The Role of Logistics Performance in Prosperity in Sub-Saharan Africa: Linking Global Value Chains (GVC) and Global Competitiveness (GCI) to Gross Domestic Product (GDP)

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Abstract
 Many countries in sub-Saharan Africa (SSA) are not fully benefiting from participation in the global value chain (GVC) due to a lack of competitive advantage and logistics inefficiencies. Yet, both competitive advantage and efficient logistics are critical for countries aiming to upgrade in GVCs and benefit from international trade in this era of liberalisation. This study examines the relationship between global value chain participation and competitiveness in SSA countries, focusing on how this relationship influences economic prosperity. The study also explores the role of logistics performance in the GVC context, examining whether it acts as a moderator or a mediator using a hierarchical regression model. The study covers the years 2007, 2010, 2012, 2014, 2016, and 2018 for 25 SSA countries with available data on logistics performance and competitiveness.

 The results confirm the significant influence of logistics efficiency in the global value chain for African participants. Moreover, the study provides further insight into the differences in the mediating role of logistics performance, depending on whether global competitiveness or global value chain participation is the primary driver of national income growth. The lack of clarity on the specificity of the mediating role of LPI in the bridge between GDP and GCI should be taken seriously. This highlights the challenge in the policy space of determining what to focus on in the ever-growing, complex global market. There is a need for greater clarity in identifying the precise role of logistics performance in the connection between GDP and GVC participation.

Keywords: *Global competitiveness; Global value chain; Interconnectedness; Logistics efficiency; Product fragmentation; Sub-Saharan Africa; Trade liberalisation.*

1.0 INTRODUCTION

 Logistics performance has long been recognised as a key driver of trade and an essential factor in global value chain (GVC) participation. It serves as a benchmark to help countries identify trade logistics challenges and opportunities, with scores ranging from 1 (low) to 5 (high) (Arvis et al., 2018). Efficient logistics enable the smooth movement of goods from suppliers to producers and from producers to consumers, making them vital for successful GVC integration (Hausman et al., 2013; Wong & Tang, 2018).

 The complexity of modern production networks depends heavily on strong logistics systems. Effective logistics underpin GVCs by supporting product flows and shaping supply chain coherence (Memedovic et al., 2008; Hesse & Rodrigue, 2004). However, many African countries remain stuck in upstream activities due to limited technology and poor logistics performance, particularly in customs procedures, infrastructure, shipment costs, logistics services, tracking systems, and delivery reliability (Takele, 2019; Kuteyi & Winkler, 2022).

Despite these challenges, some African countries have recently improved their logistics performance, advancing into downstream activities within GVCs (Emerging Markets Logistics Index 2022, 2022). Yet, the continent as a whole still faces significant gaps in logistics efficiency, which limits its ability to add value to raw materials and expand its participation in GVCs (Mensah & Fofana, 2018).

Logistics performance is not only about facilitating trade. It also plays a direct role in driving economic growth through enhanced GVC participation (Gani, 2017; Sergi et al., 2021). Countries with stronger logistics systems are better positioned to capture greater value in global markets, diversify their exports, and promote sustainable economic growth (Allard et al., 2016; Khadim et al., 2021).

This study investigates the role of logistics performance in linking GVC participation and competitiveness to economic prosperity in Sub-Saharan Africa (SSA). Specifically, it examines whether logistics performance mediates or moderates the relationship between GVC participation, global competitiveness, and GDP growth. Drawing on the product fragmentation theory (Arndt & Kierzkowski, 2001; Jones et al., 2005) and the new trade theory (Helpman et al., 2003; Melitz, 2003), the study explores how logistics capabilities can help African countries strengthen their GVC positions and improve economic outcomes.

2.0 MATERIALS AND METHODS

Logistics performance has been widely recognised as a critical factor in international trade and economic development. Several studies confirm that efficient logistics systems enhance trade by reducing costs, improving supply chain reliability, and facilitating the smooth movement of goods. Arvis et al. (2018) describe the Logistics Performance Index (LPI) as a tool for assessing countries' logistics capabilities, including customs efficiency, infrastructure quality, shipment costs, logistics services, tracking, and delivery reliability. Hausman et al. (2013) and Wong and Tang (2018) further support the argument that countries with higher LPI scores tend to experience stronger trade flows and better integration into global markets. Gani (2017) also finds a significant positive relationship between logistics performance and trade, emphasising that improved logistics systems are vital for sustaining international trade growth.

Beyond trade, global value chains (GVCs) have emerged as key drivers of economic growth by enabling countries to engage in fragmented production processes across borders. Studies by Amador and Cabral (2017) and Del Prete et al. (2017) show that GVC participation enhances productivity, export diversification, and income growth, especially for developing countries. In the African context, Mensah and Fofana (2018) argue that GVC integration is essential for economic transformation, particularly for countries seeking to shift from exporting raw commodities to higher-value products. However, many African economies face challenges in upgrading their positions within GVCs due to weak logistics, inadequate infrastructure, and limited institutional support, as noted by Cattaneo et al. (2013) and Raei et al. (2019).

Recent studies focusing on Africa have explored the unique logistics constraints in the region. Kuteyi and Winkler (2022) highlight digitalisation as a promising avenue for improving logistics efficiency in Sub-Saharan Africa (SSA), although many countries continue to struggle with systemic issues such as poor transport networks, high logistics costs, and inefficiencies in customs processes. Takele (2019) similarly stresses the need for enhanced logistics coordination in African trade agreements, warning that without improved logistics services, many African countries will miss out on the benefits of regional integration efforts such as the African Continental Free Trade Area (AfCFTA). Despite these insights, much of the existing research remains fragmented, often focusing on individual logistics components rather than examining the broader impact of overall logistics performance on economic growth in Africa.

Additionally, only a limited number of studies examine the mediating or moderating role of logistics performance in the relationship between GVC participation, global competitiveness, and economic prosperity. Khadim et al. (2021) investigate the moderating role of logistics in the link between infrastructure and economic growth in developing countries, while Goel et al. (2021) analyse the effects of supply chain disruptions on economic growth during the COVID-19 pandemic. Sergi et al. (2021) compare the influence of logistics and competitiveness across

Africa, Asia, and Europe, finding notable differences among regions. However, most of these studies focus on direct effects or moderating roles, with limited attention to mediation effects. Only a few studies explicitly analyse mediation effects involving logistics performance. For example, d'Aleo (2015) and Civelek et al. (2015) demonstrate that logistics performance mediates the relationship between global competitiveness and GDP in mixed-country samples. However, these studies do not specifically focus on African economies. This leaves a clear research gap concerning the mediating role of logistics performance in linking GVC participation, global competitiveness, and GDP growth in Africa.

Given this gap, the present study seeks to address this overlooked area by examining whether logistics performance serves as a mediator between GVC participation, competitiveness, and economic prosperity in Sub-Saharan Africa. By focusing on African economies, the study contributes to a deeper understanding of how logistics capabilities can influence economic outcomes within the region's unique trade and development context.

It is based on a worldwide survey of logistics operators on the ground. Logistics have been an essential driver of trade, as it facilitates the movement of goods from supplier to producer and from producers to consumer (Wong & Tang, 2018). The complexity of production systems characterised by the setting of GVCs and networks depends on efficient logistics to support and shape the coherence of GVCs and networks (Hausman et al., 2013; Hesse & Rodrigue, 2004; Memedovic et al., 2008). It is, thus, no surprise that many African countries are low on the downstream because of the lack of the relevant technology to improve efficiency in converting raw materials into finished and semi-finished goods. In addition, there is an inadequate support (Takele, 2019) for the efficiency of the clearance process (Customs), quality of trade and transport-related infrastructure (Infrastructure), ease of arranging competitively priced shipments (International Shipments), competence and quality of logistics services (Logistics Quality), ability to track and trace consignments (Tracking and Tracing), and frequency with which shipments reach the consignee as scheduled (Timeliness). These are the dimensions of logistics performance (Arvis et al., 2018).

Nonetheless, a few African countries have been able to move into downstream production in recent times. For instance, South Africa has the highest trade logistics performance in Africa with an LP score of 3.38 points. Côte d'Ivoire and Rwanda are close followers with LPI scores of 3.08 and 2.97 points, respectively[1]. In addition, Nigeria and Benin are emerging as Africa's leaders in trade. Nigeria is ranked tenth in the world for domestic logistics and growth in intraregional trade. On the other hand, Angola, Burundi, and Niger recorded the lowest trade logistics performance (2.07, 2.05, and 2.05, respectively) on the continent for 2018[2] (*Emerging Markets Logistics Index 2022*, 2022).

From the discourse, it is important to understand the relationship between GVC and LPI because it is clear that the extent of GVC participation rests on the efficiency of logistics performance, which is a catalyst for job creation and growth of the economy (Takele, 2019). More importantly, the rewards for active and increased participation in the GVC cannot be underestimated, especially for African countries, given that it is home to large deposits of natural resources, have a strong labour force, and are one of the most open continents in the world (Mensah & Fofana, 2018). The global value chain is seen as a new avenue for economic growth, and participation must be coupled with logistics efficiency in order to reap the benefits (Mensah & Fofana, 2018). The advantages of GVC participation largely stem from exports of downstream goods and services in which the continent is lagging by large margins. For instance, as one of the most open regions in the world, West Africa's share of international trade stands at 0.7% of exports as against 0.5% of imports (Mensah & Fofana, 2018).

One can almost deduce naturally that the end game for improved logistics efficiency is not just increased levels of GVC participation, but economic growth and prosperity, which is largely measured by the Gross Domestic Product (GDP). While inferences can be made from high levels of GVC participation to imply corresponding levels of GDP, we can estimate the impact

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[1] https://www.agility.com/en/emerging-markets-logistics-index/highlights/
[2] Statista.com

from the data. Thus, while GVC is a determinant of GDP, it is mediated by LPI (i.e. there is a direct relationship between GVC and GDP, but an indirect relationship between LPI and GDP). This is the crux of the study. We investigate the mediating role of LPI on the link between GVC and GDP. The intuition is that LPI fuels GVC, which in turn fuels GDP. This analogy is in line with Sergi et al. (2021) and supported by theories in the GVC literature.

The current literature shows that the African markets portray a continent that is emerging strategically as an important trading bloc, particularly for Asia and parts of Europe, based on its vast resources, growing wealth and larger middle class accompanied by a higher purchasing power (Adewole & Struthers, 2019). The recent adoption of the African Continental Free Trade Area (AfCTA) also improves the potential of the continent, as indicated by a Sub-Saharan regional GDP growth of 3.4% in 2021 amidst the sway of the COVID-19 pandemic. But without improvement in logistics efficiency, African countries cannot benefit from this and the increasing trade liberalisation and openness, such as the EPA between West African countries and the European Union, which came into effect in 2014. One of the core enablers of development is an effective logistics sector, which is recognised almost everywhere (Kuteyi & Winkler, 2022).

Logistics performance across Sub-Saharan Africa (SSA) varies significantly. South Africa leads the continent with the highest trade logistics performance, recording a Logistics Performance Index (LPI) score of 3.38 in 2018. Côte d'Ivoire and Rwanda follow with LPI scores of 3.08 and 2.97, respectively (Arvis et al., 2018). Nigeria and Benin have also emerged as notable players, with Nigeria ranked among the top ten globally for domestic logistics and experiencing growth in intraregional trade (Emerging Markets Logistics Index 2022, 2022).

In contrast, several SSA countries continue to face serious challenges. Angola, Burundi, and Niger recorded the lowest LPI scores in Africa in 2018, with scores of 2.07, 2.05, and 2.05, respectively (Emerging Markets Logistics Index 2022, 2022). These scores reflect persistent barriers such as inefficient customs procedures, weak transport infrastructure, high shipping costs, low-quality logistics services, limited tracking systems, and unreliable deliveries (Arvis et al., 2018).

These differences in logistics performance highlight the varying capacity of SSA countries to participate in GVCs. Countries with stronger logistics systems are better positioned to diversify their exports, advance into downstream production, and capture greater value from global markets (Mensah & Fofana, 2018; Takele, 2019). This reinforces the critical role of logistics in promoting economic growth across the region (Gani, 2017; Sergi et al., 2021).

Despite the growing recognition of logistics as a driver of trade and growth, limited research explores its mediating or moderating role between GVC participation, competitiveness, and economic growth in Africa. Most existing studies either focus on advanced economies or examine only the direct effects of logistics (Khadim et al., 2021; Goel et al., 2021). This study addresses this gap by analysing whether logistics performance mediates or moderates the relationship between GVC participation, global competitiveness, and GDP in SSA. Grounded in the product fragmentation theory (Arndt & Kierzkowski, 2001; Jones et al., 2005) and new trade theory (Helpman et al., 2003; Melitz, 2003), this study offers insights into how African countries can strengthen their GVC positions through logistics enhancements to drive economic prosperity.

In addition, participants in international trade, particularly exports, need to strengthen their logistics performance in order to reap the rewards of their activities (Gani, 2017). While the poor level of participation of African and developing countries in the GVC and stunted economic growth have been attributed to poor logistics performance, among other things, there is little empirical evidence to support this claim. The trend in the literature examines the effect of logistic efficiency on either GVC or global competitive index (GCI), without extending to the impact on economic prosperity (i.e. GDP). Further, the mediating role of LPI on the nexus between GVC and GDP is largely left out. Furthermore, there is no consensus on the direction of impact of LPI on economic well-being. For example, Magazzino et al. (2021) examined the determinants of logistics performance and how it, in turn, influences economic growth and environmental sustainability. It was shown that human development, urbanisation, and trade openness are predictors of LPI, while improvements in LPI are detrimental for economic growth and

environmental soundness in the 25 topmost logistics countries. Also, the LPI and its sub-indices are shown to have heterogeneous impact on bilateral trade in different classes of goods across the European Union and Central and Eastern European (CEE) countries (Zaninović et al., 2021). While we acknowledge that it is important to assess all the aspects of LPI on the economy, we surmise that only seeing LPI as a direct determinant can undermine its impact on economic prosperity. With many CEE countries bearing features of African nations, mediation of LPI in the nexus can shed more light on directed policy decisions.

Akin to our study is Khadim et al. (2021), who find that the efficient performance of logistic infrastructure plays a moderating role in economic growth in 50 developing countries. Furthermore, overall logistics performance is used, among other factors, to examine the impact on economic growth amidst COVID-19 disturbance for 130 countries (Goel et al., 2021). They divulge varying growth impacts across countries in accordance with their growth rates. The only study on Africa alone focuses on a particular dimension of LPI without recourse to the others. Kuteyi and Winkler (2022) investigated the challenges and opportunities of digitalisation in logistics infrastructure in Sub-Saharan African countries. They surmise that adopting digital technologies to boost logistics performance will also boost economic growth. The foregoing discourse leaves a lot to be investigated as far as the subject matter is concerned. First, the studies do not divulge the portions of the findings attributable to only the African countries used (see Goel et al., 2021). Second, the moderating role of LPI is examined without its mediating role.

Third, the use of moderating is ambiguous as used in the study. It is not explicit to the reader whether the impact of LPI is to amplify or diffuse the benefits from participation in the global value chain. Fourth, the moderation (or mediation) of LPI as used in the study is not delineated and sequential to bring out its influence on GDP (see Khadim et al., 2021). Fifth, fixation on only one or a few dimensions of LPI in studying the impact on GVC, GCI, or economic growth is inadequate. This is especially true because all the dimensions are equally important in arriving at a complete picture of the logistics performance of a country. Hence, it is better to use all dimensions or the composite index of LPI. Sixth, there is an unsettled debate on the direction of the effect of logistics performance and economic growth through the global value chain. In this study, we shed more light on this debate in the context of African countries; this is crucial because much of the literature is centred on developed countries, the EU, and Asia. Further, studies on the drivers of global value chains participation in Africa are fragmented and less comprehensive to inform policy (Cattaneo et al., 2013; Raei et al., 2019).

In this study, we address these important gaps through our use of data, scope, methods, and insights. We focus only on SSA countries in order to obtain more bespoke findings to inform policy and implementation. Further, in order to be apt in our contribution to the debate on the impact of LPI on economic growth, we recognise the indirect relation between LPI and GDP. We apply hierarchical regression, consistent with the procedure outlined by Baron and Kenny (1986) and used in subsequent studies (Civelek et al., 2015; Sergi et al., 2021). All the various forms of impact can be determined using this regression technique (see also Zhao et al., 2010). The approach is essential to inform policy actions that are directed towards either direct, indirect, complementary, or competitive mediation of logistics performance.

In order to gain more insights and to expand the study as well as for the purposes of robustness, we examine the mediation role of LPI on the link between Global Competitiveness Index (GCI) and GDP. The literature supports an analogous relationship between LPI, GCI, and GDP. For instance, Sergi et al. (2021) examine the constituents GCI on the composite index of LPI Africa, Asia and the EU regions. They find that all three clusters for higher efficiency in GCI (i.e. human factor, infrastructure, and institutions) are central to the development of Africa's logistics. More literature predicts a correlation between logistics performance and global competitiveness (see Martí et al., 2014; Önsel Ekici et al., 2016, 2019).

This study is situated in the product Fragmentation Theory. The theory proposes that the logistics performance of countries affects GVC participation by countries either at the individual level or interacts to influence the ability to upgrade their GVCs participation. This is premised on the fragmentation into multiple slices of production processes and is located in different countries. This makes economic sense when there are cost savings, lower service link, and low

set-up cost (Arndt & Kierzkowski, 2001; Jones et al., 2005). This implies that economies can participate in global value chains if resources and policies capable of reducing the cost of linkage exist. A supporting theoretical basis is the New Trade Theory. It provides a way to understand the decision of firms related to the creation of and integration into GVCs, which is based on product differentiation, monopolistic competition, and firm heterogeneity (Helpman et al., 2003; Melitz, 2003). Both theories hinge on the efficiency of production and the transportation of goods and services. Thus, countries where production and logistics efficiency can be assured stand a better chance of GVC participation and hence attain economic prosperity.

Our study is beneficial in several ways. First, this study on Africa provides a new perspective on the debate about the direction LPI's impact on GVC participation and GCI and by extension, economic growth. It is an important literature for policy and investment decisions for both indigenous and international stakeholders. We have already indicated the place of Africa in global trade due to the size of exports, the current progress in GVC and growing purchasing power. Investors can use the findings from this study to inform their choice of participation in the GVC and where to be located. Second, our use of mediation of LPI proffers a broader perspective to afford directed policy actions in boosting the overall logistics performance in the region and to maximise global value chains participation.

Third, an understanding of the drivers of GVC and GCI can help foster a united force to benefit from GVC participation since Africa is already homogeneous in terms of product, lower level of income, economic size, and low levels of trade flows across borders due to trade impediments (Bouët et al., 2017; Obasaju et al., 2019). This study provides insight as to what deserves the maximum attention (GVC or GCI) in order to achieve GVC participation. Fourth, while GVC is beneficial, it does come with its adverse shocks, especially when the participating country is unable to capitalise on the gains.

Given that Africa has, since the mid-1990s, increased its trade openness and entered into several partnerships, it is vulnerable to external shocks if it is not competitive in the global market (Allard et al., 2016). Especially with a focus on improving logistics performance spurred by new technologies, this bias diminishes the comparative advantage of African countries in traditionally labour-intensive manufacturing (and other) activities, and reduces the gains from trade. Subsequently, stimulating GVC participation through logistics prowess will make it harder for low-income countries to use their labour cost advantage to offset their technological disadvantage (Rodrik, 2018). Thus, it is critical not just to spur economic growth through logistics performance, but it has to be done with the full knowledge of all the transmission paths to ensure that the cost and competitive advantages are not sacrificed. This study affords the opportunity for that deeper insight to make potent policy decisions.

Our empirical findings suggest that there is a Complementary mediating role of LPI in the nexus between GDP and GVC. On the other hand, the type of mediating role of LPI is unclear for the link between GDP and GCI. Nonetheless, we find a clear mediating presence of LPI in this relationship. The findings align with a number of studies, including d'Aleo (2015) and Civelek et al. (2015). The results have important policy and investment implications for SSA governments and trading partners alike. The remainder of the paper is as follows: Section 2 presents the materials and methods, followed by a preliminary analysis of the data in Section 3. Sections 4 and 5 cover the analysis and discussion of findings and conclusions, respectively.

3.0 METHODOLOGY

This study investigates the mediating role of logistics performance in the relationship between global value chain (GVC) participation, global competitiveness, and economic prosperity in Sub-Saharan Africa (SSA). To analyse the mediating role of logistics performance, this study applies the hierarchical regression approach developed by Baron and Kenny (1986). This method is widely used in logistics and GVC research (Civelek et al., 2015; Sergi et al., 2021; Zhao et al., 2010) and enables testing of mediation effects within a structured regression framework. The mediation analysis proceeds in three key steps:

1. The Logistics Performance Index (LPI) is regressed on GVC participation or the Global Competitiveness Index (GCI).

2. GDP is regressed on GVC participation or GCI.
3. GDP is regressed on both GVC participation or GCI and LPI simultaneously.

The direction of mediation is conceptualised in Figure 1. According to Baron and Kenny (1986), there are two types of mediation effects (direct and indirect). The proof of mediation is strongest when there is only an indirect effect, which is known as full mediation. Partial mediation is evident when there are both indirect and direct effects. In other words, there is a significant relationship on Path α, there is a significant relationship on Path β, and Paths α and β are controlled (Path γ is no longer significant, and the strongest mediation occurs if it is zero). Further, Zhao et al. (2010) identify three patterns consistent with mediation and two with non-mediation. These are:

i. Complementary mediation - Mediated effect (Paths α and β) and direct effect (Path γ) are both significant and point in the same direction.
ii. Competitive mediation - Mediated effect (Paths α and β) and direct effect (Path γ) are both significant and point in opposite directions.
iii. Indirect-only mediation - Mediated effect (Paths α and β) exists, but no direct effect.
iv. Direct-only non-mediation: Mediated effect (Path γ) exists, but no indirect effect.
v. No-effect non-mediation: Neither direct effect nor indirect effect exists.

In this study, we follow the patterns suggested by Zhao et al. (2010) to determine the role of LPI in the link between GVC/GCI and GDP.
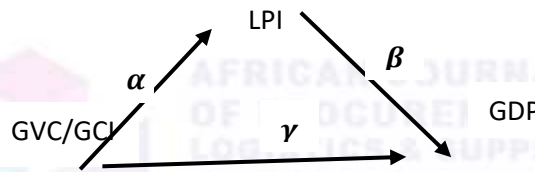

Figure 1: Mediation model based on Baron and Kenny (1986).

Following from the model in Figure 1 and with inspiration from Civelek et al. (2015), the following hypotheses are presented, which correspond to equations 1, 2, 4, and 4, respectively.

H1: Logistics Performance Index is positively influenced by Global Value Chain/Global Competiveness Index

H2: Gross Domestic Product is positively influenced by the Logistics Performance Index

H3: Gross Domestic Product is positively influenced by the Global Value Chain/Global Competiveness Index

H4: Logistics Performance Index has a mediator effect on the nexus between Global Value Chain/Global Competiveness Index and Gross Domestic Product

$$LPI = \beta_0 + \beta_1 GVC + e \qquad (1)$$
$$GDP = \beta_0 + \beta_1 LPI + e \qquad (2)$$
$$GDP = \beta_0 + \beta_1 GVC + e \qquad (3)$$
$$GDP = \beta_0 + \beta_1 GVC + \beta_2 LPI + e \qquad (4)$$

$$LPI = \beta_0 + \beta_1 GCI + e \qquad (5)$$
$$GDP = \beta_0 + \beta_1 LPI + e \qquad (6)$$
$$GDP = \beta_0 + \beta_1 GCI + e \qquad (7)$$
$$GDP = \beta_0 + \beta_1 GCI + \beta_2 LPI + e \qquad (8)$$

Before proceeding with the regression analysis, a Pearson correlation matrix was computed to assess the strength and direction of the linear relationships among the key

variables. This preliminary analysis provided initial insights into the relationships among the variables and helped identify any potential issues of multicollinearity. The correlation results also served as an important diagnostic step to confirm the relevance of the planned mediation analysis.

The analysis relies on panel data for 25 SSA countries, covering the years 2007, 2010, 2012, 2014, 2016, and 2018. These years were selected based on the availability of consistent data for logistics performance, GVC participation, global competitiveness, and gross domestic product (GDP). Four composite indices were employed in this study: the Logistics Performance Index (LPI), the Global Value Chain (GVC) Participation Index, the Global Competitiveness Index (GCI), and Gross Domestic Product (GDP).

The LPI captures six key dimensions: efficiency of customs clearance, quality of trade and transport-related infrastructure, ease of arranging competitively priced shipments, competence and quality of logistics services, ability to track and trace consignments, and timeliness of shipments (Arvis et al., 2018). The GVC reflects countries' involvement in international production networks. It includes four components: domestic value added (DVA) in exports, foreign value added (FVA) in exports, indirect domestic value added (DVX) in exports, and total value added.

The GCI measures national competitiveness based on twelve pillars: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation, while the GDP represents the total economic output, measured in current US dollars.

4.0 RESULTS AND DISCUSSIONS

The analysis begins with the Pearson correlation matrix presented in Table 1, which provides an overview of the relationships among the key variables in the study. The results confirm statistically significant relationships between Gross Domestic Product (GDP), Global Value Chain (GVC) participation, Global Competitiveness Index (GCI), and the Logistics Performance Index (LPI) in a pairwise manner.

The strongest correlation is observed between GDP and GVC participation, with a coefficient of 81%. This is followed by the correlation between LPI and GCI at 50%, LPI and GDP at 35%, LPI and GVC participation at 34%, GCI and GDP at 26%, and finally, GCI and GVC participation at 23%. All the correlations are positive, which aligns with the relationships discussed in the literature and reinforces the expectation that LPI plays a mediating role between GDP and GVC participation, and potentially between GDP and GCI.

The analysis also shows that the GVC Participation Index (GVCPI) does not exhibit a significant relationship with any of the variables, including GDP. Although GVCPI is often regarded as an important indicator of backwards and forward linkages in global value chains for African economies (Yedan, 2019), it does not appear relevant in this study based on the available data. This result is not unexpected, as many African countries primarily engage in upstream activities within global value chains, focusing on the export of raw or minimally processed inputs rather than higher-value activities (Foster-McGregor et al., 2015). In light of these findings, the GVCPI is excluded from the subsequent analysis, contrary to the initial assumption.

Table 1: Correlations

	GDP	GVC	GCI	LPI	GVCPI
GDP	1				
GVC	0.81 (0.00)	1			
GCI	0.26 (0.00)	0.23 (0.00)	1		
LPI	0.35 (0.00)	0.34 (0.00)	0.50 (0.00)	1	
GVCPI	-0.05 (0.52)	-0.03 (0.72)	-0.01 (0.94)	0.07 (0.35)	1

4.1 The nexus between GDP and GVC

This section presents the results of the investigation into the mediating role of the Logistics Performance Index (LPI) in the relationship between Gross Domestic Product (GDP) and Global Value Chain (GVC) participation. The results are shown in Tables 2a, 2b, and 2c. A similar analysis is conducted for GDP and the Global Competitiveness Index (GCI) to provide additional robustness. The estimates for this analysis are presented in Tables 3a, 3b, and 3c.

The analysis begins with the relationship between GDP and GVC participation. Table 2a shows that all four regression models demonstrate reasonable explanatory power, as indicated by their adjusted coefficients of determination. Models three and four are of particular interest. In Model three, approximately 12 per cent of the variation in GDP is explained by changes in GVC participation. However, when LPI is included in Model four, the proportion of explained variation in GDP rises to around 66 per cent.

This represents an increase of about 54 per cent, clearly demonstrating the significant role of LPI in this relationship. These results confirm the mediating role of LPI, consistent with the findings of previous studies such as those by d'Aleo and Civelek. The specific nature and direction of the mediation effect are further detailed in Table 2c.

Table 2a: Model results for the nexus between GDP and GVC

Model	R	R^2	Adjusted R^2	Standard Error
1	0.3413	0.1165	0.1114	1.029
2	0.8109	0.6576	0.6556	5.867×10^{10}
3	0.3496	0.1222	0.1171	9.395×10^{10}
4	0.8146	0.6636	0.6597	5.833×10^{10}

The statistical significance of the models is assessed using the analysis of variance (ANOVA) results shown in Table 2b. The findings indicate that the independent variables collectively explain variations in GDP across all models. All models are statistically significant at conventional levels, except for Model 4. In this case, the model is significant at the 10% level, which is generally considered acceptable within the context of empirical economic research.

Table 2b: Model ANOVA for the nexus between GDP and GVC

Model		SS	DF	MS	F	p-value
1	Regression	24.006	1	24.0055	22.678	0.00
	Residuals	182.068	172	1.0585		
	Total	206.074	173			
2	Regression	1.1373×10^{24}	1	1.1373×10^{24}	330.35	0.00
	Residuals	5.9215×10^{23}	172	3.4428×10^{21}		
	Total	1.7295×10^{24}	173			
3	Regression	2.1130×10^{22}	1	2.1130×10^{22}	23.938	0.00
	Residuals	1.5182×10^{24}	172	8.8267×10^{21}		
	Total	1.5393×10^{24}	173			
4	Regression	1.1476×10^{24}	2	1.1476×10^{24}	337.3287	0.08
	Residuals	5.8179×10^{23}	171			
	Total	1.7294×10^{24}	173			

Table 2c: Model results for the nexus between GDP and GVC

Model	Estimate	Std. error	t-value	p-value

1	Constant	1.786233***	0.820918	21.759	0.00
	GVC	3.3744×10^{8}***	7.086×10^{9}***	4.762	0.00
2	Constant	1.7802×10^{10}***	4.6812×10^{9}	3.803	0.00
	GVC	7344.8***	404.1	18.176	0.00
3	Constant	-1.6760×10^{10}	1.4377×10^{10}	-1.166	0.26
	LPI	3.2021×10^{10}***	6.5447×10^{10}	4.893	0.00
4	Constant	4.3268×10^{9}	9.0157×10^{9}	0.480	0.63
	GVC	7090.2***	427.4	16.590	0.00
	LPI	7.5441×10^{9}*	4.3228×10^{9}	1.745	0.08

In analysing the results presented in Table 2c, this study applies the mediation definitions proposed by Baron and Kenny (1986) and Zhao et al. (2010), as outlined in Section 3. Given that the approach by Zhao et al. (2010) refines and extends the earlier framework by Baron and Kenny (1986), this analysis primarily relies on the method by Zhao et al., though it is noted that both approaches share some overlapping definitions. The results show that the coefficients of the independent variables are statistically significant at conventional levels in all four models, with the exception of Model 4, where significance is observed at the 10% level. In addition, all coefficients across the four models are positive, suggesting consistent directional relationships among the variables.

These findings have important implications. First, they confirm that logistics performance, as measured by the Logistics Performance Index (LPI), acts as a mediator in the relationship between economic prosperity, captured by Gross Domestic Product (GDP), and Global Value Chain (GVC) participation. In particular, LPI appears to amplify the extent to which GVC participation influences GDP, a pattern that also aligns with the results shown in Table 2a. Second, the findings indicate a complementary mediation effect based on the classification by Zhao et al. (2010).

This corresponds to what Baron and Kenny (1986) describe as partial mediation. These results are consistent with previous studies by d'Aleo (2015) and Civelek et al. (2015), which also identified a mediating role for logistics performance. However, it is important to note that the existing studies by d'Aleo and Civelek focused on the relationship between GDP and global competitiveness, whereas the present study examines the link between GDP and GVC participation. This distinction marks a notable contribution to the existing literature by extending the analysis to GVC participation.

The evidence of partial mediation by logistics performance carries significant policy and business implications. It suggests that enhancing logistics performance alone may not fully address the challenges associated with increasing GVC participation and fostering economic growth in Africa. While logistics improvements are crucial, other areas such as strengthening the competitiveness of downstream exports also require focused attention. Moreover, as Rodrik (2018) cautions, excessive reliance on technological advancements in logistics may reduce the traditional comparative advantage of African economies in labour-intensive manufacturing industries. Policymakers should therefore pursue a balanced strategy that improves logistics efficiency while simultaneously supporting industrial competitiveness and export diversification.

4.2 The nexus between GDP and GCI

This sub-section examines the mediating role of the Logistics Performance Index (LPI) in the relationship between Gross Domestic Product (GDP) and the Global Competitiveness Index (GCI). The importance of global competitiveness in driving economic growth through enhanced participation in global value chains is well established in the literature (Martí et al., 2014; Sergi et al., 2021; Önsel Ekici et al., 2019). Countries with stronger competitiveness are generally

better positioned to integrate into global value chains, which in turn can foster economic prosperity.

Tables 3a, 3b, and 3c present the results of the analysis. These tables report the regression estimates used to assess the mediating effect of logistics performance in this relationship.

Table 3a: Model summary for the nexus between GDP and GCI

Model	R	R^2	Adjusted R^2	Standard Error
5	0.10968	0.01203	0.00535	0.836
6	0.19693	0.03878	0.03229	1.043×10^{11}
7	0.32047	0.1027	0.09661	1.008×10^{11}
8	0.35944	0.1292	0.1173	9.961×10^{10}

Similar to the relationship between Gross Domestic Product (GDP) and Global Value Chain (GVC) participation shown in Table 2a, the model summary presented in Table 3a reveals that the inclusion of logistics performance improves the explanatory power of the model linking GDP and the Global Competitiveness Index (GCI). Specifically, the adjusted coefficient of determination increases from approximately one percent in Model three to around twelve percent in Model four, indicating an improvement of eleven percent. Although modest, this increase suggests that logistics performance plays a role in shaping the relationship between GCI and GDP. The specific nature of this role is further examined through the results presented in Table 3c.

Turning to the analysis of variance in Table 3b, the results show that, with the exception of Model one, the remaining three models are statistically significant at the five percent level. This indicates that, while variations in logistics performance cannot be explained by changes in GCI, variations in GDP can be explained by changes in GCI and LPI together. This finding points to the potential mediating role of logistics performance in the link between global competitiveness and economic growth, which has been highlighted in previous studies (Sergi et al., 2021; d'Aleo, 2015; Civelek et al., 2015). It also aligns with the broader argument that logistics performance can significantly influence economic outcomes, particularly in developing and emerging economies (Khadim et al., 2021; Goel et al., 2021).

Table 3b: Model ANOVA for the nexus between GDP and GCI

Model		SS	DF	MS	F	p-value
5	Regression	1.259	1	1.25913	1.8014	0.18
	Residuals	103.446	148	0.69896		
	Total	104.705	149			
6	Regression	6.4947×10^{22}	1	6.4947×10^{22}	5.971	0.02
	Residuals	1.6098×10^{24}	148	1.0877×10^{22}		
	Total	1.6747×10^{24}	149			
7	Regression	1.7195×10^{23}	1	1.7195×10^{23}	16.934	0.00
	Residuals	1.5028×10^{24}	148	1.0154×10^{22}		
	Total	1.6748×10^{24}	149			
8	Regression	2.1632×10^{23}	2	2.1632×10^{23}	21.800	0.01
	Residuals	1.4584×10^{24}	147	9.9213×10^{21}		
	Total	1.6747×10^{24}	149			

In Table 3c, it is unclear which specific mediation effect of LPI on the link between GDP and GCI is being represented, based on the definitions provided by Baron and Kenny (1986) and Zhao et al. (2010). But it is evident that there is a strong mediation role. This is evident from the significant positive relationships observed in Models 1, 2, and 3. Thus, we rule out

complementary mediation and competitive mediation. This result partially replicated those of d'Aleo (2015) and Civelek et al. (2015).

Table 3c: Model results for the nexus between GDP and GCI

Model		Estimate	Std. error	t-value	p-value
5	Constant	2.016767***	0.161671	12.475	0.00
	GCI	0.005609	0.004179	1.342	0.18
6	Constant	6.763×10^{09}	2.017×10^{10}	0.335	0.7378
	GCI	1.274×10^{09}*	5.213×10^{8}	2.444	0.0157
7	Constant	-3.826×10^{10}	2.330×10^{10}	-1.642	0.10
	LPI	4.052×10^{10}***	9.848×10^{09}	4.115	0.00
8	Constant	-7.038×10^{10}*	2.759×10^{10}	-2.551	0.01
	GCI	1.059×10^{09}*	5.009×10^{08}	2.115	0.04
	LPI	3.825×10^{10}***	9.793×10^{09}	3.906	0.00

This portion of the study provides greater clarity on how the mediating role of LPI differs depending on whether global competitiveness or global value chain participation is the primary driver of national income growth. The lack of clarity on the specificity of the mediating role of LPI in the bridge between GDP and GCI should be taken seriously. This points to the difficulty in the policy space as to what to focus on in the ever-growing, complex global market. This is particularly true for African countries, which remain vulnerable due to their predominant focus on upstream participation. More clarity is needed on this front while chasing the clearer role of LPI in the link between GDP and GVC.

5.0 CONCLUSIONS

In this study, we sought to investigate the mediating role of LPI on the link between GDP and GVC on the one hand and GDP and GCI on the other hand. This is informed by the importance of logistics efficiency in the global value chain and the subsequent gains from which can spur growth and prosperity in participating countries. This is especially true for African countries that are open and liberal in international trade, as well as exporting large volumes of raw materials year-on-year. In so doing, we also note that competitiveness can be a determining factor for the levels of GDP, but it is also mediated by logistics performance.

Our study is situated in the product fragmentation theory and supported by the new trade theory. We employed data on 25 African countries for the years 2007, 2010, 2012, 2014, 2016, and 2018. The hierarchical regression model proposed by Baron and Kenny (1986) was used to infer the specific mediating role of LPI in this study. The results, in general, confirm the important influence of logistics efficiency in the global value chain for the African participants. The literature that supports this assertion includes, but is not limited to, Marti et al. (2014), Allard et al. (2016), Mensah and Fofana (2018), Takele (2019), Ekici et al. (2019), Sergi et al. (2021), Khadim et al. (2021), and Kuteyi and Winkler (2022). Specifically, the findings corroborate those of d'Aleo (2015) and Civelek et al. (2015) for the Complementary and Partial mediating role of LPI on the nexus between GDP and GVC.

The results have important policy and investment implications for African governments and trading partners alike. The implication is that the pursuit of logistics efficiency in Africa should be done cautiously since it does not solve all the problems of increased global value chain participation and hence economic prosperity. While pursuing logistics efficiency to improve performance, other areas, such as the competitiveness of the downstream export of production, need attention. After all, improving logistics performance spurred by new technologies may be disadvantageous for the comparative advantage of African countries in traditionally labour-intensive manufacturing, as warned by Rodrik (2018).

In subsequent studies, all the different dimensions of LPI can be examined for their respective mediating roles. The fixation on only one or a few dimensions of LPI in studying the

impact on GVC, GCI, or economic growth is inadequate, as seen in many studies. This is especially true because all the dimensions are equally important in arriving at a complete picture of the logistics performance of a country. Second, while all dimensions are important, they affect GVC in different and heterogeneous manner. Thus, lumping up all the dimensions by using the composite logistics performance index conceals essential information which can cloud policy decisions. It is important to delineate the impact of all the dimensions of LPI on several aspects of the GVC so that policy efforts can be directed at the deficient and well-functioning ones.

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