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Effect of Infrastructural Development on Kenya's Manufacturing Exports to EAC Region

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Abstract

Manufacturing industries have played a significant role in boosting economic wellbeing in the world through accelerating and maintaining greater productivity growth, boosting employment options for semi-skilled workers, and increasing country competitiveness through exports. Kenya, like many other developing nations, is working to build a strong manufacturing industry. Agriculture and services have been the primary drivers of growth in the country. Historically, the manufacturing sector's contribution to Kenya's economy has remained constant at 10% of GDP, and in 2021 it was around 8.4 percent. As a result, the country has seen an early deindustrialization, as evidenced by the manufacturing sector's contribution to GDP, which was just 8.4% in 2021 and 9.2% in 2016. Boosting manufacturing sector results remains a key priority for Kenya, as evidenced by the slew of planned interventions for the industry that have been created over the years. The government has established Vision 2030, the Kenya Industrial Transformation Programme (KITP), and, most recently, the Big 4 Agenda to modernize the industrial sector. The major goal of this research was to see how infrastructure development (ID) affected Kenya's manufactured exports to the East African Community (EAC). The specific goals were to determine the impact of infrastructure development on Kenya's manufacturing exports to the EAC region. Gravity model was used as the theoretical framework for the study, which is based on the theory of international trade and employs a correlation research design that is ideal for dynamic panel data models. Each country's data for the study variables was obtained from the United Nations Conference on Trade and Development (UNCTAD), Kenya Nation Bureau of Statistics, World Bank development and African Development Bank for six EAC members for the period 2007–2021. Unit root test, Im-Pesaran and Shin, Levin-Li-Chu tests were used in the study. The Im-Pesaran unit root test results at Levels indicated that all the variables except inflation had unit root at levels as indicated by the p-values>0.05, except inflation which had a p-value of 0.0006<0.05. However, all the variables achieved at first difference with (p-value<0.05). Hausman Test Results of fixed effect model indicated that manufacturing exports were positively and significantly determined by infrastructure development with a (P-value of 0.0000<0.05) and ($\beta 3=4.392823$). The government of Kenya and other stakeholders should invest more in infrastructure and improve capital through education, training, health, and housing, according to this report, in order to increase labor productivity and boost manufacturing exports. Government supply-side policies, such as government subsidies and tax rebates, are recommended to lower production costs and attract and channel foreign direct investment (FDI) to more productive and comparative advantaged manufactured exports, thereby improving domestic producers' productive and export supply capacity, lowering inflation rates, and increasing efficiency.

Keywords: Manufacturing exports, infrastructural development, manufacturing, inflation

1 Introduction

Manufacturing is the process of enhancing the value of goods for use or sale through the use of labor, machines, equipment, chemicals, and biological processing (World Bank, 2018). Manufacturing is under a lot of strain right now, all across the world. Shorter product life cycles, the formation of new business models, the creation of new materials, and enhanced production methods have all contributed to increased competitive pressures at the firm level (IMF, 2021). Over much of the last few decades, the world economy's continuous globalization has been accompanied with typically strong expansion in international trade. Since 1990, the entire value of international goods and services trade has expanded six fold, to over $24 trillion in 2014. (UNCTAD, 2020). Manufacturing products account for more than half of global commerce ($13 trillion), and growth in these products has outpaced growth in natural resources and agricultural exports over the last decade (Loto,2018). Between 2005 and 2014, Asia had the highest annual average growth rate in manufacturing exports (8.3%), followed by Africa (7.4%), Europe (4.3%), the Americas (3.9%), and Oceania 2.7% this shows that manufacturing exports remain a significant source of revenue in developing countries (IMF 2021).

Low growth in exports, particularly industrial exports, has been linked to the poor performance of many African economies in recent decades (AFDB, 2019). However, according to (UNECA, 2019), from 2005 - 2014, manufacturing exports from Africa to other continents increased by 2%. For example, manufacturing exports from Africa as a whole increased by 10% on an annual basis in 14 out of 34 groups of the products, with the fastest growth in non-primary plastics (17.9 percent), telecommunication and sound recording apparatus (15.9 percent), chemical materials and products (14.5%), and specialized machinery (14.5 percent). (13.3 percent) Fertilizers and inorganic chemicals both have a content of more than 5%. (Song we, Vera & Deborah, 2012). Similarly, Africa contributes for more than 4 percent of global exports of leather, leather manufacturing, and dressed Fur skins, as well as roughly 2% of global exports of garments and clothing accessories (Kireyev, 2017). In contrast, the share of intra-African manufacturing exports in total African manufacturing export value increased by about 15 percent between 2005 and 2019, reaching 34% (UNECA, 2015). Intra-African manufacturing exports amounted for more than 70% of overall exports in Ghana, Rwanda, Tanzania, Uganda, and Zambia in 2014, and as high as 82 percent in Zambia. Ghana's intra-African share was also high in 2013, at 67.5 percent (Dinh, Palmade & Chandra, 2018).

Though manufacturing exports to other parts of the world have fluctuated significantly in recent years, Kenyan manufacturing exports have tended to rise from 1994 to 2018, peaking at 28.4 percent in 2019. Kenya's trade with East African countries fell from $1.26 billion in 2015 to $1.21 billion in 2016, owing to ongoing trade disputes with Tanzania and lower food production, beverages, tobacco, leather and related products, rubber and plastics, and non-metallic minerals, according to the Kenya National Bureau of Statistics (KNBS) Economic Survey 2018. Nonetheless, Kenya's manufacturing exports to the East African Community have declined (EAC). The value-added outputs of the manufacturing sector have been steadily increasing

(Githuku, 2010). This value increased by Ksh 210 billion from 2011 - 2017, and the Integrated National Exports Development and Promotion Strategy predicts that it would reach Sh2,235 trillion by 2022. (KNBS, 2018). A competitive manufacturing sector will be critical if Kenya is to attain the 15% share of GDP target set out in the 'Big Four' agenda and accomplish its Vision 2030 economic pillar. As a result, the purpose of this proposed study is to see how chosen macroeconomic aggregates (inflation, infrastructure, and human capital development) affect manufacturing exports to EAC over the study period.

1.2 Infrastructure Development and Manufacturing exports

Most countries rely on infrastructure to help them develop (Shinyekwa & Ntale, 2017). Global infrastructure development has increased, with cities on the American and Asian continents experiencing massive mega structure growth (Swerts & Denis, 2017). In the same way, China, Europe, and Brazil have experienced a real estate boom, with a focus on the development of social and infrastructure amenities to boost industrial production and meet the needs of a growing middle and upper-income population (Kigume, 2018). Kenya's manufacturing sector has resulted in the USD 3.5 billion Standard Gauge Railway (SGR) connecting Nairobi to the port of Mombasa, allowing Kenya to meet targets and, as a result, value added exports, realizing the goal of 1.3 million jobs (KNBS,2018). Similarly, Kenya's government launched a multibillion-dollar infrastructure project in 2015, including a US$653 million expansion of its main airport to increase trade and cement its status as a regional commercial hub, as well as the 2014 construction of a new US$13.8 billion railway that will eventually connect its Indian Ocean port of Mombasa with Uganda, Tanzania, Rwanda, and Southern Sudan, Ndung'u &Kaimenyi (2015). According to the Knight Frank Global Cities Report (2018), these projects drew a large number of foreign direct investors looking to invest in the manufacturing sector because of the availability of manufacturing raw materials in the hinterland. Infrastructure development is critical for Kenya to achieve manufacturing growth in line with the Big Four goal. The objective of this study was to investigate the consequences of Kenya's infrastructure development and how it has affected industrial exports to the EAC.

1.2 Statement of the Problem

In developing economies, agriculture to manufacturing transition is widely regarded as the way to greater productivity as well as higher living standards. Almost two decades into the twenty-first century, industrial exports remain critical to global economic development, and developing economies strive for stronger manufacturing growth, particularly through exports. Manufacturing value addition in Kenya has steadily declined as a percentage of GDP (gross domestic product), falling from 12 percent in 2008 to 9.2 percent in 2016 to 8.4 percent in 2021. Kenya's goal for the economic pillar of the Vision 2030 blueprint is to develop a strong, diverse, and competitive manufacturing sector by 2030 in order to transform the country into a middle-income economy. Kenya's big four programs have emphasized the manufacturing sector, and thus manufacturing exports, as a critical engine of economic growth and development. Its overall goal is to increase its GDP contribution by at least 15% by 2022. Many of the studies examined in this study addressed the expansion of manufacturing exports, though they primarily focused on wealthy and newly industrialized countries such as Brazil and Singapore. However, research on African countries has been limited, Dinh, Palmade, and Chandra (2012). As a result, research findings on how inflation, human capital development, and infrastructure development affect manufacturing exports cannot be generalized to the EAC region as a whole. As a result, little is known about the impact of inflation, human capital development, and infrastructure development on industrial exports in the EAC region. This was the rationale behind the study, which looked into the effects of inflation, human capital development, and infrastructure development on Kenya's industrial exports to the EAC region.

1.3 Objectives of the Study

To find out the effects of Infrastructure Development on Kenya's manufacturing exports to EAC region from 2007-2021.

Research Hypothesis

i. ***H_{01}:*** There is no statistically significant relationship between infrastructural development and Kenya's manufacturing exports to EAC region.

1.4 Significance of the Study

Kenya takes part in economic integration programs aimed at increasing market access. A larger market can increase the number of products that can be exported, as well as the number of businesses and jobs that can be created. Economic integration reduces trade friction and provides a huge chance to encourage economic growth, as it did for the Newly Industrialized Countries (NICs) through the expansion of exports, particularly manufactured exports. As a result, this study empirically determined how chosen macroeconomic aggregates affect manufacturing export, which is crucial for policymakers in planning and executing relevant policies to benefit Kenya (Kamukunji, 2017). Due to low-value agricultural exports, Kenya's GDP has not reached the required level. This could be enhanced if manufacturing exports to the East African Community (EAC), a crucial regional trade bloc for reaching Vision 2030. Manufacturing exports diversify the economy and boost capital and labor productivity, as well as attracting FDIs. Because Kenya's manufacturing sector is important to the trade bloc, and member nations' closeness to Kenya facilitates market access, the EAC was chosen for this study. Furthermore, it harmonizes policy in common-interest sectors (De Melo & Tsikata, 2015).

1.5 Theoretical Framework

The gravity model has been used to explain origin-destination (Ij) flows such as international or regional trade, transportation flows, population movement, commodity flows, and information flows. The success of this model, according to (Sen, 2010) in their monograph, is due to the simplicity of its mathematical structure and the intuitive nature of its underlying assumptions.

The gravity model is based on Newton's gravitational theory and uses the concept of gravitational pull to explain the volume of global trade, financial movements, and migration. According to Newton's theory, the force of attraction between two independent entities I and j is proportional to their respective masses and inversely proportional to the square of their distance, as indicated in equation 1.1.

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$$F_{ij} = \frac{GM_iM_j}{D_{ij}^2} \quad (1.1)$$

Where F_{ij}=gravitational force between j and i; M_iM_j=masses; D_{ij}=Distance between i and j; G=gravitational constant.

The gravitational force in Newton's law is replaced by trade flows or exports from country I to country j in the gravity model of international trade, while GDP is used as a proxy for a country's mass, and distance is often measured using 'great circle' calculations in accordance with equation 1.1. The gravity model of international trade between countries is represented by equation 1.2

$$X_{ij} = \frac{KY_i^{\alpha}Y_j^{\beta}}{T_{ij}{}^{\theta}} \quad (1.2)$$

Where X_{ij}=Exports (in value) between country i and j; K=gravitational constant; Y_{ij}=economic size (GDP or Population) for country i and j; T_{ij}=trade costs between country i and j. If α=β=1 and θ=2, we get the Newton's law.

The above equation can be converted into a Log-linear form

$$LnX_{ij} = K + \alpha LnY_i + \beta LnY_j - \theta LnT_{ij} \quad (1.3)$$

The amount of exports between pairs of countries, Xij, is a function of their incomes (GDPs), population, geographical distance, and a set of dummies, according to the generalized gravity model of commerce. The following is the generic gravity model:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} N_i^{\beta_3} N_i^{\beta_4} D_{ij}^{\beta_5} A_{ij}^{\beta_6} DU_{ij}^{\beta_7} \quad (1.4)$$

Where Y_i (Y_j) represents the GDP of the exporter (importer), N_i (N_j) are the populations of the exporter (importer), D_{ij} measures the distance between the two countries' capitals and A_{ij} represents other factors that could aid or impede trade between countries, $DU_{ij}$is a vector of dummies.

In Log-linear form

$$LnX_{ij} = \beta_0 + \beta_1 lnY_i + \beta_2 lnY_j + \beta_3 lnN_i + \beta_4 lnN_j - \beta_5 lnD_{ij} + \beta_6 lnA_{ij} + \beta_7 lnDU_{ij} \quad (1.5)$$

1.6 Scope of the Study

The research emphasizes on the macroeconomic factors that influence manufacturing exports between Kenya and the EAC countries over a 15-year period, from 2007 to 2021. The fifteen years were sufficient to accommodate the majority of structural changes that have a substantial impact on the industrial industry. Kenya witnessed post-election violence in 2007, which had a notable influence on manufacturing exports to EAC members, which is why 2007 was chosen as the starting year. Similarly, between 2007 and 2021, many infrastructure developments happened in Kenya, affecting Kenya industrial exports to the EAC. The introduction of flagship projects such as the Standard Gauge Railway (SGR) in 2013, Mombasa Port Modernization (2015), the Lamu Port-South Sudan-Ethiopia-Transport (LAPSSET) project (March 2012), and airport and airstrip rehabilitation (2015) have all had a significant impact on the ease of trade and goods flow to other EAC countries. The six countries of EAC are the target for study because of their proximity to each other, such that their cross-border trade can be quantified, for example the Uganda market so big that most goods from Kenya go to Uganda. Lastly, updated data for the period under study was available hence giving accurate result for the study. The EAC is located between latitudes 12^{o}N and 10^{o}S, and Longitude 24^{o}w and 43^{o}E.

2 Literature review

Using the VAR technique developed by (Tong et al., 2014), the study examined the dynamic linkages between transportation infrastructure, economic production, and exports in the United States (Toda & Yamamoto, 1995). The findings are summarized in the following paragraphs. First, despite the observation of causality from economic output to the formation of transportation infrastructure, the study's results from both Granger causality tests and generalized impulse response functions did not show a direct effect of transportation infrastructure on aggregated economic output, in contrast to some previous studies that did. Second, even after taking into account national defense, non-transport infrastructure capital (e.g., educational structures, power, sewer, and water systems, as well as residential, office, and commercial structures) had long-term positive effects on economic production and exports. Third, there is evidence that Granger contributes to total exports through both transportation and non-transport public infrastructure. Fourth, impulse response functions revealed that economic output and exports respond quickly. Finally, the data show that non-transportation infrastructure investment has a long-term positive impact on private capital formation and employment.

Hansson and Olofsdotter (2017) studied the impact of trade facilitation and other trade-related institutional constraints on manufacturing export performance in 124 developed and developing countries, with a focus on Africa, between 2006 and 2016. He developed a gravity model that took into account variables like trade facilitation, regulatory quality, and infrastructure, as well as endogeneity and remoteness controls. In terms of providing an investment and business environment conducive to private sector development, Sub-Saharan Africa (SSA) has been shown to lag behind other regions.

Schclarek (2017) investigated how infrastructure influences exports by lowering transportation costs. They predict a positive relationship between infrastructure degree and trade volume for pairs of countries where it is advantageous to invest in infrastructure by indigenizing transportation costs and infrastructure formation. They present gravity model results from European countries. Portugal-Perez and Wilson investigated the impact of four trade facilitation indicators on the export performance of 101 developing economies: physical infrastructure, ICT, border and transport efficiency, and the business and regulatory environment (Wilson et al., 2013). Unlike previous studies, which used principal component analysis to create the aggregate indicator, this one used factor analysis. As a result, it was discovered that physical infrastructure has the greatest impact on exports. Furthermore, (Hernandez & Taningco, 2010) examined behind-the-border factors influencing East Asian bilateral trade flows, such as telecommunications services, port infrastructure quality, trade time delays, and credit information depth, using a gravity model technique. They discovered that the effects of their products differed depending on the industry or product category.

According to gravity model studies, infrastructure is very important in commerce (Shepherd & Wilson, 2018). They discovered that transportation infrastructure, particularly ports and ICT, influenced Southeast Asian export flows. Poor roads and ports, underperforming customs agencies and procedures, regulatory capacity gaps, and limited access to finance and business services all had an impact on exports, according to the report (Hoekman & Nicita, 2008). When applied to trade facilitation measures and a larger sample of 75 economies, (Wilson, Mann, & Otsuki, 2018) discovered that port efficiency and proxies for infrastructure quality in the services sector, such as internet use, speed, and cost, had a significant impact on export flows.

(Wilson et al., 2018) discovered that increasing port and airport efficiency could benefit intra-APEC exports. The study used a gravity model to examine the impact of infrastructure on trade volume via its impact on transportation costs, and it discovered that infrastructure had a strong and positive relationship with trade volume. As a result, transportation cost disparities between economies may reveal inequalities in their ability to compete in global markets. Furthermore, disparities in transportation costs and, as a result, competitiveness may be explained by differences in infrastructure volume and quality. Improved transportation and infrastructure improves access to international markets and increases trade.

According to Djankov, Freund, and Pham (2010), infrastructure has a direct impact on transportation costs because it influences the mode of transportation used and the time it takes for commodities to arrive. They calculated the impact of delays on commerce using data on export and import times, discovering that each extra day spent moving products from the warehouse to the ship reduced trade by at least 1%, equivalent to a 70-kilometer increase in distance between an economy and its trading partner. Trade expenses were equivalent to a 170 percent ad-valorem tax in industrial economies (Anderson & Van Wincoop, 2011). They calculated that transportation costs accounted for 21% of total trade in developed countries, with border-related obstacles accounting for 44% and distribution costs accounting for 55%. For perishable or other time-sensitive items, time cost was especially important. (Hummels & Schaur, 2012) discovered that the time cost of one day in transit for US imports was equivalent to a 0.8 percent ad-valorem tariff rate, implying a 16.0 percent tariff rate on a 20-day trans-Pacific shipment on average. Infrastructure improvements, such as those that reduce transit times, border crossing procedures, or port delays, have an impact on an economy's proclivity to export.

Few studies have been conducted on the impact of ICT on trade flows, such as (Sekkat, 2012), which discovered that the high cost of a phone call had a significant negative impact on bilateral trade flows. Furthermore, using principal components to construct two indicators on infrastructure and institutional quality, researchers discovered that institutional quality, along with transportation and communications infrastructure, was a significant determinant of an economy's export levels as well as prospective exports. The findings support the theory that institutional quality, as well as access to communication and transportation facilities, influence export success. Furthermore, (Sekkat, 2012) discovered a link between poor institutional quality and low-quality industrial exports.

Tingting et al. (2014) used the VAR approach developed by Toda and Yamamoto to investigate the dynamic links between transportation infrastructure, economic production, and exports in the United States (1995). The following is a summary of the findings: First, despite the observation of causality from economic output to transportation infrastructure formation, the study's results from both Granger causality tests and generalized impulse response functions did not indicate a direct effect of transportation infrastructure on aggregated economic output, in contrast to some previous studies that supported a direct economic impact of transportation infrastructure.

2.2 Theoretical literature review

The study was guided by the following Theory;

Neoclassical Theory of investment

According to Cockcroft and Riddell's (2020) neoclassical theory of investment, the inflow of investment into a country is influenced by factors such as macroeconomic policies and taxation. According to the hypothesis, FDI inflows boost capital growth in an economy both directly and indirectly through technology transfers, R&D, the introduction of new types of human capital, industry growth, and infrastructure development. Multinational Enterprises will be drawn to countries that have appropriate policies in place, such as tax breaks, quick in getting licenses and launching businesses, and improved infrastructure, resulting in increased investment and employment in the host country (George, 2019). When a country's employment rate rises, the host country's income per capita rises, implying that more people will seek better living conditions through better housing and other important social amenities such as improved education, recreation, and health centers (Francois, 2017) These requirements lead to enhanced infrastructure development and industrialization in the long run (Baumgarten, 2018).

Taking Kenya as an example, after the announcement in 2013 of a 20% corporate tax deduction for investors who would invest in manufacturing, (GoK, 2019), foreign investors in the manufacturing sector were drawn into the country in an effort in getting advantage of the tax incentives and promising government policy, which resulted in a boom in infrastructural development. Cytonn Investment (2013) Real Estate Report for the third quarter of 2013, construction and real estate had the highest growth in diverse sectors of the economy at 14.1%, followed by agriculture at 7.1% and financial services at 10.1%. Furthermore, as these companies expand their operations into the host country, they bring new ways of doing business with them, such as Stanlib's income real estate investment in Kenya, which local companies like NSSF are considering replicating after its success. (Razak 2019). Kenya has an open and active interaction with its external foreign investors, and the study highlighted the importance of infrastructure development, human capital development, and inflation in determining manufacturing export rates in Kenya. As a result, this concept served as the foundation for this research.

2.3 Summary of the research gaps

The literature reviewed reveals that very few studies have attempted to investigate the relationship between manufactured exports and human capital development. Despite a number of panel and cross-section studies, the majority of EAC countries were left out. In order to close the gap, researchers investigated the impact of human development on Kenya's manufactured exports to the EAC region.

Various methodologies have been used to estimate the effect of infrastructure development on manufactured exports (see, for example, Tinting 2014; Toda and Yamamoto; that used the VAR model, Tomasz 2007; Portugal-Perez, 2012; Wilson et al., 2005); Wilmsmeier & Martinez-Zarzoso, 2010); and (Francois & Manchin, 2017) that used panel data. This study sheds more light than previous research, which yielded inconclusive results, by applying the gravity equation and panel data analysis to the influence of inflation, human capital development, and infrastructure development on Kenya's manufacturing exports to the EAC area.

3.0 Research Methodology

3.1 Data collection methods

The study used secondary data. Annual time series data Keny as manufacturing exports to east Africa was obtained from Kenya Association of Manufactures (KAM) infrastructure development and inflation were obtained from World Bank statistics, Central Bank of Kenya, Kenya Revenue Authority (KRA), Ministry of Finance data on National Budgets, and Kenya National Bureau of Statistics (KNBS) using triangulation method for the period 2007-2021.

3.2 Model specification

The empirical model employed was very similar to the one used by (Gilbert, Scollay, & Bora, 2001). The goal of the model, among other things, was to see if joining the Regional Trade Agreement (RTA) would result in more trade creation (this was carried out using dummy variables to capture participation in RTAs). The study comprised a sample of six nations that are Kenya's commercial partners (including Kenya). The empirical model utilized in this study was stated as follows by amending model (1.5) to include the variables of inflation (INF), human capital development (HCD), and infrastructure development (ID) and following Gilbert et al. (2015):

$$LnMXP_{ijt} = \alpha_{ijt} + \beta_{1_t} LnFDI_{ijt} + \beta_2 LnHCD_{ijt} + \beta_3 LnID_{ijt} + \beta_4 LnD_{ijt} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where: Ln denotes in natural logs. α_{ij}Is a constant. INF_{ij}, HCD_{ij} and ID_{ij} are the variables of the study as per the objectives, D_{ij} is the distance from country i (exporting country-kenya) to j (importing EAC member country) at time *t*.

The expected signs of coefficient of $D_{ijt}INF_{ijt}$and is negative while,$HCD_{ijt}ID_{ijt}$ are all positive. The coefficients of variables in logarithmic form are interpreted as elasticities, that is, proportionate change inMXP_{ijt} due to a unit change in these variables.

The distance between two nations (in kilometers between Kenya's capital city and that of a trading partner) was an essential element in shaping trade patterns and was used as a proxy for transaction costs. A country's trade is substantial if the benefits from trade outweigh the expenses of achieving those benefits. The more the transaction costs, the greater the distance. Trade flows and distance were expected to have a negative relationship. Transaction costs may be such that trade does not increase beyond a certain distance.

In regression analysis, a dummy variable is one that has the values 0 or 1 to indicate the presence or absence of a categorical effect that could influence the outcome. When the dummy is set to 1, its coefficient serves to change the variables that are included in the regression model in the same way that quantitative variables are. The first dummy variable is Neighboring Countries (DVNC), which is one if the country is a neighbor of Kenya and zero otherwise, and the second dummy variable is Common Colony (DVCC), which is one if both countries were colonized by the same colonizer and zero otherwise. The coefficient is assumed to be positive.

3.3 Measurement of variables

Manufacturing Exports in Kenya (MXP) -Manufacturing is the added-value production of goods for use or sale using labor, machines, tools, chemicals, and biological processing. This data came from statistical abstracts published by Kenya's National Bureau of Statistics (KNBS). It is denominated in US dollars.

Human Capital Development (HCD) is a measure of a country's living standards in terms of health, education, and life expectancy. This information was obtained from the website of the United Nations Development Program. It is calculated as an index. It was standardized for logarithms by multiplying by a factor of one hundred.

The quantity and quality of roads, streets, and highways, rail lines, airports and airways, ports and harbors, waterways, and other transit systems that allow goods to move and people to access internal and global markets is referred to as infrastructure development (ID). A higher rating indicates better infrastructure. Increased trade and, as a result, increased Kenyan exports should result from improved infrastructure. This information was obtained in the form of a percentage index from the African Development Bank's online database.

Distance (DIS): The geographical distance in kilometers (km) between Kenya's economic centers (capital cities) and its trading partners as the bird flies. World Bank Statistics, a distance calculator website, was used to obtain distance information.

3.4 Research design

A research design is a collection of methodologies and procedures for determining and evaluating variables as specified in a research challenge (Burns and Groove, 2016). The design of a study specifies the type of study, research problem, data collection techniques, and statistical analysis. It's a method for determining the answers to research questions (Mugenda, 2013). A correlation panel research design was used in this study. Researchers utilize this research design when they sample a group, or panel, of individuals and then test some variables of interest from this sample at multiple points in time. It gives empirical evidence that two or more variables are connected, as well as the direction of the relationship, allowing for a more in-depth analysis of the data (Gujarati, 2017).

3.5 Random Effects vs. Fixed Effects Estimation

Both the RE and FE estimators can consistently estimate the random effects model. We prefer the RE estimator if we are confident that the individual-specific effect is truly unrelated (RE1). A (Durbin-Wu-) Hausmann test is commonly used to test this. The Hausmann test, on the other hand, is only valid in the presence of homoscedasticity and cannot account for time-dependent effects. The unrelatedness assumption (*RE1*) is better tested by running an auxiliary regression (Wooldridge 2010, p. 332, eq. 10.88, Mundlak, 1978):

$$y_{it} = \alpha + x_{it}'\beta + z_i'\gamma + \bar{x}_i'\lambda + \delta_t + u_{it} \quad (3.23)$$

Where $\bar{x}_i = 1/T\sum_t x_{it}$are the time averages of all time-varying regressors? Include time fixed $\delta_t$if they are included in the RE and FE estimation. A joint Wald-test on $H_0{:}\,\lambda = 0$tests *RE1*. Use cluster–robust standard errors to allow for heteroscedasticity and serial correlation.

Note: RE1 is a very strong assumption, and the FE estimator is almost always much more convincing than the RE estimator. Accepting RE1 despite not rejecting it is not the same as accepting it. The desire to understand the effect of time-invariant variables is not a sufficient reason to employ the RE estimator (Baltagi, 2008).

$$Y_{it} = \beta X_{it} + \varepsilon_{it} \quad (3.24)$$

Where $i = 1,2,\cdots,N$the number of observations selected firms is Y_{it} was either return on asset or assets turnover. $t = 2005, 2006, \cdots, 2013$ Years, X_{it} were the independent variables. This is stated as;

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_7 \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_7 \end{bmatrix} \beta + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_7 \end{bmatrix} \quad (3.25)$$

The data generation process is described by linearity, independence, strict exogeneity (mean independence) and error variance.

3.6 Hausman Test

Hausman and Taylor (1981) proposed the Hausman Taylor Method, which is superior to both the FEM and the REM in terms of estimating time invariant variables and addressing the problem of endogeneity (HTM). The unobserved individual heterogeneity is the source of potential endogeneity bias in gravity model estimations (Rault et al., 2009). HTM uses variables specified in a regression equation as instruments to solve the endogeneity problem. This removes the correlation between the explanatory variables and the unobserved individual effects, reducing the REM's utility in the gravity model context (Keith, 2006). Another advantage of HTM is that it is frequently difficult to find variables not specified in an equation that can serve as valid instruments for endogenous regressors. The Haussmann Taylor method was used to choose between fixed and random effect models.

In a regression model, the Hausman test (also known as the Hausman specification test) detects endogenous regressors (predictor variables). The values of endogenous variables are determined by other variables in the system. The Hausman test can assist in deciding whether to use a fixed effects model or a random effects model. The null hypothesis states that the preferred model has random effects, while the alternate hypothesis states that the model has fixed effects. The tests essentially look to see if there is a relationship between the unique errors and the regressors in the model. The Hausman test estimates the following equation under the null hypothesis.;

$$H = (\rho^{1} - \rho^{0})'\left(\mathrm{Var}(\rho^{0}) - \mathrm{Var}(\rho^{1})\right)^{\dagger}(\rho^{1} - \rho^{0}) \quad \ldots\ldots\ldots\ldots\ldots (3.26)$$

4.0 Results and discussion

Descriptive Statistics and Normality

The descriptive nature of the data was determined in order to detect outliers. Various statistical measures, such as mean, standard deviation, minima and maxima values, were used to describe the data.

According to the descriptive statistics results in Table 1, Kenya's manufactured exports had a logged mean of Ksh. 15.608 billion, a logged minimum of Ksh.12.151 billion, and a logged maximum of Ksh.19.717 billion, with a logged standard deviation of Ksh.2.099 billion.

Table 1: Descriptive Statistics Results

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Log MXP	55	15.60808	2.098543	12.15074	19.71667
Log IDI	55	6.628867	.5138961	5.616771	7.25347
Log DIS	44	6.474741	0.2227396	0.222739	6.755769

Source: Stata computation 2021

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The logged mean for the Infrastructure Development proxy was 6.629. (index). It has a logged minimum (index) of 5.617 and a maximum of 7.253. (index). It had a standard deviation of 0.5139. (index). The larger deviation from the mean indicates that infrastructural development varies widely across east African countries. The reported distance was 0.222739 kilometers with a maximum of 6.755769 kilometers, indicating the city farthest away from Nairobi. This is the distance between Nairobi and Kigali, while the shortest distance between Nairobi and Nairobi was 0.222739. The standard deviation was less than the mean for the majority of the variables, indicating that there were no outliers and that the data had a normal distribution, according to the summary statistics.

4.2 Correlation Matrix

Pairwise correlation analysis was performed to determine the nature and direction of association between variables in this study, and the results are shown in table 2.

Table 2 Correlation matrix Results

	MXP	ID	DIS
Log MXP	1.0000		
Log IDI	0.4865* (0.0002)	1.0000	
Log DIS	-0.0962* (0.0344)	0.5872* (0.0000)	1.0000

Source Stata 2021

***Note. Values in parentheses ( ) indicate p-values and * shows significance at 5% level of significance i.e. p-value < 0.05* (Author's Survey Data, 2021)**

According to the correlation results in Table 2, the infrastructure development index and manufacturing exports had a positive value of 0.4865* and Kenya's manufactured exports to East Africa are negatively correlated with distance. The variables' p values are in brackets and are all p 0.05. Furthermore, the correlation between independent variables was significant, but none were greater than 0.8, indicating that the independent variables are not highly correlated, thereby ruling out multicollinearity.

4.3 Panel Unit Root Tests

After determining the nature of the data generation processes, the unit root among the time variant variables had to be tested. Manufactured Exports and Infrastructure Development are the Table 3 summarizes the findings

Table 3: Im- Pesaran unit root test of unit Root at Levels

Variable	Z(t)	Prob> |t|	Critical Values 1%	5%	10%	Conclusion
lMXP	- 2.3353	0.0835	-2.540	-2.210	-2.060	Unit root
Lidi	-1.1819	0.6934	-2.540	-2.210	-2.060	Unit Root

Source: (Author, 2021)

Table 4 Im- Pesaran unit root test of unit Root at first difference

Variable	Z(t)	Prob> |t|	Critical Values 1%	5%	10%	Conclusion
lMXP	-3.7989	0.0016	-2.660	-2.280	-2.100	Stationary
Lidi	-2.9016	0.0084	-2.660	-2.280	-2.100	Stationary

According to the Im – Pesaran panel unit test results in table 3 above, all variables' data contained unit. Manufacturing Export had a unit root at levels (p-value 0.0835 > 0.0500) and Infrastructure Development Index had a unit root at levels (p-value 0.6934 > 0.0500). This meant that the null hypothesis of unit root data was accepted and the alternative hypothesis of stationarity was rejected. This demonstrated that the variables contained unit roots at various levels. However, after the first difference all of the variables had (p-values 0.0500) according to the unit root test results in table 4 above, indicating that the series were stationary at first difference. As a result of rejecting the null hypothesis of a series with a unit root in favor of the alternative hypothesis of a series without a unit root, it was determined that the series were stationary at first difference.

4.4 Hausman Test

The Hausman test is a statistical hypothesis test that compares an estimator's consistency to that of another, less efficient estimator that is known to be consistent (Hausman et al,2018). The Hausman test statistic was used to choose the best fixed effect and random effect panel regression models. The Hausman test's null hypothesis states that H0: the difference in coefficients is not systematic (random effect is appropriate). According to the Huasman test results in table 4.5 below, the Probability chi-square value was less than 0.05 (Prob>chi2 = 0.0261). This means that the random effect model is useless. As a result, the null hypothesis was rejected, which states that the difference in coefficients is not systematic (random effect is appropriate). Table 5 displays the Hausman Test results.

Table .5: Hausman Test Results

Coefficients				
	(b) Fe	Re (B)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Log of infrastructural development	4.392823	4.11712	0.275703	0.0148
Log of Distance	-7.5662	-7.31092	-0.25528	.

Source (STATA, 2021)

*b = consistent under Ho and Ha; obtained from regression; B = inconsistent under Ha, efficient under Ho; obtained from regression; Test: Ho: difference in coefficients not systematic; chi2 (6) = (b-B)'[(V_b-V_B) ^ (-1)] (b-B) = 12.83; Prob>chi2 = 0.0261; (V_b-V_B is not positive definite) From the Hausman test result above it is evident that the appropriate regression panel model for this study is the fixed effect model which is as shown in table 4.6 below

4.5 Regression Analysis and Test of Hypotheses Based on Fixed Effects Model

After determining the model that could be estimated, GLS regression was estimated. According to equation, both random and fixed effect models were estimated, and the Hausman test was used to determine the best model, which was best on the gravity model (3.1). The fixed effect regression model was chosen based on the Hausman test results.

Vol. 6, No.10; 2022

ISSN: 2456-7760

Table .6: Fixed Effect Regression

Fixed Effect (Within) Regression		Number of Observations =44		
Group Variable	Year	Number of Groups		=11
		Observation per group		=4
		Minimum		4
R^2Within	0.8681	Average		4.0
R^2Between	0.3802	Maximum		4.0
R^2Overall	0.7631	F(4,29)		47.67
Corr(u,i, Xb)	0.0686	Prob. > F		0.0000
Log of Manufactured Exports	Coefficient	Std. Error	T	P>|t|
Log of Infrastructural Development	4.392823	0.33796	3.70162	0.0000
Log of Distance	-0.75662	0.852258	-8.880	0.0000
Constant	36.3811	6.060841	6.00	0.0000
Sigma_u	0.647551			
Sigma_e	0.809496			
Rho	0.3902096			
F-Test that all u_i = 0: F(10, 29)	1.41	Prob. > F		0.0032

Source: *Authors Survey Data, 2021*

Table 6 displays the results of fixed effects. The F – statistic was found to be significant (p–value 0.0032 0.05), indicating that the variables fit the model very well (the model was well-identified). The overall R Square was 0.7631, indicating that the independent variables accounted for 76.31 percent of the variation in Kenya's manufacturing exports to the East African Community (dependent variable). This is high because fixed and random effects models do not compute R square value from the dependent variable's mean. In this case, the primary emphasis is on model specification and the overall significance of the coefficients. This has been accomplished in the current study because the overall fit is F stat 0.0032 0.05.

The variance due to observed covariate (sigma u) is 0.6476, which is less than the variance due to time invariant covariates (sigma e, 0.6476). (0.8095). the fraction of variance due to u i is 0.3902, which is between sigma u and sigma e, indicating that the model is not distorted. Following this, the Hausman test was used to select between the coefficients of fixed and random effects. Table 6 displays the results, which show that their fixed effect was the most interpretable model (p–value 0.000 0.05). The distinction between random and fixed effect models is based on the assumptions of the residual distribution of the regression estimates. In such cases, the fixed effect model is usually preferred for interpretation because it reduces the number of assumptions and adheres to well-established normal probability distributions (Baltagi,2018; Hsiao, 2020). Appendix I contains the results of the random effect.

The next step was to test the hypotheses, provide economic implications, and compare them to prior results from existing theoretical, empirical, and scientific studies after establishing the model specification test, diagnostics tests, and the coefficients to be estimated within random and fixed effects. This is done in the order listed below, in accordance with the objectives and hypotheses of the study.

4.6 Discussion of the results

4.6.1 Infrastructure Development (ID) and Manufactured Exports

The goal of the study was to assess the impact of infrastructure development on Kenya's manufacturing exports to the EAC. The hypothesis of the study stated that infrastructure development has no effect on Kenya's manufacturing exports to the EAC. Infrastructure development, according to the regression results, had a positive and significant impact on Kenya's manufactured exports to EAC countries (p-value =0.0000 0.05). Furthermore, the beta coefficient for infrastructure development is 4.393, implying that every 1% increase in infrastructure development increases Kenya's manufacturing exports by approximately 4.393 units.

Exports can be a driver of economic growth, according to the export-led growth hypothesis, by increasing employment and income in the exporting country, improving resource allocation efficiency, and achieving economies of scale (Gylfason, 2020). Increased trade through manufacturing exports, on the other hand, may stimulate the need for and development of transportation infrastructure. Greetings, Chandra, Palmade, and Dinh (2018) In contrast, a country's infrastructure development can have an impact on manufactured export trade. Domestic economic conditions that promote export growth, such as high product demand and/or agglomeration economies, can be beneficial. Lottery (2018). Previous research has found a link between transportation infrastructure and trade, either through lower transportation costs or better infrastructure quality. Kireyev (2017)

However, (Kamukunji, 2017) and (Francois & Manchin, 2007) argue that the relationship between infrastructure development and economic growth and, in general, poverty reduction is neither definite nor automatic. Infrastructure, on the other hand, provides links to the global market that are critical for export competitiveness and manufacturing, both of which are regarded as critical drivers of economic performance. More broadly, empirical evidence indicates that infrastructure quality is a significant predictor of trade performance (Francois and Manchin, 2007; Limao and Venables, 2001; Nords and Piermartini, 2004, Portugal-Perez and Wilson, 2010, Brandi, 2013). According to Jaen and Rodrigue (2010), efficient transportation and logistics services have emerged as strategic components of trade facilitation: "Trade facilitation means providing a more predictable, secure, and efficient international trading environment through the simplification, standardization, and harmonization of administrative formalities" (Sourdin & Pomfret, 2012). According to, the effects on trade are complex due to a lack of standardization (Nugroho, 2014). The benefits of increased predictability from trade facilitation can be perceived as lower trade costs and higher domestic gains, according to (Helble, Shepherd, & Wilson, 2009).

The findings support previous findings that improvements in economic infrastructure result in significant gains in manufactured exports, with hard infrastructure outperforming soft infrastructure. As a result, infrastructure such as power, rail, roads, and airports are critical to increasing EAC manufacturing exports. Transparency and accountability, internet access, and phone service all improve efficiency and the business environment, which aids in manufactured goods exportation. It is concluded that in order to promote manufactured product exports, the EAC region must mobilize resources for economic infrastructure investment.

According to the study's findings, infrastructure development had a significant (p-value 0.00000.05) positive effect on manufactured exports ((3 = 4.392). This shows a very strong effect, which could imply that Kenya is attempting to repair infrastructure. Kenya's government launched a multibillion-dollar infrastructure project in 2015, including a US$653 million expansion of its main airport to boost trade and cement its status as a regional commercial hub, as well as the US$13.8 billion construction of a new railway in 2014, which will eventually connect its Indian Ocean port of Mombasa with Uganda, Tanzania, Rwanda, and Southern Sudan. According to Hass real estate investment reports, these projects drew a large number of foreign direct investors into the country who wanted to invest in infrastructure development as well as the industrial sector (2019).

4.7 Diagnostic Tests

Multicollinearity, Heteroscedasticity, and Serial Correlation were the diagnostic tests used. These tests are typically performed following a regression analysis.

ISSN: 2456-7760

4.7.1 Multicollinearity

When there are strong correlations between two or more predictor variables, multicollinearity occurs. Another option is to use one predictor variable to predict another. The Variance Inflation Factor is used to assess multicollinearity. If the average VIF value is less than 10, there is no multicollinearity.

Table .7: Variance Inflation Factor (VIF).

Variable	VIF	1/VIF
Log of Dis	2.32	
Log of HDI	1.55	0.643808
Log INF	1.08	0.923434
Log of IDI	1.96	0.509384
Mean VIF	2.95	

Source: Authors Survey Data, 2021

The results in table 7 above indicated mean VIF of 2.95 < 10 showing that there was no Multicollinearity.

4.7.2 Heteroscedasticity Test

The Breusch-Pagan-Godfrey test is used to test for heteroscedasticity in a linear regression model with normally distributed error terms. It determines whether the independent variable values affect the variance of the errors in a regression. The null hypothesis states that there is no heteroscedasticity. Table 4.7 of Appendix III shows that the probability of F-statistic = 0.0006 was less than the 0.05 level of significance. The null hypothesis was thus rejected, and homoscedasticity was discovered.

5 Summary, conclusion and recommendation

The results revealed a significant positive relationship Coefficient value (4.392823) and (P=0.0000), resulting in the null hypothesis being rejected. In conclusion Infrastructure Development had a positive coefficient, indicating that it is important for Kenya's manufactured export. Lastly Distance, on the other hand, had a negative effect, leading to the conclusion that increasing distance by one unit resulted in a decrease in manufactured exports. Distance hinders international trade by raising transportation costs, causing delays, and causing other logistical issues.

Kenya's current level of infrastructure development, according to the study's findings, has a greater impact on the country's manufacturing exports. The current government's emphasis on infrastructure development is a step in the right direction because it will not only facilitate Kenya's external trade, but will also increase manufacturing export supply capacity, lower transportation and other transaction costs, and, in the long run, increase the relative competitiveness of Kenyan-made goods on the regional trade bloc and the global market. Again, incentivizing individuals to trade and invest in human and physical capital has the long-term effect of increasing consumer and investor confidence in the economy. Even as Kenyan institutions improve in terms of effectiveness, efficiency, and trade friendliness, trade barriers persist, and certain institutions require development and change. For example, large levels of corruption prevail due to a widespread lack of rule of law, and the entire investment regime is inefficient and opaque. As a result, it is strongly advised that policies and legislative reforms aimed at increasing openness, accountability, and integrity in our institutions be aggressively pursued in order to boost investor confidence in the country and thus attract more foreign direct investment.

According to the study's findings, distance has a negative impact on trade volume. Increased economic integration among economic blocs, according to the findings, is required to reduce transportation costs. A common language is expected to improve communication and documentation, leading to increased international trade; lower the electricity tariff for heavy steel industries by at least 50% to make local products competitive in regional markets; promote regional trade agreements to improve market access and induce increased demand for products; and strengthen regional integration by improving border logistics and regional transportation networks.

6 Suggestions for Further Research

The identification and deep knowledge of factors that have a major impact on Kenya's export sector's productive capacity is required for implementation of supply-side strategies advocated in this study. Future research could look at studying Kenya's manufacturing exports using disaggregated data from individual industries inside the gravity model.

The current analysis is not able to determine which nations Kenya has untapped manufacturing export potential and which countries it has reached its limit with. Future studies should take this into account in order to help Kenya select nations with high potential for developing its manufacturing exports so that it may optimize its profits.

Based on the results of the current study, another study could be conducted to assess the impact of infrastructure on Kenya's manufactured exports and other trade flows to the EAC and other Kenyan trading partners; as a result, a study to fill this gap should be conducted.

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