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Abstract

Purpose: This study investigated the effect of per capita income, foreign direct investment, manufacturing value-added, and ICT infrastructure development on intra-industry trade in transport services between Kenya and the selected East African Community members, to enhance trade in transport services integration in the region.

Methodology: Purposive sampling was applied in selecting the economies of Kenya,Uganda,Tanzania,Rwanda and Burundi which constituted the target population. Gravity model with PPML estimator was used for analysis,with annual panel data (2005 to 2024) sourced from World Bank, CEPII, World Trade Organization and African Development Bank.

Findings: The intra-industry indices revealed that Kenya had a lower than 50 percent intra-industry trade in transport services with the Uganda and Tanzania. However, Kenya trade in transport services with Burundi and Rwanda was mainly inter-industry trade. Difference in per capita income (β=0.004, p=0.013) had a positive effect while FDI (β= -0.69, p=0.000), and ICT Infrastrucuture development (β= -0.92, p=0.000) had a significant negative effect on Kenya intra-industry trade in transport services with th EAC.

Unique Contribution to Theory, Practice and Policy: This study reveals the significance of harmonising ICT infrastrucutre development across the EAC in order to enhance intra-industry trade in transport service. This will encourage interoperability between ICT transport infrastructure that will promote trade in transport services integration across the region.

Keywords: *Intra-Industry Trade, Transport Services, East African Community, Gravity Model*

JEL Classification: *F12, F19, F15, F11*

INTRODUCTION

Hoekman and Shepherd (2017) observed that growth in services trade offers developing countries a wide range of benefits, including employment creation, increased GDP contribution, enhanced environmental sustainability, reduced workplace risks, and greater efficiency in manufacturing. Despite these potential gains, the East African Community (EAC) member states have recorded limited progress in services integration, even after the adoption of the 2010 EAC Common Market Protocol (EAC, 2023). Moreover, developing economies are facing the problem of pre-mature deindustrialization that makes trade in services a critical component for sustainable economic development (Rodrik, 2018).

This is not different from the transport services in EAC despite the common market protocol ratification in 2010, which encourages regional integration of roads, railways, air travel, ports, and special treatment to land-locked partner States (EAC, 2023). Specifically, though the protocol has proposed for co-ordination and harmonization of transport policies, the partner states still experience challenges along the transport corridors, air travel and cross-border delays (EAC, 2007; Mwesigye, 2021). Transport services hold a critical role in business process networks by facilitating economic activities and satisfaction of human needs by means of geographical change of position by people and goods and services (Kherbash & Mocan, 2015). In EAC, transport plays a big role in integration of partner states by bringing in connections between different productive and consumption regions, that help increase the GDP and provide employment for the emerging youthful populations.

Transport services involve the movement of people, animals, goods and services across borders, using the air, sea, road and rail (International Transport Forum-ITF, 2025). The main mode of transport in the EAC region is the road transport (ITF,2025). However, maritime transport is the main transport sub-sector in the world with over 90 percent of global transport trade (EAC,2023). The road transport is supplemented by the rail and air transport. Notably in EAC, there are ongoing transport infrastructure development ranging from from roads to rail, though most under the public sector. Internal water ways and space transport are less developed (EAC, 2023).

Kien and Thao (2016) observed that while trade is the concept that involves movement of goods and services between two or more economies, intra-industry trade (IIT) occurs when there is concurrent export and import of products (services) which fall under similar category. For instance, the export and import of differentiated television sets between China and Japan. Kien and Thao (2016) further defined inter-industry trade as that which involves exchanging of products from different categories, for example, the export and import of flowers and radio sets between two economies.

Intra-industry trade determinants can be categorised as country-specific or industry-specific (Greenaway & Milner ,1986). Andresen (2003) opined that country–specific characteristics that can affect IIT include distance, GDP, per capita income, common language, market size, exchange rate, trade orientation and level of economic integration. The industry–specific characteristics include product differentiation, foreign direct investment, intensity of human capital, tariff, market structure, economies of scale, technological advancement and the product life cycle.

United Nations Conference on Trade and Development (UNCTAD) (2013) noted that hard infrastructure like ports, roads, rail lines and airports are key enablers of international trade, while soft infrastructure that include the internet infrastructure determines trade volumes with

relation to cost and time taken to transact. Though the level of infrastructure development is key to any country's economic undertakings, in Africa, infrastructure is underdeveloped and costlier compared to other developing countries in Asia and South America (UNCTAD, 2013).

Based on transport and logistics infrastructure, EAC has a few major airports that link the EAC partner states and global world (Mwesigye ,2021). They include the Jomo Kenyatta International Airport in Nairobi, and Moi International Airport in Mombasa, both in Kenya; Dar es Salaam International Airport in Tanzania, Entebbe International Airport in Uganda; Kigali International in Rwanda and Bujumbura International Airport in Burundi (Mwesigye ,2021). Regional airports that also serve as links within the EAC, include Wilson, Eldoret and Kisumu Airports in Kenya; Arusha, Mwanza and Mbeya Airports in Tanzania; Arua and Kasese in Uganda; and Kamembe and Gisenyi Airports in Rwanda (Mwesigye ,2021).

The main sea ports in the EAC region are the port of Mombasa and Lamu in Kenya and Dar es Salaam in Tanzania. Other existing ports that need major facelifts include Tanga, Bagamoyo, Mtwara and Maruhubi in Tanzania (Mwesigye ,2021). The railway network in EAC is not well developed, though there is the construction of the Standard Gauge Railway (SGR) to link Kenya, Uganda, Rwanda and Burundi, a collaboration that is taking place between the Kenya Railways Corporation (KRC) and Uganda Railways Corporation (URC). The major limitation of railway network is the low operation speeds and limits to the permissible axle loads and fleet restrictions on capacity (Mwesigye ,2021; EAC, 2023).

To support and sustain social and economic development across the Eastern region, the EAC has ongoing joint infrastructure programs that include the two main transport corridors and the SGR. First is the 1700 km northern corridor, that starts at the Port of Mombasa and serves the economies of Rwanda, Uganda, Burundi, and the Eastern part of DRC (Ochieng, Abala & Mbithi, 2020). The estimated 1,300 km central corridor, which is the second, starts from the port of Dares Salaam, and is expected to serve the economies of Rwanda, Uganda, Eastern DRC, Uganda and Zambia. Then of recent we have the Standard Gauge Railway (SGR), that is expected to run from the city of Mombasa in Kenya to Malaba border between Kenya and Uganda, and be extended to Juba (South Sudan) and to Kigali (Rwanda) and finally to Bujumbura in Burundi (Ochieng, Abala & Mbithi, 2020).

Statement of the Problem

The EAC Strategy Report (2023–2033) on trade in services highlights the slow pace of services integration and the declining competitiveness of services trade across the region. The challenges attributed to the low services trade integration includes; weak infrastructure, limited technological capacity, restrictions on foreign direct investment (FDI), and limited knowledge on services tradability by public policy makers (EAC, 2023). Moreover, for the transport services, border delays and weighbridges alone cost 0.4% and 0.2% of Kenyan gross domestic product respectively (Gasiorek, Mendez-Parra, & Willenbockel ,2017). While the report identifies above economic constraints as barriers to services trade, their specific impact on intra-industry trade in transport services within the EAC remains unclear, a gap that this study sought to address.This study sought to fill the gap by examining how key economic factors namely, per capita income, manufacturing value added, FDI, and ICT infrastructure; shape intra-industry trade in transport services within the EAC, given their little-known relationship. Poisson Pseudo Maximum Likelihood with High-Dimensional Fixed Effects (PPMLHDFE) estimator for gravity model is used to establish this relationship and consequently the study

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provides policy recommendations and lays an empirical foundation on intra-industry trade in transport services within the EAC region.

Objectives

The main objective of the study is to analyze the influence of the key economic determinants on intra-industry trade in transport services between Kenya and the East African Community members. The specific objectives were to:

i. Establish the influence of difference in Per capita income on IIT in transport services between Kenya and EAC partner states.
ii. Investigate the effect of ICT infrastructure development on IIT in transport services between Kenya and the EAC partner states.
iii. Establish the influence of manufacturing value added on IIT in transport services between Kenya and EAC partner states.
iv. Investigate the effect of FDI on IIT in transport services between Kenya and EAC partner states.

LITERATURE REVIEW

Theoretical Foundations of the Gravity Model

Since the application of gravity model by Tinbergen (1962) to analyse cross border trade flows, the gravity equation has become the principal tool for international trade based on its capability to correctly estimate bilateral trade flows (Leamer and Levinsohn 1995). Tinbergen (1962) explains gravity model of trade flows between economies as follows. Assuming two counties K and P, then trade between them is explained by equation (1).

$$X_{kp} = A\frac{Y_k^{\alpha}Y_p^{\beta}}{D_{kp}^{Y}} \quad \text{..... (1)}$$

Whereby X represents the exports flows from country k to county p, Y are the economical masses (GDP) for country k and p while distance (D) is the distance between the capital cities of the countries. α and β denotes the elasticities of the exporting and importing economies' GDP respectively, while γ is the elasticity of distance (Head, 2003). According to Tinbergen (1962), the volume of exports by country k depend on the economic size (Y_k) whereas the volume of imports by country p depends on its purchasing power or income (Y_p).

Under the gravity model, several methods have been proposed to handle zero value observations in the dependent variables especially for trade flows (Shepherd, 2016). For instance, ignoring the zero values and applying Ordinary Least Square in log-Linear form can drastically reduce the sample and result to loss of valuable information; this can lead to biased estimates (Shepherd, 2016). One can also adopt the Tobit estimation where the zeros are replaced with very small positive trade flow (Head and Mayer, 2014). However, truncation or censoring at zero is not right as trade flows cannot be negative, since zero trade values characterize an economic decision anchored on why countries engage in bilateral trade (Head and Mayer ,2014). Salvatici (2013) noted that because log-linear models cannot effectively account for zeros trade flows, the shift to non-linear estimators of gravity models has been significant, for instance the use of Poisson Pseudo Maximum Likelihood (PPML) estimator.

Krugman (1979) New trade theory opined that economies with larger market sizes provide better chances of economies of scale for domestic market firms. Under this theory, economies

can concentrate on the production of a few ranges differentiated products or services at larger scale efficiently. Krugman (1979) new trade theory also well explains the present trade patterns, by focusing on product/services differentiation, loyalty, competitive and strategic pricing, that are features of dominant big firms. Product differentiation can be horizontal in nature (production of goods with difference in attributes) and vertical (goods that are produced with difference in qualities) (Fontagne L. & Freudenberg, M. 2002).

Trade in services occurs when a given service is supplied across country borders in one of the four modes: Mode 1 (cross-border trade), Mode 2 (consumption abroad), Mode 3 (commercial presence), and Mode 4 (movement of natural persons) (WTO,2002). For instance, under this study, dominance of big firms is brought about by foreign direct investment whereby firms expand into foreign countries to services differentiated needs of consumers in foreign economies under the Mode 3. Mode 3 occurs when a service provider establishes some local unit in a foreign country to supply services, majorly driven by firm-level scale economies to overcome trade cost. A case for mode 3 in EAC is when Kenya Cooperative Bank opens subsidiaries in Uganda or Tanzania to offer tailored financial services to consumers in Uganda or Tanzania. Another case is Mode 4, that is motivated by specialized human capital and firm-specific expertise that cannot be easily digitized or replicated abroad. For instance, a Kenyan law firm can send a group of lawyers to offer specialised legal services to a client in Burundi. These two modes facilitate transportation services across the EAC member countries via movement of staff of various subsidiaries across the EAC region thereby resulting to simultaneous demand of transport services. Under mode 2, transport services are demanded facilitate the movement of persons across the EAC partner states as consumers seek to consume services in foreign partner states. For instance, Kenyans visiting Uganda for tourism expedition will demand different modes of transport services for facilitation, similarly for Ugandans visiting Kenya for consumption of education, medical or other services.

Empirical Literature

Jing *et al.* (2010) used panel data modelling techniques to analyse China IIT for products in agriculture for the period 1997 to 2006. Jing *et al.* (2010) study revealed low IIT between China and her 13 main trade partners and established that GDP had a positive impact on IIT. Using panel data from 1995 to 2006, Leitão and Faustino (2009) investigated Portugal IIT in the automobile sector with her trading partners that includes the EU-27, the BRIC countries, and USA. The study revealed a positive association between average GDP and IIT in automobile sector. Sen, Saray and Karagoz (2009) empirically tested various country-specific hypotheses and IIT between Turkey and her 28 trade partners from the OECD group (Organization for Economic Corporation and Development). The outcome of the study showed that GDP had a positive influence on IIT. The findings of these studies reveal higher GDP positively impact intra-industry trade.

Yilmaz (2022) analysed the IIT between the UK and the USA for the manufacturing sector from period 1993 to 2019 by using ARDL approach. After test for cointegration, the study found that difference in per capita income was significant in both long run and short run. This finding supports Linder's Overlapping demand theory which postulates that there is a higher likelihood for economies with similar levels of per capita income to have higher levels of intra-industry trade.

Sichei, Harmse and Kanfer (2005) used bootstrapped panel data econometric analysis to investigate factors affecting IIT in selected services between South Africa and the USA. The

study covered the period 1994 to 2002, and showed that IIT between South Africa and US was negatively affected by differences in per capita income. Botric (2013) applied a panel General Least Square method to investigate IIT between EU and Western Balkans in manufacturing products from 2005 to 2010. Relative factor endowments, distance, common border, total employment, relative trading costs, total employment and export time were used as the explanatory variables. From the findings, distance had negative influence on IIT. These studies reveal that differences in per capita income and distance negatively affect intra-industry trade.

Sotomayor (2012) investigated determinants for intra-industry trade of Mexican non-maquiladora industry, from 1994 to 2006. The study revealed that foreign direct investment positively influenced IIT, HIIT and VIIT. Tatar (2020) investigated IIT within the manufacturing industry for the economies of Turkey and the Economic Cooperation Organization from 2000 to 2017. With the income average, foreign investment, openness and distance as the independent variables, the study found out that foreign investment was statistically significant to IIT. These study findings underscore the positive effect of foreign direct investment on intra-industry trade.

Cernosa (2009) study applied panel techniques to examine factors affecting intra-industry trade the economy of Slovenia. The study revealed that the economies of scale positively influenced HIIT and VIIT. Moshirian *et al.* (2005) adopted New trade theory's main elements to analyse their effects on IIT in the banking sector. The outcome of Moshirian *et al.* (2005) study showed that economies of scale had a positive effect on the banking sector. Ochieng, Abala and Mbithi (2020) used the augmented gravity model with PPML estimator to investigate the influence of infrastructure stock on trade flows for 11 East African economies from 2000 to 2018. The outcome revealed that transport and ICT infrastructures positively impacted on the total trade volumes of the East African countries. From the reviewed literature, most of the studies on intra-industry trade have not only focused on advanced economies, but also centred more on trade in goods. This study focussed on notably in the transport services sector in the EAC.

Research Gaps

Although studies on intra-industry trade have been increasing over time across the globe, empirical literature with regards to Africa and specifically the EAC bloc member countries remain scarce, notably in the services sector. This study significantly contributes to international trade literature by providing a foundation on intra-industry trade in transport services between Kenya and the EAC member countries. Lee and Lloyd (2002) argued that, with role of services trade getting widely recognized, having models that can explicitly explain the intra-industry trade determinants in services is significant. Several studies have used different methodologies including, panel GMM, OLS, and Tobit models in analysing the determinants of IIT. Though a few of the studies like Leitao and Shahbaz (2012) applied gravity model in their analysis, the focus was on trade in goods. Using the PPMLHDFE estimator for gravity model, this study lays the foundation for empirical studies on intra-industry trade in service not only in the EAC region but also other regional economic communities in Africa.

METHODOLOGY

Using purposive sampling, this study focused on intra-industry trade in transport services in the EAC bloc on the Republics of Kenya, Burundi, Rwanda, Uganda, and the United Republic of Tanzania. Correlation research design was applied to establish the relationship between intra-industry trade in transport services and the explanatory variables using the gravity model. This quantitative study applied annual panel secondary data from 2005 to 2024. In addition to

limited statistics on bilateral trade in services data in EAC, this study applied the (World Trade Organization) WTO data due inconsistent national data collection methods, and a lack of harmonized sectoral reporting frameworks across the EAC partner states. Moreover, priority is given to merchandise trade over services by most national bureaus of statistics, resulting in an inadequate services data (EAC,2023, pp. 44,49; East Africa CEO Investment Forum, 2026). The study period was based on the year 2005 following the ratification of the Customs Union in 2004, together with data availability as most data on trade in services from WTO are reported from 2005.

Measurement of Variables and a Priori Expectation

Both difference in gross domestic product and geographical distance variables were incorporated as control variables. Table 1 shows measurement of study variables and their priori expectations.

Table 1: Variable Measurement and A Priori Expectation

Variable Name	Variable Measurement	Source	Expected Sign	Source
Intra Industry transport Services (IIT)	The unadjusted Grubel and Lloyd (1975) IIT index (With 0- pure inter-industry trade,1-pure intra-industry trade	Calculated from WTO database	N/A	
Difference in Gross Domestic Product (diffGDP)	Data measured in current prices in US Dollars	WDI	-	Tinbergen (1962),Head(2003)
Difference in Per Capita Income (diffPCI)	Data measured in current U.S. Dollars	WDI	-/+	Linder (1962) Leitao and Faustino (2009)
Foreign Direct Investment (FDI)	Data measured in current U.S. Dollars	WDI	+/-	Leitao (2011), Sotomayor (2012), Jambor (2015)
Manufacturing Value Added (MVA)	Data measured in current U.S. Dollars	WDI	+	Hartman *et al.* (1993)
Geographical Distance (DIST)	Measured in kilometers	CEPII database	-	Tinbergen (1962), Head(2003), Letao(2012)
ICT Infrastructure development (INFRA)	ICT composite index	African Development Bank database	+	Domor *et al.* (2024), Adeleye *et al.* (2021),

Formulation of Intra-Industry Trade Indices for Transport Services

The intra-industry trade in transport services indices was calculated using the unadjusted Grubel and Lloyd (1975) index, expressed in percentage form (Equation 2). This is in line with

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Finger (1975) as this study's focus is on trade patterns indices. The percentage form of the G-L equation is given as;

$$IIT_{jkpt} = \left[1 - \frac{|X_{jkpt} - M_{jkpt}|}{(X_{jkpt} + M_{jkpt})}\right] \times 100 \quad \ldots\ldots (2)$$

Where:

IIT_{jkpt} is the intra-industry trade index j between country (k) and country (p) for time t

X_{jkpt} are the exports of country (k) of service sector j to country (p) for time t

M_{jkpt} are the imports of country (k) of service sector j from country (p) for time t

The G-L index values take the interval $0 \leq G\text{-}L \leq 100$ when expressed in percentage form. Zero (0) values indicate pure inter-industry trade in transport services while one hundred (100) indicate pure intra-industry trade in transport services.

RESULTS

Description of Intra-Industry Trade Indices for Transport Services

To identify the main trends in the IIT in services, the period 2005-2024 was divided into two stages: 2005-2010 (the pre-ratification period); and 2011-2024 (the post-ratification period). The G-L index values greater than 50 percent indicate more of intra-industry trade, while G-L index less than 50 percent indicates the trade to be inter-industry trade (Grubel-Lloyd, 1975).

Table 2: Unadjusted GL Indices for IIT in the Transport Services in Percentage

Year	Tanzania	Uganda	Rwanda	Burundi
2005	22.22	0	0	0
2006	18.18	18.18	0	0
2007	30.77	15.38	0	0
2008	20.00	23.53	0	0
2009	23.53	25.00	0	0
2010	27.27	19.05	0	0
2011	16.67	20.00	0	0
2012	18.75	24.00	0	0
2013	13.33	16.67	0	0
2014	11.76	16.00	0	0
2015	22.22	28.57	0	0
2016	18.18	21.05	0	0
2017	20.00	20.00	0	0
2018	27.27	24.00	0	0
2019	24.00	20.69	0	0
2020	35.29	18.18	0	0
2021	38.46	23.08	0	0
2022	36.84	24.24	0	40
2023	40.00	18.18	0	40
2024	38.89	17.14	0	40

Source: Author's Computation, 2026 (WTO Data)

From Table 2, IIT in transport services varies distinctly between Kenya and the selected EAC member countries. For instance, Kenya has a lower intra-industry trade in transport services

with the economies of Tanzania and Uganda. On the contrary, Kenya trade in transport services with the economies of Rwanda and Burundi are majorly inter-industry trade.

Kenya's IIT trade in transport services with the economy of Tanzania had a lower IIT of below 50 percent across the study years. The significant decrease in the IIT indices after the year 2010 signifies the increased exports of transport services by Kenya to the economy of Tanzania because of decreased trade barriers in transport services, following the ratification of the common market protocol(EAC, 2023).

Table 2 further shows the dominance of Kenya in transport services exports (lower IIT below 50 percent) with the economy of Uganda throughout the study period. This is attributed to land locked characteristic of Uganda that makes it rely on the port of Mombasa for her imports(EAC, 2023). Moreover, there was a decline in IIT in transport services to a low of 18.18 percent in the year 2020 that was as a result of Covid-19 lock down by many countries (EAC, 2022).

Contrary to the economies of Tanzania and Uganda, Kenya trade in transport services with the economies of Rwanda and Burundi is majorly inter-industry trade (majority of 0.00 %) and the ratification of the Common Market protocol in 2010 had no significant impact. This is attributed to the two economies being land locked and also smaller in market size compared to the Kenya's economy (EAC, 2023).

Description of Variables

Table 3: Descriptive Analysis of Dependent and Explanatory Variables

Statistic	IIT transport services	diffGDP	DiffPCI	FDI	MVA	INFRA	DIST
Mean	12.706	4.41e+10	802.887	6.85e+08	2.45e+09	3.978	654.31
Minimum	0.00	3.43e+08	40.121	31593.78	1.32e+08	0.0003	503.5
Maximum	40	1.17e+11	1913.01	3.26e+09	8.15e+09	14.332	801.99
Std. Dev	13.497	3.01e+10	436.321	7.37e+08	2.41e+09	3.929	127.467
Observations	80	80	80	80	80	80	80

Source: Author's Computation, 2026

Table 3 shows that IIT in transport services between Kenya and the selected EAC trade partners had a mean of 12.71 per cent, a maximum of 40 per cent and a minimum of 0.00 per cent. This means Kenyan IIT in transport services with the selected economies is below average. This therefore provides evidence that services trade integration in the EAC is still lower (EAC,2023).

The difference in gross domestic product has a maximum of 1.17e+11 USD and an average of 4.41e+10 USD. Difference in PCI has an average of 802.887 USD and a maximum of 1913.01 USD. FDI for Kenya's trading partners had a maximum of 3.26e+09 USD and an average of 6.85e+08 USD. Manufacturing value added had an average of 2.45e+09 USD and a maximum value of 8.15e+09 USD. The ICT infrastructure development index had an average of 3.978 indicating low ICT connectivity among the EAC member states and a maximum 14.332. The furthest capital city from Nairobi is Bujumbura (Gitega is the political capital) of Burundi with approximately 801.99 km while the closest capital city is Kampala of Uganda with approximately 503.5 km.

Normality

Normal distribution of observation in variables is a fundamental statistical assumption for equation modelling. Normality is the distribution of data for individual metric variable and its relationship with the normal distribution benchmark (Hair Jr *et al.*, 2010).

Jarque-Bera test for normality was carried out. Under this test, the null hypothesis state that the variable has a normal distribution. From Table 4, only diffpci variable has a normal distribution 5 percent level of significance.

Table 4: Jarque-Bera test for Normality

Variable	Observations	chi2(2)	Prob>chi2
IIT transport	80	6.787	0.0336
Diffpci	80	5.126	0.0771
Diffgdp	80	6.079	0.0478
Fdi	80	39.63	2.5e-09
Mva	80	9.647	0.008
Infra	80	7.993	0.0184
Dist	80	11.36	0.0034

Source: Author's Computation, 2026

To mitigate the non-normal distribution of the non-negative dependent variable and the independent variables, this study applies PPML with high dimensional fixed effects (ppmlhdfe) that well handles gravity models in multiplicative form. PPML estimation method neither requires the dependent variables and the error terms to follow a normal distribution, nor does it require the variables to follow a Poisson distribution (Correia, Guimaraes & Zylkin,2020).

Correlational Analysis for Transport Services

A scatter plot test on correlation was carried out and the results showed there is no linear correlation between the intra-industry trade in transport services and the independent variables as shown in the Figure 1. Since most of the variables have non-normal distribution, in addition to the non-linear correlation, Spearman rank correlation coefficient was done.

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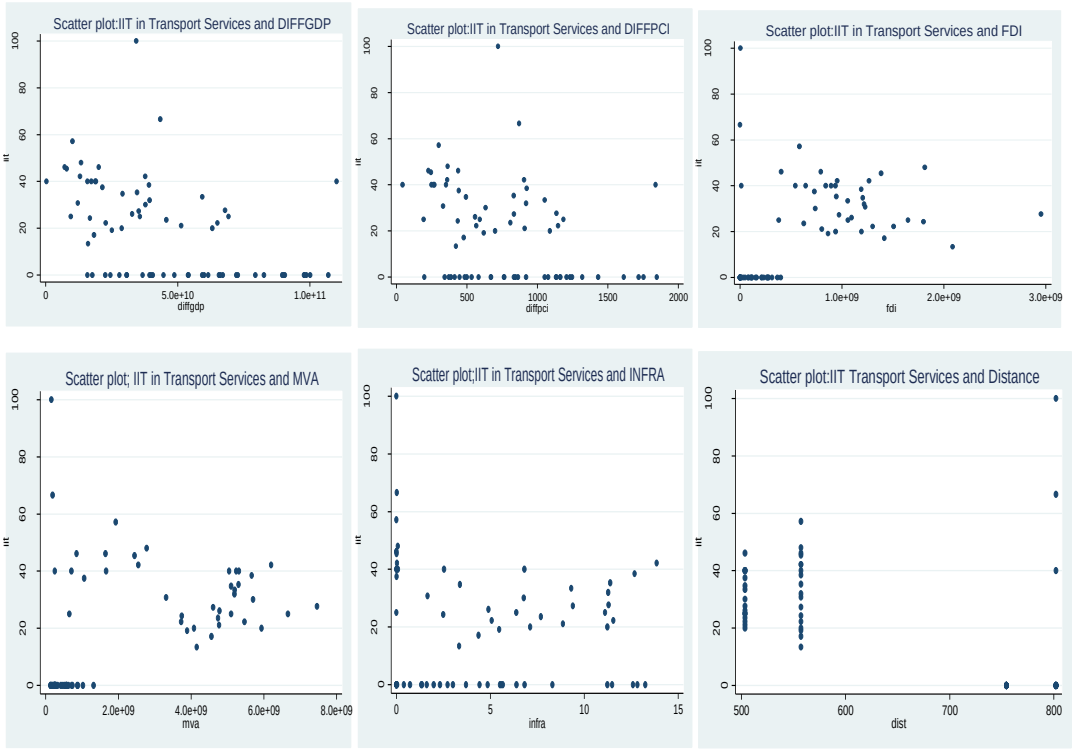

Figure 1: Scatter Plots for IIT in Transport Services and Independent Variables

Source: Author's Computation, 2026

Spearman Rank Correlational Analysis for Transport Services

Table 5: Spearman Rank Correlation Coefficient for Transport Services

	IIT TRANSPORT	DIFFGDP	DIFFPCI	FDI	DIFFMVA	INFRA	DIST
IIT TRANSPORT	1.000						
DIFFGDP	-0.2584 (0.0207)**	1.000					
DIFFPCI	-0.1047 (0.3552)	0.9336 (0.0000)*	1.000				
FDI	0.6631 (0.0000)*	-0.3158 (0.0043)**	-0.2364 (0.0348)*	1.000			
MVA	0.7057 (0.0000)*	-0.1583 (0.1607)	-0.1033 (0.3618)	0.9180 (0.0000)*	1.000		
INFRA	0.2849 (0.0104)**	0.6504 (0.0000)*	0.6667 (0.0000)*	0.3778 (0.0005)*	0.5149 (0.0000)*	1.000	
DIST	-0.5979 (0.0000)*	0.4333 (0.0001)*	0.4169 (0.0001)*	-0.8328 (0.0000)*	-0.8608 (0.0000)*	-0.1099 (0.3318)	1.000

Source: Author's Computation, 2026

Note: * Shows Significant Level at one per cent

** Show Significant level at five per cent

Table 5 shows that there is a positive association between IIT in transport services and the explanatory variables; foreign direct investment, ICT infrastructure development indices, and manufacturing value added. Contrary, there is a negative association between IIT in transport

services and the explanatory variables; difference in difference in gross domestic product, difference in per capita income and distance. The correlation matrix among the explanatory variables showed that the variables were not highly correlated except for the one between difference in gross domestic product and difference in per capita income (0.9336).

However, any suspicion of multicollinearity is corrected by using the poison pseudo maximum likelihood high-dimensional fixed effects (ppmlhdfe) estimator, such that unlike the ppml estimator that looks for problematic regressors, the ppmlhdfe estimator looks for problematic observations to avoid perfect multicollinearity and thus produces plausible results (Correia, Guimaraes & Zylkin, 2019).

Cross Section Dependence

This study applied Pesaran (2004, 2015) CD-test for the cross-section dependence because the time dimension (T=20 years, 2005-2024) of the panel is larger than the cross-sectional dimension (N=4). Under this test, the null hypothesis of cross-section independence (CD ~ N (0,1)) was tested (Pesaran, 2004, 2015).

Table 6: Cross Section Dependence Test for Transport Services

Variable	CD-test	p-value	Average joint T
IIT transport	1.351	0.177	20.00
diffGDP	10.761	0.000	20.00
diffPCI	10.639	0.000	20.00
FDI	4.887	0.000	20.00
MVA	9.749	0.000	20.00
INFRA	10.75	0.000	20.00
DIST	0	1.000	20.00

Source: Author's Computation, 2026

From Table 6, all the variables, except for distance variable (p=1.000) and IIT in transport (p=0.177), have p<0.05, implying that there is cross-section dependence among the variables. Presence of cross-sectional dependence in gravity models can be controlled by the use of country-pair fixed effects; these methods account for the serial autocorrelation within groups for instance the importer and exporter pairs (Yotov *et al.*, 2016). The exporter-time and importer-time fixed was applied to control for the cross-section dependence.

Panel Unit Root Tests

The second-generation test by Pesaran (2007) was applied because of the presence of cross section dependence across the panel entities and its capabilities in handling small time series (Pesaran, 2007). Under the Pesaran (2007) test, the variable is said to be stationary at a given level of significance if the absolute value of the CIPS statistic is greater than any of the given significant levels.

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Table 7: Pesaran (2007) Panel Unit-root Test at Level

Variable	CIPS statistic	10%	5%	1%	Remarks
IIT transport	-2.424	-2.74	-2.88	-3.15	Non-stationary
diffGDP	-1.885	-2.74	-2.88	-3.15	Non-stationary
diffPCI	-2.525	-2.74	-2.88	-3.15	Non-stationary
FDI	-1.750	-2.74	-2.88	-3.15	Non-stationary
MVA	-2.070	-2.74	-2.88	-3.15	Non-stationary
INFRA	-1.600	-2.74	-2.88	-3.15	Non-stationary
DIST	1.700	-2.74	-2.88	-3.15	Non-stationary

Source: Author's Computation, 2026

From Table 7, all the variables are non-stationary since the absolute value of the CIPS statistic for the variables are less compared to those across all the significance levels. Consequently, the variables were tested at first differenced level to confirm their stationarity.

Table 8: Pesaran (2007) Panel Unit-root Test at First Difference

Variable	CIPS statistic	10%	5%	1%	Remarks
d.IIT	-3.980	-2.74	-2.88	-3.15	Stationary
d.diffGDP	-3.179	-2.74	-2.88	-3.15	Stationary
d.diffPCI	-3.928	-2.74	-2.88	-3.15	Stationary
d.FDI	-5.977	-2.74	-2.88	-3.15	Stationary
d.MVA	-4.290	-2.74	-2.88	-3.15	Stationary
d.INFRA	-3.732	-2.74	-2.88	-3.15	Stationary
d.DIST	1.700	-2.74	-2.88	-3.15	Non-stationary

Source: Author's Computation, 2026

Table 8 shows that the variables IIT, diffGDP, diffPCI, FDI, MVA and INFRA are stationary at first difference at 5 percent level of significance. However, d.DIST variable remained non-stationary. This is because the distance variable is time invariant. Santos Silva and Tenreyro (2011) opined that the PPML estimator can be applied for gravity equation in levels and the data need to be of Poisson distribution. To mitigate the issue of non-stationarity in the panels, this study applied PPML estimator with time-year dummies (Yotov *et al.* ,2016). Dropping the distance variable from the gravity model may lead to model misspecification that can lead to biased estimates.

Results for Gravity Model

This study applied the PPML estimator in analysing the determinants of intra-industry trade in transport services using equation (3).

$$IIT_{jkptr} = \exp\left[\beta_0 + \beta_1 GDP_{kt} + \beta_2 GDP_{pt} + \beta_3 diffgdp_{kpt} + \beta_4 diffPCI_{kpt} + \beta_5 FDI_{pt} + \beta_6 MVA_{pt} + \beta_7 INFRA_{pt} + \beta_8 DIST_{kp}\right] \times \varepsilon_{kpt} \quad (3)$$

Equation 2 has the IIT index for the transport services as the dependent variable, while difference in gross domestic product (diffGDP), Distance between capital cities of the trading countries (DIST), difference in Per Capita Income (diffPCI), Foreign Direct Investment (FDI), Manufacturing value added (MVA), and the ICT Infrastructure Development index (INFRA)

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are the explanatory variables. ε_{kpt} is the two-way error component term of the model. Where $\varepsilon_{kpt} = v_k + \gamma_t + \mu_{kpt}$ such that v_k is the unobserved individual effects (captures the country specific unobservable effects – the exporter and importer fixed effects which is the multilateral trade resistance term), γ_t unobserved time effect and μ_{kpt} is the remaining part of the stochastic disturbance term. In gravity models, country year dummies can be used to control for Multilateral Trade Resistance (MTR) (Baldwin and Taglioni ,2006).

Table 9: PPML Gravity Regression Results for IIT in Transport Services

Independent Variables	Estimate Coefficient	Std error	P-value
Intercept	-0.479	1.680	0.775
Difference in gross domestic product	-3.492 *	0.477	0.000
Difference in per capita income	0.004**	0.002	0.013
Foreign direct investment	-1.189*	0.298	0.000
ICT infrastructure development index	-2.560*	0.566	0.000
Distance	-1.465*	0.192	0.000
Diagnostic Statistics			
Pseudo R2 = 0.653			
Deviance = 355.426			
Log pseudolikelihood = -282.315			

Source: Authors Computation, 2026

Note: * Shows Significant Level at one per cent

** Show Significant level at five per cent

From Table 9, the difference in GDP and the geographical distance, that were used as control variables are all negative, at 1 percent significance level. The manufacturing value added variable was dropped due to multicollinearity. The difference in GDP ($\beta_3 = -3.492\,; P = 0.000\,,\ (e^{-3.492} - 1) = -0.97$) has a negative and significant relationship with the IIT in transport services between Kenya and the EAC. Empirical literature postulates that trading economies with higher GDP are likely to experience higher IIT (Andresen, 2003). These results are in line with Varma and Ramakrishnan (2014) and Ferto (2007) whose findings on IIT in processed food items for India and trade partners and on Hungary's Agri- products on partners respectively found difference in GDP to have a negatively impact on IIT. The negative relationship implies that IIT in transport services is negatively affected by increase in the differences in the economic sizes between Kenya and her EAC trading partners. This result aligns with the theoretical foundation of gravity model that predicts increase in IIT with similarity in GDP between trading partners (Head,2003).

Geographical distance between trading partners ($\beta_8 = -1.465\,; P = 0.000\,,\ (e^{-1.465} - 1) = -0.77$, has a negative and significant relationship with the IIT in transport services between Kenya and the selected EAC members. This implies that IIT in transport services is negatively impacted by distance between Kenya and her EAC member economies. These study results resonate with the empirical findings of Musonda (1997) study that also applied the gravity model to investigate the degree of IIT among PTA/COMESA 11 members in East and South Africa. Similarly, Lee (1989) study found distance to have a negative impact on IIT among the Pacific Basin countries. This result conforms with the gravity theory, that predicts negative

effect of distance on trade flows between trading countries (Head, 2003; Tinbergen ,1962; Salvatici, 2013).

The coefficient for difference in Per Capita Income was positive and significant ($\beta_4 = 0.004\,; P = 0.000\,,\ (e^{0.004} - 1) = 0.004$) meaning a unit change in dissimilarity in level of per capita income positively impacted on IIT trade in transport services between Kenya and her selected EAC member economies by 0.004 units. This study corroborates with the empirical finding by Leitao and Faustino (2009) who used augmented gravity model to investigate the determinants of IIT in the automobile sector and found a positive relationship between dissimilarity in PCI and IIT with the Portuguese the trading partners. The difference in PCI represents difference in consumer tastes which the explains the difference in import composition (Krugman, 1979). However, this study results contradicts Sichei, Harmse and Kanfer (2005) and Yilmaz (2022) studies that revealed a negative relationship of difference in PCI and IIT trade in services between the economies of South Africa and the USA. This result therefore postulates that difference in demand structure and consumers' preference for differentiated products or services positively impacts on IIT in transport services between Kenya and her trading partners in the East African Community.

The result for FDI was negative and significant at 1 per cent level ($\beta_5 = -1.189\,; P = 0.000\,,\ (e^{-1.189} - 1) = -0.69$). This contradicts majority of empirical literature on IIT. For instance, Arip *et al.* (2011) study on IIT between China and East Asia countries and Kyereboah-Coleman *et al.* (2025) study on intra- African trade among 54 African countries found FDI to have a positive and significant effect. However, this result resonates with the Jambor (2015) that found a negative effect of FDI on both HIIT and VIIT in agri-food items between EU and the Visegrad countries. This result is negative because most manufacturing firms in the East Africa, majority being Multinational Corporations, adopt lean inventory practices and utilize freight consolidation and optimization strategies (Lawrence and Mupa ,2024). These strategies help the MNCs to streamline and shrink their transportation footprint or truck trips across the transport corridors.

The coefficient for the variable of ICT infrastructure development is negative, and significant ($\beta_7 = -2.560\,; P = 0.000\,,\ (e^{-2.560} - 1) = -0.92$) at 1 per cent level. Meaning that a unit increase in ICT infrastructure development index among the EAC members results to a 0.92 decrease in IIT in transport services between Kenya and EAC members. However, most studies relating ICT adoption and trade between two economies reveal a positive and significant relationship (Adeleye *et al.* 2021). This is because ICT evolution has reduced institutional paper work and trade barriers, and significantly increased trade volumes. For instance, Dumor *et al.* (2024) and Abendin *et al.* (2022) studies found a that ICT development deepened bilateral exports among the EAC members. Similarly, Kere and Zongo (2023) found ICT to have a positive and significant effect on exports of primary products but revealed no effect on Intra-African exports of manufactured goods. Moreover, Ochieng, Abala and Mbithi (2020) study on the influence of infrastructure stock on trade flows for 11 East African economies revealed ICT infrastructure positively impacted on their total trade volumes.

This result is however negative because digital literacy and infrastructure development in East Africa remain uneven, which therefore limits the interoperability between different digital platforms(Hamisi and Kileo, 2024). Moreover, different levels of adoption of digital logistics tools (that include online customs clearance and electronic payment solutions) results to inconsistent enforcement and limited cross-border interoperability of transport services among the EAC member states (Daniel, 2025). This contrast the case for developed economies, where

digital logistic tools are supported by robust ICT infrastructure that is deeply integrated and there is seamless inter-agency data sharing (Organisation for Economic Co-operation and Development (OECD), 2025)

Heteroskedasticity

The use of PPML in gravity models is specifically modelled to address the issue of heteroskedasticity and autocorrelation whereby the variance of the error term is not constant across observations. PPML handles this by allowing the variance to be proportional to the mean of the dependent variable, which is common in gravity models (Santos Silva and Tenreyro,2006).

Multicollinearity

Multicollinearity refers to a case in which two or more explanatory variables in the regression model are highly correlated (Gujarati,2004). High Variance Inflation Factor (VIF) values indicate presence of multicollinearity that can lead to instability in PPML estimates. Gujarati (2004) provides that if VIF exceeds 10, that variable is said to be highly collinear. The results from Table 10 indicate that no variable exceeded VIF greater than 10 (VIF>10) therefore none of the variables are highly collinear.

Table 10: Variance Inflation Factor Results for Transport Services

Variable	VIF	1/VIF
Zdist	3.62	0.183837
Zdiffgdp	3.84	0.276183
Zinfra	2.31	0.433746
Zfdi	3.04	0.328411
Diffpci	2.65	0.376825
Mean VIF	4.15	

Source: Author's Computation, 2026

Note: VIF> 10 Shows presence of Multicollinearity

Ramsey RESET Test (Model Mis-Specification)

The Ramsey RESET test confirms if the model is correctly specified based on conditional mean, that is carried out by checking the significance of an additional regressors (Santos Silva and Tenreyro,2006). The null hypothesis states that the model does not suffer from misspecification errors suggesting the model is correctly specified. The null hypothesis is rejected when the p-value is smaller than the critical value (Yotov et al., 2016). The results from Table 11 indicate that the model does not suffer from misspecification errors.

Table 11: Ramsey RESET Test Results for Transport Services

Item Result Name	Value
Chi2(1)	1.89
Prob>Chi2	0.169

Source: Author's Computation, 2026

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CONCLUSION AND RECOMMENDATIONS

Summary

This study sought to investigate the effect of difference in per capita income, ICT infrastructural development , manufacturing value added and foreign direct investment on intra-industry trade in transport services between Kenya and the East African Community partner states. Difference in PCI had a positive and significant effect on IIT in transport services (β_4= 0.004 ;P=0.000 , (e^0.004-1)=0.004).This result corroborates with Leitao and Faustino (2009) finding but contradicted Sichei, Harmse and Kanfer (2005) and Yilmaz (2022) research outcomes. This result shows that difference in demand structure or consumers' preference for differentiated goods or services positively impacts IIT in transport services between Kenya and her trading partners in the EAC.

ICT infrastructure development had a negative and significant effect on transport services (β_7= -2.560 ;P=0.000 , (e^(-2.560)-1)=-0.92) at 1 percent level. Though most studies show a positive relationship between ICT development and trade flows (Dumor et al.,2024; Abendin et al.,2022 ; Kere & Zongo,2023), this result is negative because of uneven digital infrastructure development across East Africa (Hamisi & Kileo, 2024), which limits the interoperability of digital transport platforms that reduces cross-border transport services between Kenya and EAC member countries.

FDI had a negative and significant effect on IIT in transport services (β_5= -1.189 ;P=0.000 , (e^(-1.189)-1)=-0.69). The finding is negative because majority of multinational corporations adopt lean inventory and freight consolidation strategies that shrinks transportation truck trips between Kenya and the EAC member countries (Lawrence & Mupa ,2024).

This study calculated the intra-industry trade in transport services indices using the unadjusted Grubel-Lloyd (1975) approach between Kenya and the EAC partner states. From the calculated indices, Kenya had lower than 50 percent IIT in transport services with the economies of Tanzania and Uganda. On contrary, trade in the transport services between Kenya and the economies of Burundi and Rwanda was majorly inter-industry trade (Majority of indices were 0%).

Conclusion

Based on the results on IIT in transport services, this study concludes that difference in per capita income has a positive effect, while ICT infrastructure development and foreign direct investment have a negative effect on IIT in transport services between Kenya and EAC members.

This study calculated the IIT in transport services indices using the unadjusted Grubel -Lloyd (1975) approach between Kenya and the selected EAC member countries. Consequently, the study concludes that Kenya has a lower IIT in transport services with the economies of Tanzania and Uganda. Kenya trade in transport services with the economies of Burundi and Rwanda was majorly inter-industry trade.

Policy Recommendations

The study revealed a negative and significant relationship between ICT infrastructure development and IIT in transport services. This points out that ICT infrastructure development among the EAC members negatively impacted IIT in transport services. This calls for the need to harmonize ICT infrastructure development in transport sector along the transport corridors and border points among the EAC partner states in order to increase transport services trade

integration in the EAC region. Moreover, more start up business-friendly policies should be put in place to encourage Rwanda and Burundi firms to invest in transport sectors to increase intra-industry trade across East African Community.

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