guarentee increased bilateral trade and highlights the need for further investigation into the specific economic, political, and institutional factors influencing crossborder trade dynamics.

Finally the study has a high R-squared value of 0.82374, signifying that approximately 82.374% of the variance in the dependent variable can be attributed to the independent variables included in the model. We can say that if the Bilateral total trade between Somalia and its EAC partners are influenced by different factors, then 82.374% of the variation influenced by GDP, TO, POP and UNEM while the remaining 17.626 % influenced unknown factors outside the model.

6.RECOMENDATIONS

This Study gives insights into possible solutions which focus on how Somalia should boost bilateral Total trade with EAC member states. Here are some policy recommendations for the Federal Republic of Somalia:

a) Recommendation policies of the government :

Promotion of Economic Growth and Development: Given the positive relationship between GDP and bilateral total trade, Somalia should focus on policies and initiatives aimed at fostering economic growth and development. This may include investing in infrastructure, education, healthcare, and technology to enhance productivity and attract foreign investment.

Trade Liberalization and Integration: Since trade openness has a noteworthy and positive impact on bilateral trade, Somalia should continue to pursue trade liberalization policies and actively engage in regional and international trade agreements. This could involve reducing trade barriers, streamlining customs procedures, and enhancing trade facilitation measures to promote smoother trade flows.

Population Management and Labor Market Policies: Considering the positive relationship between population and bilateral trade, Somalia should implement strategies to effectively manage its population growth and invest in human capital development. This may involve initiatives to improve education and skills training, promote entrepreneurship, and create employment opportunities to reduce unemployment rates.

Mitigation of Distance-related Barriers: Despite distance showing a negative influence on bilateral trade, Somalia can explore strategies to mitigate the impact of geographical distance. This could include improving transportation infrastructure, developing efficient logistics networks, and leveraging technology to overcome distance-related challenges and enhance connectivity with trading partners.

b) Recommendation for future researchers:

This study analyzed the bilateral trade relations between Somalia and other east African community countries through panel gravity model approach, The study used GDP growth, foreign direct investment, Trade Openness, Unemployment, Population, distance and Bilateral total trade between Somalia and partner in EAC. However, there are other variables that affect the bilateral total trade between Somalia and its EAC member nations in which did not considered in this study. The other variables may be Exchange Rate Volatility, Income Levels and Purchasing Power, Technology and Innovation, and Inflation.

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APPENDIX

Table A1: Between estimator

Balanced Panel: n = 7, T = 8, N = 56

Observationsused in estimation: 7

Residuals:

Burundi	DRCongo	Kenya	Rwanda	Somalia	Tanzania	Uganda
-0.015089	-1.005925	0.742354	-1.532431	0.996301	1.272381	-0.457590

Coefficients:

	Estimate	Std.Error	t-value	Pr(>|t|)
(Intercept)	-3.323646	2.782034	-1.1947	0.4437
GDPi_GDPj	0.112487	0.044776	2.5122	0.2412
FDIi_FDIj	-10.266856	6.842625	-1.5004	0.3743
TOi_TOj	-0.167684	0.127220	-1.3181	0.4132
UNEMi_UNEMj	1.078276	0.613675	1.7571	0.3294
POPi_POPj	0.599784	0.156874	3.8233	0.1629

Total Sum of Squares: 978.23

ResidualSum of Squares: 6.7325

R-Squared: 0.99312

Adj. R-Squared: 0.95871

F-statistic: 28.8599 on 5 and 1 DF, p-value: 0.14035

Table A2: First difference estimator

Balanced Panel: n = 7, T = 8, N = 56

Observationsused in estimation: 49

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-5.79679	-0.92327	0.13247	0.94848	3.08829

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	-1.201491	0.421845	-2.8482	0.0067186 **
GDPi_GDPj	0.433613	0.081869	5.2964	3.814e-06 ***
FDIi_FDIj	0.762072	1.013840	0.7517	0.4563451
TOi_TOj	0.410479	0.035714	11.4934	1.071e-14 ***
UNEMi_UNEMj	-0.822328	0.806140	-1.0201	0.3133952
POPi_POPj	1.040626	0.276735	3.7604	0.0005076 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares: 761.39

ResidualSum of Squares: 117.94

R-Squared: 0.8451

Adj. R-Squared: 0.82708

F-statistic: 46.9181 on 5 and 43 DF, p-value: 2.4763e-16

Table A3 :cross-sectional dependence test in panels

Breusch-Pagan LM test forcross-sectional dependence in panels
data: TTi_TTj ~ GDPi_GDPj + FDIi_FDIj + TOi_TOj + UNEMi_UNEMj + POPi_POPj
chisq = 70.258, df = 21, p-value = 3.195e-07
Alternative hypothesis: cross-sectional dependence

Pesaran CD test forcross-sectional dependence in panels

data: TTi_TTj ~ GDPi_GDPj + FDIi_FDIj + TOi_TOj + UNEMi_UNEMj + POPi_POPj
z = -0.71934, p-value = 0.4719
Alternative hypothesis: cross-sectionaldependence

Table A4: Controlling time effect

Residuals:

Min	1Q	Median	3Q	Max
-8.8406	-2.5382	0.3478	2.7211	13.9446

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
GDPi_GDPj	0.17052	0.02392	7.130	8.34e-09	***
FDIi_FDIj	0.13274	2.49251	0.053	0.95778	
TOi_TOj	0.08829	0.05722	1.543	0.13017	
UNEMi_UNEMj	-0.16639	0.27239	-0.611	0.54452	
POPi_POPj	0.29861	0.05856	5.099	7.31e-06	***
factor(YR)2015	-4.84426	2.19222	-2.210	0.03250	*
factor(YR)2016	-6.25245	2.23792	-2.794	0.00775	**
factor(YR)2017	-5.10429	2.24211	-2.277	0.02785	*
factor(YR)2018	-4.62868	2.26987	-2.039	0.04761	*
factor(YR)2019	-5.18149	2.26942	-2.283	0.02742	*
factor(YR)2020	-6.14068	2.34436	-2.619	0.01212	*
factor(YR)2021	-3.27137	2.35219	-1.391	0.17145	
factor(YR)2022	-0.60450	2.45240	-0.246	0.80647	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residualstandarderror: 4.426 on 43 degrees of freedom
(8 observationsdeletedduetomissingness)
Multiple R-squared: 0.9637, Adjusted R-squared: 0.9528
F-statistic: 87.87 on 13 and 43 DF, p-value: < 2.2e-16

Table A5: Two ways effect in Random effect model

```
Balanced Panel: n = 7, T = 8, N = 56
Effects:
varstd.devshare
idiosyncratic 2.477   1.574 0.278
individual    6.423   2.534 0.722
time          0.000   0.000 0.000
theta: 0.7855 (id) 0 (time) 0 (total)

Residuals:
    Min.   1st Qu.    Median   3rd Qu.      Max.
-6.304214 -1.024193  0.035629  1.505586  6.297655

Coefficients:
                   EstimateStd.    Error         z-value     Pr(>|z|)
(Intercept)       -15.145126   3.495093 -4.3333 1.469e-05 ***
GDPi_GDPj           0.272606   0.045367  6.0089 1.868e-09 ***
FDIi_FDIj           1.213585   1.840007  0.6596 0.5095396
TOi_TOj             0.381143   0.049729  7.6643 1.798e-14 ***
UNEMi_UNEMj        -1.066000   0.316374 -3.3694 0.0007532 ***
POPi_POPj           0.254398   0.074117  3.4324 0.0005983 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1888.5
ResidualSum of Squares: 325.25
R-Squared:      0.82777
Adj. R-Squared: 0.81055
Chisq: 240.312 on 5 DF, p-value: < 2.22e-16
```

Table A6: Least Square Dummy Variables (LSDV)

```
Residuals:
Min          1Q          Median          3Q          Max
-5.1545    -0.9669       0.0494         0.8962        4.3883

Coefficients: (3 not definedbecause of singularities)
                              Estimate   Std. Error  t value      Pr(>|t|)
GDPi_GDPj                      0.33667    0.06495    5.184        5.25e-06 ***
FDIi_FDIj                     -0.40991    1.38729  -0.295 0.769021
TOi_TOj                      0.38880    0.03916   9.928 8.33e-13 ***
UNEMi_UNEMj          -2.51236    0.69790  -3.600 0.000804 ***
POPi_POPj                      0.66926    0.10873   6.156 1.99e-07 ***
COMLANij- Dummy      38.24119   15.58357   2.454 0.018158 *
LANDLOCKNESSij-Dummy  -31.69458    3.30256  -9.597 2.34e-12 ***
COMBORDERij- Dummy            -36.00175    4.42946  -8.128 2.65e-10 ***
factor(CNTRY)Burundi       16.26283    2.55905   6.355 1.01e-07 ***
factor(CNTRY)DR Congo     -24.87465    4.42284  -5.624 1.20e-06 ***
factor(CNTRY)Kenya              NA         NANANA
factor(CNTRY)Rwanda        35.59569    8.16210   4.361 7.69e-05 ***
factor(CNTRY)Somalia (I)        NA         NANANA
factor(CNTRY)Tanzania     -27.06331    5.73124  -4.722 2.40e-05 ***
factor(CNTRY)Uganda             NA         NANANA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residualstandarderror: 1.847 on 44 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.9935,  Adjusted R-squared:  0.9918
F-statistic: 563.6 on 12 and 44 DF,  p-value: < 2.2e-16
```

NOTE: (NA) means not accounted/Available

Table A7: Individual and Time effect test

Lagrange MultiplierTest - two-wayseffects (Gourieroux, Holly andMonfort)
chibarsq = 21.825, df0 = 0.00, df1 = 1.00, df2 = 2.00, w0 =
0.25, w1 = 0.50, w2 = 0.25, p-value = 6.05e-06
alternativehypothesis: significanteffects

Table A8: LM test for Fixed Vspooling OLs

Ho: Pooled OLS is consistent
Ha: Fixedmethod is consistent
F test forindividualeffects
data: TTi_TTj ~ GDPi_GDPj + FDIi_FDIj + TOi_TOj + UNEMi_UNEMj + POPi_POPj
F = 40.958, df1 = 6, df2 = 44, p-value< 2.2e-16
alternativehypothesis: significanteffects