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INTERCONNECTEDNESS OF GLOBAL COMPETITIVENESS, LOGISTIC PERFORMANCE, AND GLOBAL VALUE CHAIN IN AFRICA

By

Priscilla Boafowaa Oppong

A Doctoral thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy

The Graduate School of Business Administration

University of the Witwatersrand

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ABSTRACT

The distribution of production units across countries has long been a component of international trade as nations import products for production and subsequent exports. This has been necessary because of technological progress, plunges in transportation costs, and enhanced liberalisation policies relating to trade, economics, and the financial system. This has led to the emergence of the global value chain (GVC) as a standard component of 21st-century trade, constituting over 70% of all international trade. This has garnered benefits for participating countries, which are prepared and disadvantages for those that lack competitive advantage. The latter has been attributed to poor logistics performance and non-competitiveness, two crucial elements that countries need to get right and at high levels in order to upgrade the GVC and reap the benefits of international trade in this era of liberalisation. Unfortunately, this describes many of the countries in sub-Saharan Africa (SSA). This has important implications for countries in SSA striving to attain many of the Sustainable Development Goals (SDGs) and their large market size for raw materials as well as being one of the most open regions in the world.

The scenario also describes an important relationship between global competitiveness and logistic performance that feeds into the level of global value chain participation by countries and the economic benefits from international trade. For the SSA region, where economic development is much needed to boost economic welfare, this complex relationship has become increasingly crucial for government and policy-makers. However, the extant literature is largely silent on this direction of research. The purpose of this thesis is to provide an empirical examination of the interrelationship among global competitiveness, logistic performance, and global value chain participation in Africa.

First, the relationship between global value chain participation and competitive competitiveness in SSA countries is investigated in light of how the relationship produces economic prosperity. In so doing, the role of logistic performance in the GVC space is examined as either a moderator or a mediator. The study spanned 2007, 2010, 2012, 2014, 2016, and 2018 for 25 SSA countries for which data[1] is available for logistic performance and competitiveness. The results confirm the important influence of logistic efficiency in the global value chain for the African participants. However, the study has thrown more light on the differences in the mediating roles logistic performance plays depending on whether global competitiveness or global value chain participation is the driving motive for improving national income earnings. The lack of clarity on the specificity of the mediating role of the logistics performance index (LPI) in the bridge between gross domestic product (GDP) and global competitiveness index (GCI) should be taken seriously. This points to the difficulty in the policy space as to what to focus on in the complex global market. This is especially true for African countries as they are positive and delicate because of their inclination towards upstream participation. More clarity is needed on this front while chasing the clearer role of logistic performance in the link between GDP and GVC.

Second, due to the importance of competitiveness in improving logistic performance and subsequently leading to greater participation in the GVC, the interaction among the pillars of GCI and the dimensions of LPI are examined for deeper insights on how they explain GVCs participation in Africa. The GCI and its 12 pillars, namely institutions, infrastructure, the macroeconomic environment, health and primary education, higher education and training, goods

[1] The same data and period is used for all the empirical studies in this thesis.

market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation, and LPI and its six dimensions, namely; customs, infrastructure, ease of arranging shipments, quality of logistics services, timeliness, and tracking and tracing are interacted using the Tree-Augmented Naïve Bayes Network (TAN-BN), Partial Least Squares Structural Equation Modelling (PLS-SEM), and Importance-Performance Map Analysis (IPMA) to ascertain causal effects, correlations, and the relative importance of the pillars of GCI to logistics performance. The results reveal a significant positive relationship between most of the Pillars of GCI. Also, technological readiness is found to be the only Pillar of GCI that has a significant direct positive relationship with logistics performance. Conversely, higher education and training has a significant indirect relationship with logistics performance. Findings from this study imply that concentration on what drives logistics performance alone may hinder policy decisions due to the existence of linkages among the Pillars. It is recommended that governments in SSA invest extensively in technology and higher education and training to enjoin improvement in logistics performance while observing other pillars of GCI with caution.

Third, considering the complex nature of the GVC and the driving force of competitiveness, the causal effect of GCI and its pillars on the various indicators of GVC is scrutinised. This is motivated by the fact that the ability of countries to maximise the benefits of GVC requires intentionality on the part of policy-makers to develop structures that facilitate and enhance the ability to participate at all levels of GVCs while recognising the complexity of the system. The network approach of Epskamp (2018) is employed to reveal the impact of competitiveness pillars on the indicators of GVCs participation in Africa as a complex network of a non-linear causal

relationship. Both the GCI and its pillars and the GVC and its indicators, namely domestic valued-added (DVA) in exports, foreign valued-added (FVA) in exports, indirect domestic valued-added (DVX) in exports, and value-added (VA) are considered as networks which require no latent variables for interaction. The results indicate that in the complex network of the 12 pillars of GCI and four indicators of GVC, there is a dichotomy of clusters for the constructs (i.e. GVC and GCI). An interesting revelation is that there are negative causal relationships between some GCI pillars, notably, with market size. Further, there are other pillars which also have a negative influence on the indicators of GVC. These findings are disturbing, to say the least, but they are also telling of the need for governments to intensify their activist duties in order to improve competitiveness, especially those that enhance efficacy and productivity. To a large extent, those are also factors, except for market size, that benefits can flow through to GDP and economic growth and development.

The results from all three empirical studies have one thing in common. That is, African countries can upgrade the GVC and international trade by improving their competitiveness and logistic efficiency to enjoy the benefits that accrue towards economic prosperity. They also point to the dominant position of market size, which can be leveraged to empower the continent in the international trade market place. Government and policy-makers are encouraged to intensify their roles as activists to foster a conducive operating environment for traders and all players in the GVC in their countries.

Keywords: Complexity; Global competitiveness; Global value chain; Interconnectedness; International trade; Logistic efficiency; Logistic performance; Product fragmentation; Supply chain; Sub-Saharan Africa; Trade liberalisation.

LIST OF PUBLICATIONS AND RESEARCH OUTPUTS

Prior to submission, portions of the thesis are under review with peer-reviewed journals.

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DECLARATION

I, **Priscilla Boafowaa Oppong**, hereby declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in fulfilment of the requirements for the award of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Priscilla Boafowaa Oppong

Signed at: **Wits Business School, Johannesburg, South Africa.**

On the 30th day of January 2024.

DEDICATION

To my Husband and Children

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The usual caveats apply.

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TABLE OF ACRONYMS AND ABBREVIATIONS

ABBREVIATION	MEANING
AfCFTA	African Continental Free Trade Area
CEE	Central and Eastern European
DVA	Domestic Value-Added
DVX	Indirect Domestic Value-added
EPA	Economic Partnership Agreement
ESA	Eastern and Southern Africa
FVA	Foreign Value-Added
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GVC	Global Value Chain
GVCPI	Global Value Chain Participation Index
IPMA	Importance-Performance Analysis
LPI	Logistic Performance Index
OECD	Organisation for Economic Co-operation and Development
PLS	Partial Least Squares
SACU	Southern African Customs Union
SEM	Structural Equation Modelling
SSA	Sub-Saharan Africa
TAN-BN	Tree-Augmented Naïve Bayes Network
VA	Value-Added
WCA	West and Central Africa

WEF	World Economic Forum

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The distribution of production units across countries has long been a component of international trade as nations import products for production and subsequent exports. The increased international division of production has been necessary because of technological progress, plunges in transportation costs, and enhanced liberalisation policies relating to trade, economics, and the financial system (Amador & Cabral, 2017). This has led to the emergence of the global value chain (GVC), which describes how production has become interconnected and challenged traditional policy-making (Amador & Cabral, 2017; Kowalski et al., 2015). Global value chains (GVCs) refer to the division of manufacturing into activities and tasks carried out in several nations. This differs from Adams Smith's division of labour's lab, where production of a pin is distributed and produced at one location, to production in the world where activities and tasks take place in different countries (Kordalska & Olczyk, 2023). The GVC has become the standard component of the 21st-century trade (Baldwin & Evenett, 2012). According to calculations by the Organisation for Economic Co-operation and Development (OECD), global value chains constitute over 70% of all international trade (OECD, 2020).

There is evidence of benefits to participants in the GVC spanning across both developing and developed countries. The readily mentioned impact of GVCs' participation is growth and productivity (Del Prete et al., 2017; Montalbano et al., 2018). It has implications for the attainment of Sustainable Development Goals (SDGs), particularly the creation of decent work (Goal 8) and economic growth and industrialisation (Goal 9). This is premised on the long-standing evidence in the economic literature that openness to international trade and investment

can be an important driver of growth and productivity (Frankel & Romer, 2009; Kose et al., 2003). Productivity is a result of the efficiency-improving effects of global competition, accessibility to information and technology from other countries, the ability to specialise, and economies of scale, among other things.

However, the benefits of GVCs' participation vary from country to country and economic zone to economic zone depending on the level and direction of participation. The level of participation also depends on trade facilitation and the trade policy of the economy. For instance, countries in the Global North are becoming more integrated, whereas those in Africa are becoming more marginalised (Ahmad & Primi, 2017). This can be traced to the fact that the bulk of participation of African countries in the GVC is forward upstream (Ofori et al., 2021). This has been attributed to poor logistics performance and non-competitiveness (Bouët, Goundan & Zaki, 2020; Omoju, 2019) due to fragmentation and the non-implementation of new trade theories. It turns out that these logistic performance and competitiveness are also two crucial elements that countries need to get right and at high levels in order to upgrade the GVC and reap the benefits of international trade in this era of liberalisation (Ekici et al., 2019; Halaszovich & Kinra, 2020; Kinra et al., 2020).

This suggests that there is an important link between global competitiveness and logistic performance that feeds into the level of global value chain participation by countries. For countries in sub-Saharan Africa (SSA), where economic development is much needed to boost economic welfare, this complex relationship has become increasingly crucial for government and policy-makers because increased participation in the GVC promises revenue for economic development. This is premised on the belief that greater participation boosts economic growth and development (Mao, 2022).

According to trade theory, factors such as factor endowments, increased savings and investments, innovations in products and production processes, entrepreneurship intensity, production resources, technology development, market conditions, international business and economic activities, government role, and company strategy and operations are among the factors that determine international competitiveness (Davidson, 1979; Nguyen, 2009a, 2009b).

Park et al. (2023) identified logistics performance as a key determinant of trade and a possible driver for increased participation in GVCs. An interactive benchmarking tool called Logistics Performance was developed to assist nations in identifying the obstacles and chances they face in their performance on trade logistics, with 1 being the lowest and 5 the most. It is based on a worldwide survey of logistic 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 producer to consumer (Wong & Tang, 2018). The complexity of production systems characterised by the setting of Global Value Chains (GVCs) and networks will depend on efficient logistics to support and shape the coherence of GVCs and networks (Hausman et al., 2013; Memedovic et al., 2008; Hesse & Rodrigue, 2004).

Similarly, the Global competitiveness index (GCI), which evaluates the key factors and the institutions that ascertain the improvement and competitiveness of countries, has been linked to the logistics performance and the ability of countries to participate in GVCs (Ekici et al., 2019; Schwab, 2017). Competitiveness is important because it can boost trade advantage, improving economic welfare in the nations of trading partners[2]. It is imperative to understand the entirety of value chains as well as the bottlenecks at the up- and down-stream. Intentional

[2] https://repository.up.ac.za/bitstream/handle/2263/26100/02chapter2.pdf?sequence=3&isAllowed=y

considerations can be taken to boost GVC participation and economic performance (Rodrik, 2018).

This thesis focuses on three main aspects of interconnectedness among global competitiveness, logistic performance, and global value chain participation in Africa. First, the relationship between global value chain participation and competitive competitiveness in SSA countries is investigated in light of how the relationship produces economic prosperity. In so doing, the role of logistic performance in the GVC space in examined as either a moderator or a mediator. Logistics, as network services, support the physical movement of goods in both domestic and international trade by influencing activities such as transportation management, terminal operations and brokerage.

The evidence from the literature suggests that an efficient logistic system is the backbone of a country's ability to participate in international trade and, hence, participation in GVCs (Nordas et al., 2006; Celebi, 2019). Attempts by researchers have led to no empirical evidence on the effects of logistic performance and its dimensions on GVCs participation to inform policy priorities (see, for example, Behar & Manners, 2008; Celebi, 2019 & Gani, 2017; Hoekman & Nicita, 2011; Iwanow & Kirkpatrick, 2009; Mart et al., 2014, Puertas et al., 2014).

However, increased GVC participation is only a means to an end. It is almost certain that the ultimate purpose of trade is to gain economic welfare or prosperity, which can be measured by gross domestic product. Thus, examining the effect of logistic performance on GVC falls short of the full story. While inferences can be made from high levels of GVC participation to imply corresponding levels of GDP, we can estimate the contributions of logistic performance from the data available. It is clear from the literature that the extant GVC participation rests on the

efficiency of logistics performance, which is a catalyst for job creation and the growth of the economy (Takele, 2019). 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 crust of the first theme in the thesis. 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. This argument is routed in both product fragmentation and new trade theories, which explicate the efficiency of production and the transportation of goods and services, enabling countries to have a better chance of GVCs participation and, hence attaining economic prosperity.

Second, the performance of the logistics system is also heavily hinged on well-functioning public sector and policy interventions that influence the quality of regulating services, infrastructure, international trade and public-private partnerships (Ekici et al., 2019). These factors are core to competitiveness as they constitute a set of indicators that drive the competitiveness of nations (Ekici et al., 2016, Martiet al., 2014). The competitiveness of countries measures their ability to enhance production and deal with their internal structures, thus making a better place to attract and participate in GVCs. This proposition sits well with the institutional theory, which offers valuable insight into how the institutional environment of countries influences logistic performance and, consequently, global competitiveness.

The World Economic Forum (WEF) has formally developed the Global Competitiveness index to measure country competitiveness based on 12 pillars, namely: institutions, infrastructure, the 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 (Arvis et al.,

2018). This suggests that competitiveness improves the logistic performance of countries, and reformation is needed for greater participation in the GVCs. There is, therefore, a possible interactive effect of logistic performance and global competitiveness on GVCs participation.

This study investigates the pillars of global competitiveness and logistics performance and its dimensions to explain GVCs participation in Africa. In so doing, in line with the construction LPI in the supply chain industry, we consider LPI as a latent variable measured by the six dimensions (i.e. customs, infrastructure, ease of arranging shipments, quality of logistics services, timeliness, and tracking and tracing (Arvis et al., 2018). The elements were selected based on theoretical, empirical, and practical research, as well as the practical expertise of logistics experts engaged in international freight forwarding (Ekici, 2019). The LPI is frequently used in global logistics research as a bench-marking and comparison tool for nations, as a starting point for the creation of new procedures and instruments, and as a method for assessing the performance of intra-national logistics (Beysenbaev & Dus, 2020; Göçer, Özpeynirci & Semiz, 2022).

Third, the importance of global competitiveness to GVCs participation is examined. The ability of countries to maximise the benefits of GVCs requires intentionality on the part of policy-makers to develop structures that facilitate and enhance the ability to participate at all levels of GVCs (Kersan-Škabić, 2019; Tinta, 2017). The competitiveness of countries measures its ability to enhance production and deal with its internal structures, thus making it a better place to attract and participate in GVCs. On the other hand, GVC is a composite of 4 indicators, namely, domestic valued-added (DVA) in exports, foreign valued-added (FVA) in exports, indirect domestic valued-added (DVX) in exports, and value-added (VA) (Arvis et al., 2018).

The exposition fit into the comparative advantage, human capital, technology, trade policies, and institutional frameworks of participating countries argument.

The extant literature has not explored the nexus between competitiveness and GVC levels adequately for a number of reasons, especially for SSA. First, the complex nature of the pillars of GCI and the indicators of GVC as an ecosystem/network is ignored. Second, the definition of GCI suggests a causal relationship with GVC has not been examined. Third, the complex nature of international trade and competitiveness submits both direct and indirect (i.e. non-linear) relationships among the pillars of GCI and the indicators of GVC, which is not addressed hitherto. This study, therefore, contributes to this literature by exploring the impact of competitiveness pillars on the indicators of GVC participation in Africa, a complex network of a non-linear causal relationship (Epskamp, 2018).

1.2 Motivation for the study

As previously stipulated, the GVCs literature and the theoretical prepositions of fragmentation and new trade theories show that the logistic performance and competitiveness of countries affect GVCs participation by countries either at the individual level or interact to influence the ability to upgrade the GVCs participation (Behar & Manners, 2008; Bouët, Celebi, 2019; Ekici et al., 2019; Gani, 2017; Goundan & Zaki, 2020; Halaszovich & Kinra, 2020; Hoekman & Nicita, 2011; Iwanow & Kirkpatrick, 2009; Kinra et al., 2020; Omoju, 2019; Rodrik, 2018). As yet, there has been a very scant systematic investigation of this possible interconnectedness. Understanding this interconnectedness may influence the policy intervention needed by policymakers to increase firms' and countries' participation in the GVCs, which will lead to prosperity.

Why is GVCs participation relevant to economies? According to the World Bank (2020), GVCs account for around half of the world trade today and have contributed significantly to a rise in income and productivity and a reduction in poverty. The available evidence suggests that the rise of GVCs has generated greater income gains and productivity at the firm level than a commensurate expansion of traditional trade (Antrás & de Gortari, 2017; Caliendo & Parro, 2013; Constantinescu, Mattoo & Ruta, 2019). Also, because GVCs spur exports, its effect on employment has been positive, especially in developing countries, in spite of being more capital-intensive. GVC firms tend to employ more workers than other firms, advance technological efficiency in operation, access foreign capital, and be well-integrated in the global market (World Bank, 2020).

Notwithstanding this perceived gain, GVC participation has its challenges if appropriate systems and structures are not in place. There is evidence of a disparity in the distribution of the gains from GVC participation across and within countries. There are also certain inequalities based on differences in the distribution of firm mark-ups, capital and labour between skilled and unskilled workers and male and female workers in various countries (Robalino & Walker, 2017; Feenstra & Hanson, 1996, 1997; Verhoogen, 2008; World Bank, 2020). Moreover, there is a significant risk that participation in GVCs will result in potential tax losses due to shifting profits from developing countries to high-income countries.

The study of interconnectedness of global competitiveness, logistics performance and global value chain participation is of major importance to African countries. Firstly, since the mid-1990s, the region has increased in trade openness and entered into partnerships with emerging markets such as China and India (Allard et al., 2016). The integration into the global economy makes them vulnerable to external shocks if they are not competitive in the global market.

Secondly, regional trade integration is low due to several factors such as homogeneity of products, lower level of income, economic size and low levels of trade flow across borders due to trade impediments (Obasaju et al., 2019; Bouët, Cosnard & Laborde, 2017). Thirdly, African countries still have ways to go to better integrate into GVCs and benefit from their participation in GVCs (African Development Bank (ADB), 2014). Fourthly, studies have shown that improved trade facilitation factors are associated with international trade competitiveness (Fernandes, Kee & Winkler, 2020). Lastly, studies on the interrelationship among global competitiveness, logistic performance, and GVC participation are conspicuously missing in the academic literature. The related studies closer to these studies have focused on the aspect of trade facilitating factors on GVC participation (Tinta, 2017; Kersan-Škabić, 2019; Fernandes, Kee & Winkler, 2020).

Though Africa has managed to join GVCs in the apparel, food, automotive industry, and service sectors, the level of participation in intermediate goods accounts for less than 3 percent of global intermediate goods (World Bank, 2020). Africa exports are generally primary and enter at the very beginning of GVCs as inputs for other countries' exports (Verter, 2017). This is a result of the similarity in economic structure and poor fundamental structures to facilitate the transformation of raw materials to intermediate goods (Ansón et al., 2017; Christ & Ferrantino, 2011; Cheng et al., 2015). Previous studies have looked at the possible factor that influences GVC participation and have identified factors such as institutions, infrastructure, tariffs, trade openness, economic diversification, the complexity of the economy, human capital development and technology (Cheng et al., 2015; Christ & Ferrantino, 2011; Fernandes, Kee & Winkler, 2020). However, studies have not yet examined the interactive effects among GVCs in addition to LPI simultaneously.

The global competitive index, organised into 12 pillars, is an annual barometer for policy-makers to look beyond short-term measures and reactions to policy and instead assess their participation in GVCs and upgrade to the upstream level. This study, therefore, contributes to the limited existing literature by adopting techniques that divulge relevant insights for traders and policy-makers pertaining to the network of global competitiveness, logistic performance, and GVCs' participation and upgrade in Africa to enhance economic prosperity. This thesis provides novel insight into the interrelationship between dimensions of global competitiveness, logistic performance and GVC participation in Africa. The study focused on GVCs data instead of trade data for 37 African countries that have a complete data set for global competitiveness, logistic performance and GVCs participation.

1.3 Statement of the Research Problem

The problem at the heart of this study dwells on the challenge faced by countries in sub-Saharan Africa (SSA) to effectively participate and benefit from global value chains (GVCs). Despite being a significant player in international trade and having a large market size for raw materials, many SSA countries find themselves marginalised (Ahmad & Primi, 2017) in the GVC landscape due to poor logistics performance and non-competitiveness ((Bouët, Goundan & Zaki, 2020; Omoju, 2019). The bulk of their participation is observed in forward up-stream activities (Ofori et al., 2021), limiting their ability to fully leverage the advantages of GVCs. This poses a significant obstacle to achieving Sustainable Development Goals (SDGs), particularly in the realms of creating decent work (Goal 8) and fostering economic growth and industrialization (Goal 9). The study proffers to investigate and address the challenges associated with improving logistics performance, competitiveness, and overall GVC participation in SSA countries to unlock the potential benefits of international trade and contribute to sustainable development goals.

Various studies have confirmed the significant role logistics performance plays in both international and domestic trade (see, Yeo, 2017; Rutner, Aviles & Cox, 2012; Korinek & Sourdin, 2011; Gani, 2017; Dollar et al., 2004; Hausman, Lee & Subramanian, 2012). The literature shows that global competitiveness can drive logistics performance and could also help maximise the gains from trade when combined with the openness of the economy (Ekici et al., 2019; WEF, 2015). However, the interrelation of global competitiveness, logistic performance and GVC participation has received little attention.

In Figure 1.0, we conceptualise the interrelationships based on the foregoing discussion. This consolidates the interrelationships among GVC, GCI, GDP, and LPI, as discussed and expanded in the subsequent chapters. First, we can infer the mediating/moderating role of LPI in the nexus between GVC, GCI, and GDP. Second, the interactive effects among the pillars of GCI and LPI is represented. Last, the causal nexus between the pillars of GCI and GVC participation fueled by LPI is also depicted.

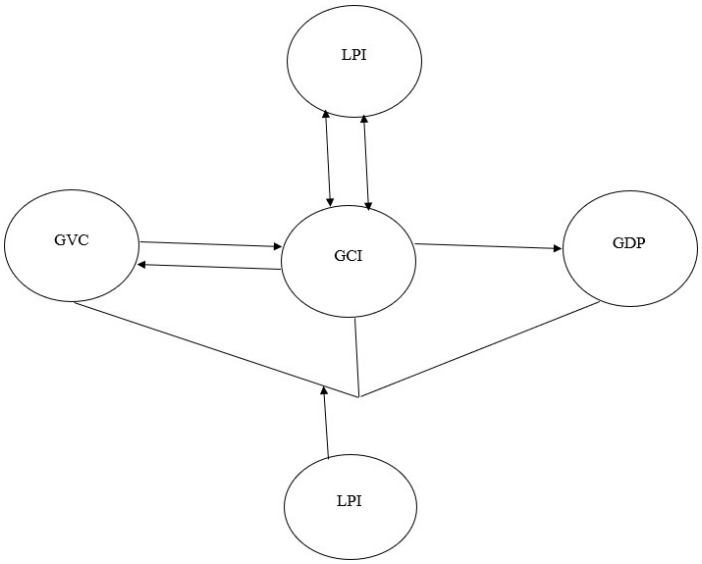


Figure 1.0: Conceptual framework

Source: Author's construction

This thesis, therefore, focuses on the interconnectedness of global competitiveness, logistic performance and GVC participation in three different approaches in Africa. The study specifically will explore the interrelation among the six dimensions of logistics performance (customs, infrastructure, ease of arranging shipments, quality of logistics services, timeliness, and tracking and tracing), the 12 pillars of global competitiveness - institutions, infrastructure, the 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, and GVC participation by addressing the following three problems:

As in all businesses in an open and liberalised global market space, the ability to survive and prosper depends on the level at which one can compete. In international trade, the GVC ecosystem, and supply chain alike, gains are subject to competitive prowess. The nature of the current global value chain is a platform for all countries to have a competitive advantage in specific areas, especially from cost-saving activities in production and services. In GVCs, production units are fragmented and separated according to fragmentation theory. Fragmentation makes sense when there are cost savings, lower service links, and low set-up costs (Arndt & Kierzkowski, 2001; Jones & Kierzkowski, 1990; Masunda & Mupaso, 2019).

However, the service link cost is predicated on an efficient logistic system. This complicates the link between competitiveness and GVC participation to accumulate economic gains. The studies that directly examined the nexus between competitiveness and GVC participation do not proffer a full understanding of the relationship. Logistic efficiency/performance of a nation, in principle, mediates the extent and direction of the competitiveness-GVC participation nexus. The extant body of literature largely ignores the African context, which, in many senses of the

word, is an important component in the global value chain and international trade (see; Goel et al., 2021).

Further, a few studies that attempt to mediate between competitiveness and GVC do not disambiguate the term "mediation" to elicit the magnitude and direction and, most importantly, distinguish it from moderation. In this study, we use the mediation approach suggested by Baron and Kenny (1986). The approach is becoming popular in the GVC literature with applications by (Civelek et al., 2015; Sergi et al., 2021) and expositions from Zhao et al. (2010). This study sheds light on the link between logistic performance and GVC participation by delineating moderation from mediation and presenting the magnitude and direction of mediation needed for both policy and practice.

According to Ekici et al. (2019), there is a correlation between competitiveness pillars and logistics performance dimensions. These associations have the potential to undermine the outcomes of interventions policy-makers pursue if specific competitiveness and logistics performance dimensions are chosen to improve the GVCs participation while neglecting its correlation with others. While all competitive pillars are important, they do not all impact logistic performance at the same time and equally. Hence, we use the Tree-augmented Naïve Bayes Network (TAN-BN) to identify the specific pillars to use. This was performed first to assess the correlation between the competitiveness pillars and logistics performance and then assess their interactive effect on the GVCs participation and importance-performance map analysis (IPMA) in a structural equation model (SEM) framework. Prior studies do not consider interactive effects among GCI and their influence on LPI, with much emphasis on a given territory.

The closest study in this regard is that of Ekici et al. (2019), which concentrated on several countries with no concentration and employed the TAN-BN and the Partial Least Square (PLS) approaches. Sergi et al. (2021), on the other hand, laid emphasis on both descriptive and inferential statistics for three clusters of GCI – infrastructure, human factor and institutions – and LPI for regions including Africa, Asia and the European Union employing the ANOVA method.

According to fragmentation theory, a firm's decision to locate a component of the production unit is based on potential gains from the fragmentation of production units, in which there are cost savings from differences in location and network set-ups (Masunda & Mupaso, 2019). Also, the new trade theory explains the link between the firm's decision to participate and integrate into GVCs, which is based on product differentiation, monopolistic competition and firm heterogeneity (Melitz, 2003; Helpman et al., 2004). Global competitiveness, which assesses countries' progress against the full set of factors that determine productivity, is anchored in this and provides an opportunity for a firm to be competitive.

The available studies have mainly been theoretical and mostly no empirical evidence (OECD, 2014). This is partly due to limited data availability. Based on these theoretical arguments, this study, for the first time, provides a comprehensive empirical assessment of the impact of competitiveness pillars on GVCs participation, and in particular, Africa, using a regularised partial correlation network (Epskamp, 2018). The method recognises the complex nature of the global value chain as in ecosystem of causal interconnections. Intentionally, the approach simplifies all the pillars of GCI and indicators of GVC in a single parsimonious model of the causal network. This engenders a deeper understanding of which pillars to focus on for policy and trade actions, given that the region lags behind several countries on the GCI league table

(Kowalski et al., 2015b), despite recent improvements (Schwab, 2019). Prior studies have failed to do this by skewing towards LPI and the role of GCI in logistic performance, with GVC and its indicators being left out.

While a number of studies have examined the important role of GCI in the GVC ecosystem and its impact on economic development and prosperity, many take an indirect approach to infer these. For instance, Sergi et al. (2021) examine the pillars of GCI on the composite index of LPI for Africa, Asia and the EU regions. Furthermore, a few studies have used the composite GCI and GVC indices in this quest (see, Efogo, 2020; Mensah & Fofana, 2018), making them susceptible to the fallacy of composition. We add to the literature by taking a direct approach to the SSA region using the individual pillars of GCI and indicators of GVC, as well as the composite indices.

1.4 Research Objectives

The study examines the interconnectedness of global competitiveness, logistics performance and global value chain participation in SSA. Specifically, the study intends to achieve the following objectives:

1. To investigate the mediator role of logistic performance in the link between the global value chain and global competitive index.
2. To examine the interactive effect among the pillars of global competitiveness and logistics performance.
3. To establish the non-linear causal network among the pillars of global competitiveness and indicators of global value chain participation.

1.5 Research Questions

The thesis seeks to find answers to the following questions:

1. Is there a mediator role of logistic performance in the link between the global value chain and global competitive index in the selected SSA countries?
2. What is the nature of the interactive effect among the pillars of global competitiveness and logistics performance in sub-Saharan Africa in the selected SSA countries?
3. What are the magnitudes and directions of the complex non-linear causal network among the pillars of global competitiveness and indicators of global value chain participation in the selected SSA countries?

1.6 Significance and Contribution to Knowledge

The several areas of contribution to knowledge, as presented in the previous sections, show that the significance of the study rests on the investigation of the possible effect of global competitiveness and logistic performance on global value chain participation. The study provides further insight into the ongoing debate in the literature about what drives GVC participation, particularly in Africa. The study contributes to the literature in several ways.

This thesis is the first, in the context of Africa, to delineate the moderating and mediating role of LPI in the journey from GCI to enhanced GVC participation to economic prosperity. The outcome of this study presents tailor-made solutions to how logistic performance can be in enhanced to improve the economic welfare of the participating countries.

There is evidence that African countries participate in GVCs upstream and have little chance of upgrading, hampering its potential to create wealth for its people (Foster-McGregor et al., 2015). The search for driving factors of GVCs participation becomes critical for policy priority. The understanding of the effect and centrality of logistic performance dimensions on GVCs

participation for effective decision making. With limited resources, the policymaker prioritises logistics investment to areas that produce the most necessary outcomes, and that is where the comprehensive evaluation of the dimensions of logistic performance becomes very relevant (Beysenbaev & Dus, 2019).

Global value chain participation requires countries to re-invent and reposition themselves as worthy of consideration. The GVCs provide avenues for the participation of the global economy in terms of trade and investment; it improve the productive sector, creates jobs and makes countries magnet for innovation. Participation in the GVC ecosystem requires policy initiatives by policy-makers to assess the global and domestic economic landscape to identify policy interventions that facilitate their countries to catch up with the global economy (WEF, 2016; Dobbs et al., 2011; Baldwin, 2011) by improving their competitiveness and logistic efficiency. Understanding the modus operandi of GVCs and the firm's location distribution choices influence policymakers' competitiveness decisions. Also, policy-makers can reap the benefits of investments in competitiveness in relation to GVCs participation if the outcome of each dimension of GVCs is known. This thesis, for the first time, provides a comprehensive assessment of the 12 pillars effects on GVCs participation in a single parsimonious framework.

The adequacy of the existing theory in explaining the theoretical orientation of the interactive effect of logistic performance and global competitiveness on GVCs participation is grey in the academic literature, and this thesis contributes to knowledge in this direction. The theory of international fragmentation of production units assumes that the influence of determinants of intermediate goods trade is stronger than on trade in final goods and, therefore, ignores the conditioning factors that enhance the trade of final goods. The study argues that the ability of countries to participate at all levels of GVCs, especially downstream, is contingent on factors

of trade facilitation at all levels. Hence, it tests the interactive effect of logistic performance and global competitiveness on GVCs participation to re-define the boundaries of fragmentation theory.

1.7 Definition of Concepts

1. 7.1 Dimensions of Logistic Performance

The Logistics Performance, which is measured as an Index score by the World Bank, reflects perceptions of a country's logistics based on the efficiency of the customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments,

Custom: Customs procedures are deemed to be efficient and effective by their swiftness, easiness, and predictability. Low customs output is usually the product of customs procedures regulatory framework, including time-consuming paperwork, frequent multi-agency inspections, and unavailability of border communication and procedures for clearance (Celebi, 2017). Low customs output is commonly cited as the greatest impediment to trade (Hummels et al., 2009; Milner et al., 2008).

Infrastructure: The standard of trade and transport networks necessary to guarantee fundamental connection and access to gateways and infrastructure sheds light on a significant portion of a country's relative trade success. Lack of transportation and communication infrastructure isolates nations and prevents their participation in international production-transport-distribution networks. The ability of a country to participate fully in the global economy and the real cost of commerce are both significantly influenced by a country's

remoteness (Celebi, 2017; Celebi et al., 2014). Bad infrastructure accounts for much of Africa's poor trade results (Limao & Venables, 2001).

International Shipments: The decision-making process and the effects of national competitiveness are significantly influenced by the availability of competitively organised shipments. According to Hausman et al. (2013), trade grows by 1.39% for every 1% drop in shipping costs. Similar to this, a 1% drop in trade's overall processing costs will result in a 0.49% increase in bilateral trade. The price of logistics services determines a country's ability to offer shipments at reasonable prices. A number of costs related to the amenities provided along the path of exchange make up the cost of the physical movement of products.

Logistic quality and competence: It involves issues concerning the satisfaction and guarantee of the needs and requirements of the consumers of service quality management. In order to achieve logistics excellence, one must continuously increase service effectiveness, responsiveness, and supportability through ongoing, dedicated investment in logistics operations through the adaption of performance requirements, market standards, and resource augmentation. In promoting the transport of foreign trade, the efficiency of the logistics services plays an important role (Arvis et al., 2016).

Tracking and tracing: It deals with transportation aspects such as documentation and traceability of the entire supply chain. Countries are benefiting significantly from the development of improved handling of trade logistics. The tariff equivalent of information cost is six percent for countries with economies like the U.S. Being able to monitor supply chain locations and shipment details can decrease the uncertainty of shipment arrival. Tracking and tracing provide a consecutive sequence of supply chain processes across the supply chain. A

clearer and more substantial trade flow would lead to an enhanced and more satisfying global trade system.

Timeliness: Time is a very crucial factor as it relates to inventory costs and the level of service of the company. There is quite a clear link between efficiency and trade volumes, which contributes to company image and profits. From our empirical estimate, each day in transit has an incremental value of 0.8 percent of the value of manufactured goods, and every 10 percent increment of time reduces bilateral trade flows by 5 to 8 percent (Hausman et al., 2013; Djankov et al., 2010). The lead time for placing orders can be long, as well as the amount of time required before your order can be ready for delivery (Nordas et al., 2006).

1. 7.2 Pillars of Global Competitiveness

Global competitiveness is assessed using various pillars or factors that contribute to a country's economic strength and overall competitiveness. The pillars of global competitiveness used in this study are obtained and defined by the World Economic Forum. These pillars are components of a comprehensive framework that helps evaluate and compare the competitiveness of nations. The World Economic Forum's Global Competitiveness Index is made up of 12 pillars.

Institutions: Time is a very crucial factor as it relates to inventory costs and the level of service of the company. There is quite a clear link between efficiency and trade volume, which contributes to company image and profits. From an empirical estimate, each day in transit has an incremental value of 0.8 percent of the value of manufactured goods, and every 10 percent increment of time reduces bilateral trade flows by 5 to 8 percent (Hausman et al., 2013;

Djankov et al., 2010). The lead time for placing orders can be long, as well as the amount of time required before your order can be ready for delivery (Nordas et al., 2006).

Infrastructure: A highly effective economic system is crucial for the proper functioning of an economy. The modes of transport are great tools of progress as they facilitate the entry of people into the workforce. However, if electricity is not reliably available, companies and shops will not be able to function properly. A robust telecommunications network facilitates speedy and unrestricted information flow, which has a substantial impact on overall economic efficiency. It is noted that the quality of infrastructure is an important explanatory variable in the relationship between GVCs participation.

Macroeconomic environment: A country's economy can experience a decline if macroeconomic stability becomes a problem. Macroeconomic disarray can harm the economy because it can be very hard to control. The government cannot administer its programs effectively without sufficient tax and spending increases. Fiscal deficits jeopardize the government's ability to manage the business cycle. Hiring issues are the by-product of too much consumer demand. The economy cannot grow to prosperity and stability unless the macro environment is secure. The macroeconomic environment has been proven to be a determinant of GVCs participation (Masunda & Mupaso, 2019).

Health and primary education: Human capital is vital in the economy as a factor in productivity. Working individuals who are sick will be less productive because they cannot function to their full potential. Being unhealthy can lead to a high cost for a business due to low morale or absenteeism. Healthcare is critical for economic reasons as well as for a clear

moral code. This pillar also includes all the pertinent political and economic considerations. Basic education is indispensable for the advancement of society.

Higher education and training: High-quality higher education, training and skills-based institutes are crucial for economies (WEF, 2018). Small countries must be prepared to educate, develop and lead the development of science and technology as a key element in their quest for global business. This is one of the three pillars of sustainability because it is important to check the levels of competence to assist businesses and improve standards for the economy. As is the case with many other important economic factors, the training of workers by employers is also taken into consideration by international economists.

Goods market efficiency: Economies with more efficiently functioning markets can better provide the different types of goods depending on their demand and supply conditions. Good market competition, both within the local market as well as in foreign markets, is the driving force of market efficiency and, thus, for the realisation of business productivity. The efficiency of markets is mostly dictated by the characteristics of the buyer/consumer orientation and sophistication. A country needs the freedom and growth of its GVCs markets (Mayer & Ottaviano, 2008; Criscuolo et al., 2015).

Labour market efficiency: A key factor for a healthy labour market is the efficiency and flexibility of the labour market, which allows workers to get the most effective role for their employment in the economy and leads to them making the most beneficial efforts. Labour markets must be able to adjust quickly in response to changes in demand so that businesses can move from one sector to another to adjust to downturns in the economy. Equal opportunity must be encouraged in the workplace, and we must give well-paying work to all equally,

regardless of race or gender. Quality of life has an impact on talent shortages and economic performance, two factors that are important in the job market (WEF, 2018).

Financial market development: A smooth financial sector hands out incentives to the productive projects which accrue the most profit and help in the growth of the economy. Productivity is critical to economic growth. These economies also require financial markets that can improve the banking sectors and securities markets, providing critical liquidity that can be utilised for development. The banking industry needs to be an honest and transparent institution, and—as was evidenced in recent horrific scandals—markets need monitoring regulations to safeguard buyers and sellers in financial markets. Efogo (2020) studied dimensions of financial sector development and found that they were relevant to the effect of GVCs' participation in Africa.

Technological readiness: Technology readiness assesses the state of technology and IT in an economy to see if there is an appropriate focus on building technological capability. It is important for a country to have the right to participate not only in the actual development of these technologies but also in their utilisation. The central concept is that supply firms should have access to advanced products and other products which they can effectively use for future purposes. To a significant extent, FDI is usually seen as providing an entry to new technology and better management techniques.

Market size: As the size of the market increases, overall productivity improves. Historically, markets have been restricted due to borders. In the wave of globalisation, foreign markets have become an important source of market for developing countries. Exports can be viewed as a substitute for domestic spending. When gauging market size, we give credit to those industries that export from one country, such as the European Union.

Business sophistication: Business sophistication is concerned with the quality of business networks and the quality of individual businesses. These elements are essential for developed countries, which are at an advanced stage of development when the productive factors are no longer expanding much. A country's business network and supporting industries are important because it is a component in strategic and regulatory markets for most national industries. When sectors or clusters are interconnected in nearby geographic areas, greater opportunities for innovation and production processes are created, allowing easier market entry for new business sectors.

Innovation: The last Pillar focuses on innovation. Innovation has great importance for economies as they are beginning to explore the boundaries of knowledge, and combining and adapting the technologies coming from the outside is liable to cease. Firms can increase profits in manufacturing by opening new production processes or creating higher-valued finished goods. We should not expect legal innovation but only some positive reactions from the government and private citizens. These are necessities that must be fulfilled to meet the challenges of the knowledge-based economy.

1. 8 Structure of the Thesis

The complete thesis report consists of five (5) chapters. The next three (3) chapters, Chapter Two, Chapter Three, and Chapter Four, empirically address each of the research objectives (or questions). Lastly, Chapter Five (5) covers conclusions, trade and policy implications, and recommendations for trade and policy based on the findings from the thesis. The chapter also highlights areas of future research opportunities.

CHAPTER TWO

THE MEDIATOR ROLE OF LOGISTIC PERFORMANCE IN SUB-SAHARAN AFRICA: THE JOURNEY FROM GLOBAL VALUE CHAIN AND GLOBAL COMPETITIVENESS TO GROSS DOMESTIC PRODUCT

2.1 Introduction

Logistics performance, over the years, has been seen as a determinant of trade and, by extension, relevant to GVCs' participation. An interactive benchmarking tool called logistics performance was developed to assist nations in identifying the possibilities and challenges that affect their performance in terms of trade logistics. Based on a worldwide survey of logistics operators in the logistics industry, logistic performance is scored from 1 (low) to 5 (high). Logistics have been an essential driver of trade, as they facilitate the movement of goods from supplier to producer and from producers to consumers (Wong & Tang, 2018). The setup 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 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 logistic services (Logistic 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 logistic 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[3]. In terms of trade, Nigeria and Benin are rising to the top in Africa. For internal logistics and growth in intraregional commerce, Nigeria is ranked ninth in the world. 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[4] (*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 extant 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, has as strong labour force, and is 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 logistic efficiency in order to reap the benefits (Mensah & Fofana, 2018). The advantages of GVC participation largely project from exports of downstream goods and services in which the continent is lagging by large margins. For

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

instance, as one 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 logistic efficiency is not just increased levels of GVC participation but also 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 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 crust 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 study is built on both product fragmentation and new trade theories, which explicate the efficiency of production and the transportation of goods and services, enabling countries to stand a better chance of GVCs participation and hence attaining economic prosperity.

It is established in the literature that the African markets emerge as a substantial trading bloc regarding the abundance resources, and wealth accumulation coupled with higher purchasing power (Adewole & Struthers, 2019). Improvement in logistics efficiency is however crucial without which the continent might not sufficiently gain from established trade agreements. For instance, the African Continental Free Trade Area (AfCFTA) has enhanced potential growth in the region as can be evidenced by Sub-Saharan regional GDP growth of 3.4% in 2021 irrespetive of the COVID-19 pandemic. Acknowledging the significance of a robust logistics sector as a key facilitator of development is a widely recognized concept (Kuteyi & Winkler,

2022). Moreover, stakeholders engaged in international trade, particularly in the realm of exports, are urged to enhance their logistical performance to maximise the benefits derived from their endeavours (Gani, 2017).

Current studies on the impact of logistics performance on economic growth, particularly in African and developing countries, demonstrate several gaps that create a myopic view of understanding. Prior studies have often focussed on specific aspects of the Logistics Performance Index (LPI) without considering its broad impact on the economy (Kuteyi & Winkler, 2022). While some studies reveal a positive correlation between logistics efficiency and economic growth, others emphasize the need for a nuanced assessment, incorporating mediating and moderating roles (Magazzino et al., 2021). Hence, the direction of the influence of logistics performance on economic prosperity in the presence of intervening factors remains unclear.

This study aims to bridge the gaps in the literature by focusing specifically on Sub-Saharan African countries. It highlights the relevance of encapsulating all dimensions of LPI and using a hierarchical regression approach to understand the direct, indirect, complementary, or competitive mediation of logistics performance on GDP (Baron & Kenny, 1986; Civelek et al., 2015; Sergi et al., 2021). The study aims to guide policy actions by offering bespoke outcomes pertinent to the unique context of African nations. Also, it explores the mediating role of LPI in the nexus between the Global Competitiveness Index (GCI) and GDP. Literature suggests a linkage among LPI, GCI, and GDP, recognising factors such as human factors, infrastructure, and institutions as essential elements for efficient logistics development (Sergi et al., 2021; Martí et al., 2014; Önsel Ekici et al., 2016, 2019).

Our study is beneficial in several ways. First, this study on Africa provides a new perspective on the debate about the direction of 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, and 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 logistic performance in the region and maximising global value chain 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 participants. 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 not competitive in the global market (Allard et al., 2016). Especially with a focus on improving logistic 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 logistic 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 logistic performance; it must 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 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 chapter is as follows: section 2.2 presents the theories that bind the study; Section 2.3, a literature review; Section 2.4, the materials and methods; followed by a preliminary analysis of the data in Section 2.5. Sections 2.6 and 2.7 entail analysis and discussion of findings and conclusions, respectively.

2.2 Theoretical Backdrop to the link between Logistic Performance, Global Value Chains and Competitiveness

The emergence of GVCs has led to a search for theories that explain the intention of firms and countries to participate in GVCs. Two theories have emerged as though unrelated to explaining GVCs participation. These are the fragmentation theory of Arndt and Kierzkowski (2001), Jones and Kierzkowski (1990) and the new trade theory by Melitz (2003) and Helpman et al. (2004). In the next section, the tenets of these theories are explained and linked to the study.

2.2.1 International Fragmentation of Production Theory

According to fragmentation theory, production processes are fragmented or separated into multiple parts and located in different countries and make sense when;

a. there are cost savings in production from fragmented production units,
b. the cost of servicing the link of connecting production blocks remotely is low; and
c. there is a small cost in network set-ups.

This theory explains that industries reduce costs by sourcing labour and other products from abroad, but they must purchase more resources to reap potential benefits. Thus, increased purchases of the service activity are necessary for increases in international sourcing. Importantly, the theory puts the coordinating and amalgamating services - such as transport, communications, efficiency, and information technology - at the centre of the discussion (Hillberry, 2011). The service link cost is associated with the efficiency of the logistic system and production technology.

In the context of this study, an efficient logistic system to be proxied by logistic performance will lower the cost of servicing the link of connecting production blocks remotely to increase GVC participation. The competitiveness of an economy is associated with production efficiency, which could lead to lower costs in network set-up. The implication of the theory is that increase in production efficiency and service links increases countries' participation in GVCs. The question of particular interest in this thesis is whether reformation in logistic performance and global competitiveness might have been responsible for Africa's GVC participation. The presumptions of fragmentation theory that the influence of determinants on intermediate goods trade is stronger than on trade in final goods limit the capability of the theory to fully explain the drivers of GVCs' participation, especially downstream.

2.2.2 New Trade Theory

The new trade theory is inspired by differentiated product competition in oligopoly markets and firm heterogeneity. There is an essential role these multinational activities play in the analyses of how firms take part in the formation of GVCs. Helpman et al. (2004) suggest that efficiency advantages in international trade, as well as the international gains from trade, lead firms to participate in international trade. That way, a few highly efficient firms can do this successfully as the logistics costs can be covered by the profits obtained from overseas business. Antràs and Helpman (2004) posit that the size and distribution of industries within a state have had a significant impact on state-owned companies' decisions to enter markets and achieve profitability. Grossman and Helpman (1991) highlight the advantages and disadvantages of vertical integration (outsourcing). The owners of intermediate goods vary when pursuing the production process by producing different end products (Antras & Helpman, 2004).

The new trade theories emphasise that imperfect competitiveness and productivity gains of intermediate goods producers stimulate intra-industry trade in homogeneous or segregated intermediate goods rather than comparative advantages, which play a dominant role in trade flows between developed countries. As a result, when monopolistic competition exists in intermediate goods markets, the size of economies becomes an important determinant of international fragmentation of output and trade in differentiated intermediate inputs between countries (Ethier, 1982). This theory, combined with the fragmentation model, provides an integrative framework for the influences of global competitiveness and logistics performance on global value chains' participation. Thus, countries where production and logistic efficiency

can be assured stand a better chance of GVCs participation and hence attain economic prosperity.

2.3 Literature Review

The current body of literature demonstrates how the African markets present a continent that is strategically emerging as a significant trading bloc, particularly for Asia and parts of Europe, based on its abundant resources, growing wealth, and larger middle class, which is accompanied by a higher purchasing power (Adewole & Struthers, 2019). The recent adoption of the African Continental Free Trade Area (AfCFTA) 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 logistic efficiency, African countries cannot benefit from this and the increasing trade liberalisation and openness, such as the Economic Partnership Agreement (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). In addition, participants in international trade, especially exports, need to strengthen their logistic 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 logistic 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 the impact of LPI on economic wellbeing. For example, Magazzino et al. (2021) examined the determinants of logistic 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 to economic growth and environmental soundness in 25 topmost logistics countries.

Also, the LPI and its sub-indices are shown to have a 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 to economic prosperity. With many CEE countries bearing features of African nations, mediation of LPI in the nexus can shed more light for 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 logistic 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 logistic infrastructure in Sub-Sahara African countries. They surmise that adopting digital technologies to boost logistic performance will also boost economic growth. The common outcome revealed by earlier studies divulge an enhancement in economic growth by an improved level of logistics performance.

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 impact of LPI is to amplify to 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 logistic 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 logistic 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 chain 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 use a hierarchical regression approach as suggested by (Baron & Kenny, 1986) and applied in (Civelek et al., 2015; Sergi et al., 2021, 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 logistic 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 the 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 logistic performance and global competitiveness (see Martí et al., 2014; Önsel Ekici et al., 2016, 2019).

2.4 Materials and Methods

In order to ascertain the important mediator role of the logistic sector in the nexus between GCI and GDP, we employ the explanatory linear regression approach. We use the suggested approach by Baron and Kenny (1986). The approach is becoming popular in the GVC literature with applications by Civelek et al. (2015) and Sergi et al. (2021) and expositions from Zhao et al. (2010). In generic terms, a mediator identifies and explains the underlying connection between a dependent and an independent variable through the addition of a third variable. The Baron and Kenny (1986) mediator model follows this process:

1) regress the mediator on the independent variable

2) regress the dependent variable on the independent variable

3) regress the dependent variable on both the independent variable and the mediator.

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 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 to the same direction.
ii. Competitive mediation - Mediated effect (Paths α and β) and direct effect (Path γ) are both significant and point to the 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.

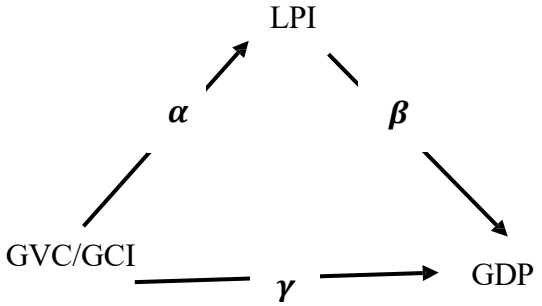


Figure 2.1: Mediation model based on Baron and Kenny (1986).

Following from the model in Figure 2.1 and with inspiration from Civelek et al. (2015), the following hypotheses are presented which correspond to equations 1, 2, 4, and 4, respectively.

H_1: Logistic Performance Index is positively influenced by Global Value Chain/Global Competitiveness Index

H_2: Gross Domestic Product is positively influenced by Logistic Performance Index

H_3: Gross Domestic Product is positively influenced by Global Value Chain/Global Competitiveness Index

H_4: Logistic Performance Index has a mediator effect on the nexus between the Global Value Chain/Global Competitiveness Index and Gross Domestic Product

$$LPI = \beta_0 + \beta_1 GVC + e \quad (1)$$

$$GDP = \beta_0 + \beta_1 LPI + e \quad (2)$$

$$GDP = \beta_0 + \beta_1 GVC + e \quad (3)$$

$$GDP = \beta_0 + \beta_1 GVC + \beta_2 LPI + e \quad (4)$$

$$LPI = \beta_0 + \beta_1 GCI + e \quad (5)$$

$$GDP = \beta_0 + \beta_1 LPI + e \quad (6)$$

$$GDP = \beta_0 + \beta_1 GCI + e \quad (7)$$

$$GDP = \beta_0 + \beta_1 GCI + \beta_2 LPI + e \quad (8)$$

2.5 Data Description and Preliminary Analysis

The data for this study is made up of panel data of the dimensions of the logistic performance index (LPI), World Economic Forum's global competitive index (GCI) and GVCs participation for the years 2007, 2010, 2012, 2014, and 2016, and 2018 for 37 African countries. The inclusion of the countries is solely based on the availability of complete datasets for three key variables. The data for LPI and GCI were extracted from https://tcdata360, worldbank.org, and GVCs are computed from OECD TiVA and EORA databases. The main variables of interest will be the dimension of the key constructs: logistic performance, global competitiveness index and GVCs participation. These are used for all the empirical chapters. Due to the lack of data for all countries and for all years, the data for GVC, GDP, and GVCPI are balanced against them for conformity reasons.

We use the composite indices for each of the variables. As per the literature, the GVC comprises the four (4) main indicators: domestic value added (DVA) in exports, foreign value added (FVA) in exports, indirect domestic valued added (DVX) in exports, and value-added (VA). The LPI has six (6) dimensions: 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 logistic services (Logistic Quality), ability to track and trace consignments (Tracking and Tracing), and frequency with which shipments reach the consignee as scheduled (Timeliness) (Arvis et al., 2018). There are twelve (12) Pillars for the GCI: 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. The Gross Domestic Product used is in

current US dollars. In Table 2.0, we have presented the definition of the variables used in this chapter and subsequent chapters.

Table 2.0: Definition of variables

Variable	Definition	Abbreviation
Global Value Chain	The division of manufacturing into activities and tasks is carried out in several nations (OECD, 2020; Amador & Cabral, 2017; Kowalski et al., 2015).	GVC
Global Competitiveness Index	A set of institutions, policies, and factors determine the level of productivity, which in turn determines the level of prosperity that can be achieved by an economy in the GVC (Arvis et al., 2018; WEF, 2015).	GCI
Logistic Performance Index	An interactive benchmarking tool that helps countries to identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance.[5]	LPI
Gross Domestic Product	The sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products[6].	GDP
Global Value Chain Participation Index	In estimate of how much an economy is connected to global value chains for its production and foreign trade. It is the sum of the share of foreign value-added in gross domestic	GVCPI

[5] https://lpi.worldbank.org/
[6] https://databank.worldbank.org/metadataglossary/africa-development-indicators/series/NY.GDP.MKTP.PP.KD#:~:text=GDP%20is%20the%20sum%20of,and%20degradation%20of%20natural%20resources.

	exports and the share of domestic value-added in gross foreign exports (Yanikkaya & Altun, 2020).	
Valued-Added	The income of the factors involved in diverse ways in the production of goods and services (Fujii-Gambero & Cervantes-Martínez, 2016).	VA
Domestic Valued-Added	Value-added is embodied either in final or intermediate goods or services that is directly consumed by the importing economy (Fujii-Gambero & Cervantes-Martínez, 2016).	DVA
Foreign Valued-Added	Value-added of inputs that were imported in order to produce intermediate or final goods/services to be exported (Fujii-Gambero & Cervantes-Martínez, 2016).	FVA
Indirect Domestic Valued-Added	Value-added that comprises the income contained in domestically produced inputs incorporated into exports (Fujii-Gambero & Cervantes-Martínez, 2016).	DVX

Table 2.1: Summary statistics and correlations

	GDP	**GVC**	**GCI**	**LPI**	**GVCPI**
Obs.	174	174	174	174	174
Median	1.23E+10	4.31E+05	39.36962	2.32000	0.00004
Mean	4.43E+10	3.61E+06	30.23207	1.90816	0.00017
Variance	1.00E+22	1.22E+14	378.43270	1.19117	0.0000
Std. Dev	1.00E+11	1.10E+07	19.4534	1.0914	0.0008
Skewness	3.2730	4.6023	-0.8047	-0.9625	7.8338
Normtest.W	0.4501***	0.3286***	0.7427***	0.7629***	0.1743***
	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

*Note: *** denote Shapiro-Wilk test of normality at 1% significance level.*

From Table 2.1, we present the summary statistics and Pearson correlation among the variables under study to get a glimpse of how they are distributed and related. For the summary statistics, we find huge averages for GDP and GVC unlike GCI, LPI, and GVCPI. This is not surprising given the deficiency of the SSA region along of lines GCI, LPI, and GVCPI for we are advocating for policy and action improve upon. We find that variances and standard deviations are GDP, GVC, GCI, LPI which are concerning because they indicate huge swings from their typical values which is a source risk. In terms of the distribution of the data, the Shapiro-Wilk test of normality adjudge all the variables as deviating from the normal distribution at the 1% confidence level. These are also confirmed by the positive (GDP, GVC, and GVCPI) and negative (GCI and LPI) skewness values. Negative skewness representing averagely smaller values of GCI and LPI than bigger values are unwelcome news in line with their small mean values. That is why the study improvement in the LPI and GCI in the region in order to enjoy the benefits of liberalisation of trade via the GVC.

As a relationship, there is confirmation of a statistically significant relationship between GDP, GVC, GCI, and LPI in a pairwise manner. The strongest link is between GDP and GVC (81%), followed by LPI and GCI (50%), LPI and GDP (35%), LPI and GVC (34%), GCI and GDP

(26%), and the least GCI and GVC (23%). The fact that all these correlations are positive corroborates the foregoing discussion in the literature about the relationship among the variables. The finding supports our main suspicion of there being a mediating role of LPI between GDP and GVC (and, by extension, between GDP and GCI).

It is clear that the GVCPI has no significant relationship with any of the variables, including GDP. Despite the purported importance of GVCPI (being the best indicator for both backward and forward linkages) in the global value chain space for Africa (Yedan, 2019), it appears not to be relevant for this study pertaining to the data used. Nonetheless, this is not surprising because GVC participation is unfavourable for many African countries given that a larger part of participation is in upstream production (i.e. the export's non-upgraded production inputs) (Foster-McGregor et al., 2015) despite recent progress. Hence, we ignore the GVCPI in our substantive method, contrary to the initial survey. Further, the correlations among the variables provide enough grounds to investigate their interrelationships in the manner that is done in this chapter.

2.6 Analysis and Discussion of Results

In this section, we submit the results and findings from the investigation of the mediating role of LPI in the nexus between GDP and GVC. The results are given in Tables 2.2, 2.3, and 2.4. Analogous to that, we do the same for GDP and GCI for purposes of robustness. The estimates are provided in Tables 2.2, 2.3, and 2.4.

2.6.1 The nexus between GDP and GVC

From Table 2.2, we find that all four models possess appreciable amounts of explanatory power as measured by their coefficients of determination (we use the Adjusted R^2 in the analysis for

obvious reasons). Of particular notice, models 3 and 4. In Model 3, just about 12% of all the changes in GDP can be explained by changes in the levels of GVC participation. However, with the addition of LPI, about 66% of all variations in GDP can be explained by the variations in GVC and LPI (Model 4). This is an increment of about 54%. It is, therefore, clear that the impact of LPI is the nexus between GDP and LPI. This finding confirms the mediating role of LPI as espoused in d'Aleo (2015) and Civelek et al. (2015). The type and direction of the role of LPI are explained by the outputs in Table 2.4.

Table 2.2: 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}

In terms of the models being meaningful, this is suggested by the ANOVA in Table 2.3. We find that all the independent variables can explain the variations in GDP for all the models at all levels of significance, except in Model 4. In Model 4, the model is only significant at the 10% level, which is adequate because it is a conventional level of significance.

Table 2.3: 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 2.4: 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 x 10^9	9.0157 x 10^9	0.480	0.63
	GVC	7090.2***	427.4	16.590	0.00
	LPI	7.5441 x 10^9*	4.3228 x 10^9	1.745	0.08

In analysing Table 2.4, we take note of the definitions of mediation by Baron and Kenny (1986) and Zhao et al. (2010), as indicated in section 3. Since the latter is an improvement upon the former, we base the analysis on that. There are also overlapping definitions in both, which is indicated. To start with, all the coefficients of the independent variables are statistically significant at all conventional levels of significance except for Model 4, which is significant at only the 10% level. We also note that the coefficients are all positive for the four models, indicating a direct link. The indication of all significance and all the same direction effects in the four models have important implications. First, this confirms that logistic performance (LPI) is indeed a mediator between economic prosperity (GDP) and global value chain participation (GVC). Specifically, LPI plays a role in amplifying the level to which GVC determines the levels of GDP (also corroborated in Table 2.2). Second, this suggests Complementary mediation, according to Zhao et al. (2010), which is the same as Partial mediation by Baron and Kenny (1986). Once again, these conform to the findings of d'Aleo (2015) and Civelek et al. (2015). The amplifying role of LPI is instructive for the region given the low levels of LPI. This implies that, if efforts are undertaken to improve on the logistic performance in the region, it will go a long way to solidify the gains from international trade.

However, our results are new and revealing in the sense that both d'Aleo (2015) and Civelek et al. (2015) examined GDP and GCI. In this study, we have improved that with GDP and GVC. This is a significant contribution to the literature. The Partial mediation role of logistic

performance is also telling for policy and business. The implication is that the pursuit of logistic 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 logistic efficiency to improve performance, other areas, such as the competitiveness of downstream export of production, need attention. After all, improving logistic performance spurred by new technologies depletes the comparative advantage of African countries in traditionally labour-intensive manufacturing, as warned by Rodrik (2018).

2.6.2 The nexus between GDP and GCI

In this sub-section, we analyse the mediating role of LPI on the interdependence between GDP and GCI. This is common in the literature, and global competitiveness is deemed essential to increase inflow through participation in the global value chain. In Tables 2.5, 2.6, and 2.7, we present the findings.

Table 2.5: 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	$1.043x10^{11}$
7	0.32047	0.1027	0.09661	$1.008x10^{11}$
8	0.35944	0.1292	0.1173	$9.961x10^{10}$

Similar to the link between GDP and GVC (in Table 2.2), we see in the model summary in Table 2.5 that logistic performance increases model adequacy from about 1% (in Model 3) to about 12% (in Model 4), representing 11% improvement. This is the only suggestion sign that

LPI has a role to play when it comes to determining the levels of GDP with GCI. The specific nature of the role can be seen in Table 2.7.

In Table 2.6, except for Model 1, all three models are meant to determine GDP using GCI and LPI at the 5% significance level. Thus, while the variations in LPI cannot be explained by variations in GCI, changes in GDP can be explained by changes in GCI and LPI.

Table 2.6: 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	$6.4947x10^{22}$	1	$6.4947x10^{22}$	5.971	0.02
	Residuals	$1.6098x10^{24}$	148	$1.0877x10^{22}$		
	Total	$1.6747x10^{24}$	149			
7	Regression	$1.7195x10^{23}$	1	$1.7195x10^{23}$	16.934	0.00
	Residuals	$1.5028x10^{24}$	148	$1.0154x10^{22}$		
	Total	$1.6748x10^{24}$	149			
8	Regression	$2.1632x10^{23}$	2	$2.1632x10^{23}$	21.800	0.01
	Residuals	$1.4584x10^{24}$	147	$9.9213x10^{21}$		
	Total	$1.6747x10^{24}$	149			

In Table 2.7, it is unclear which specific mediation effect is portrayed by LPI for the link between GDP and GCI according to the definitions of both Baron and Kenny (1986) and Zhao et al. (2010). However, it is evident that there is a strong mediation role. This is seen by significant relationships in Models 1, 2, and 3, which are all positive. Thus, we rule out complementary mediation and competitive mediation. This result partially replicated those of d'Aleo (2015) and Civelek et al. (2015).

Table 2.7: 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	$6.763x10^{09}$	$2.017x10^{10}$	0.335	0.7378
	GCI	$1.274x10^{09}$*	$5.213x10^{8}$	2.444	0.0157
7	Constant	$-3.826x10^{10}$	$2.330x10^{10}$	-1.642	0.10
	LPI	$4.052x10^{10}$***	$9.848x10^{09}$	4.115	0.00
8	Constant	$-7.038x10^{10}$*	$2.759x10^{10}$	-2.551	0.01
	GCI	$1.059x10^{09}$*	$5.009x10^{08}$	2.115	0.04
	LPI	$3.825x10^{10}$***	$9.793x10^{09}$	3.906	0.00

This portion of the study has thrown more light on the differences in the mediating roles LPI play depending on when global competitiveness or global value chain participation is the driving motive for improving national income earnings. 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 especially true for African countries as they are delicate because of their inclination towards upstream participation. More clarity is needed on this front while chasing the clearer role of LPI on the link between GDP and GVC.

2.7 Conclusions and Recommendations

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 logistic efficiency in the global value chain and the subsequent gains from which it 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 also mediated by logistic performance.

Our study is situated in the product fragmentation theory and supported by the new trade theory. We employed data from 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 logistic 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 finding corroborates those of d'Aleo (2015) and Civelek et al. (2015) regarding 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 logistic 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 logistic efficiency to improve performance, other areas, such as the competitiveness of downstream export of production, need attention. After all, improving logistic 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 logistic performance of a country. Second, while all dimensions are important, they affect GVC in a different and heterogeneous manner. Thus, lumping up all the dimensions by using the composite logistic 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.

CHAPTER THREE

THE INTERACTIVE EFFECT AMONG THE PILLARS OF GLOBAL COMPETITIVENESS AND LOGISTICS PERFORMANCE IN SUB-SAHARAN AFRICA

3.1 Introduction

Globalisation and internationalisation have influenced modern logistics (Beysenbaev & Dus, 2020). As such, international logistics is elated by advancements in global economic integration, and the tendency for businesses to operate globally adds to the development of global logistics systems and supply chains on the market (Beysenbaev & Dus, 2020; Ekici, Kabak & Ülengin, 2019; Sergi et al., 2021). The exchange of commodities and services between nations through export and import activities constitutes the global market. On a global scale, there is competition between market participants, or in this case, countries, just like in any market system in line with the new trade theory. The new trade theory enhances the globalisation of production, the need for government support, such as subsidies for improved industrialisation, helps local firms to compete with international ones and ensures trade competition among similar countries. The development of benchmarking tools, such as the World Economic Forum's annual Global Competitiveness Report and the Institute for Management Development's World Competitiveness Yearbook, demonstrates that the need for nations to have competitive market positions through global integration has been acknowledged by the international community.

Policy-makers are aware that nations with the capacity to produce items of higher quality at lower costs or to act as handy and affordable transportation corridors for goods will have a clear competitive edge on the global market (Sergi et al., 2021). International competitiveness

is severely lacking in nations with high logistical costs. The high logistical cost is germane on the part of African countries to which Sub-Saharan Africa is no exception and is borne with less capacity to ensure lean and agile logistics (Kuupiel, Bawontuo & Mashamba-Thompson, 2017). Predicated on its abundant resources, growing wealth, and expanded middle class, which has a higher purchasing power, the current body of literature shows that the African markets represent a continent that is strategically emerging as a significant trading bloc, particularly for Asia and parts of Europe (Adewole & Struthers, 2019). Sub-Saharan regional GDP growth of 3.4% in 2021, despite the influence of the COVID-19 pandemic, is evidenced that the recently adopted African Continental Free Trade Area (AfCFTA) enhances the capacity of the continent.

The EPA between West African nations and the European Union, which took effect in 2014, is only one example of the growing trade liberalisation and openness that African countries cannot take advantage of without an improvement in logistical efficiency. One of the key factors enabling development is a strong and globally recognised logistics industry (Kuteyi & Winkler, 2022). In order to benefit from their efforts, participants in international trade, particularly exporters, must also improve their logistic performance (Göçer, Özpeynirci & Semiz, 2022). This demands that governments within the Sub-Saharan region evaluate the current region's logistics system to determine its optimisation, development, and creation through policies and initiatives from the region's global competitiveness level. The study aims to investigate the interactive relationships among the pillars of GCI and how they feed into logistics performance.

Prior studies have predominantly addressed concerns on micro-logistics (see, Adetiloye & Pervez, 2015; da Mota Pedrosa, Blazevic & Jasmand, 2015) due to the absence of reliable proxies for country-level to global-level analysis. However, acknowledging the prominence of assessing regional logistical and transport systems, recent studies have emerged, highlighting the role of macro-logistics (see, Ekici, Kabak & Ülengin, 2019; Göçer, Özpeynirci & Semiz, 2022). The LPI is usually employed as a benchmarking tool in global logistics research, aiding in nation-level comparisons and intra-national logistics assessment (Beysenbaev & Dus, 2020; Göçer, Özpeynirci & Semiz, 2022).

We seek to investigate the extent to which GCI can improve LPI. Prioritising GCI pillars, the study aims to guide policymakers on factors influencing logistics performance and the interactive effects among GCI pillars. Existing studies on GCI and LPI have predominantly been comparative or country-specific (Ekici, Kabak & Ülengin, 2019; Beysenbaev & Dus, 2020; Khan et al., 2020; Karaman, Kilic & Uyar, 2020; Göçer, Özpeynirci & Semiz, 2022). However, a notable gap exists in studies exploring the interactive effects of GCI and LPI in specific regional contexts. Noting logistics as a competitive advantage for businesses and regions, this study focuses on Sub-Saharan African (SSA) countries to offer tailored insights for policy formulation (Sergi et al., 2021). Unlike previous studies, we aim to examine the interactive effects of GCI pillars on LPI, toward addressing literature gaps.

To achieve this, we employed the Tree-augmented Naïve Bayes (TAN-BN) and Partial Least Square Structural Equation Modelling (PLS-SEM) approaches, building on the methods suggested by Ekici et al. (2019). The TAN-BN enables the evaluations of causal connections amid GCI and LPI factors, while PLS-SEM improves the model inputs. Accentuating the

indirect nexus resulting from interactions among the pillars of GCI, we establish that these interactions play a crucial role in influencing overall LPI scores (Ekici et al., 2019). This approach allows for a more comprehensive understanding of the dynamic relationships between GCI pillars and logistics performance in the context of SSA countries.

Policy-makers within the Sub-Saharan region can effectively utilise their limited resources to raise the logistical competitiveness of their nations by taking these connections into account and concentrating on the crucial competitiveness pillars. Additionally, using this method will allow policymakers to determine which GCI pillars are more important than others in terms of influencing the final LPI score when deciding where to allocate the limited resources needed to improve a nation's logistics performance within the region. Categorically, these approaches are essential to inform policy actions that are directed towards either direct, indirect, or complementary effects of GCI and on logistics performance.

We make four unique contributions to the existing literature on the nexus between GCI and logistics performance. First, we ascertain the interactive effects of the 12 pillars of GCI in Sub-Saharan Africa as a territory or region rather than through a comparative study within the region. This is necessary for the formulation of single policies for the regional bloc on important pillars due to the increasing removal of barriers and liberalisation policies by governments that have facilitated international trade and integration. Second, we reveal important pillars that contribute to logistics performance while recognising pillars that might have indirect effects on logistics performance. In this manner, the improvement of indirect pillars within the Sub-Saharan region may feed into other pillars, which may have a substantial direct impact on logistics performance. Third, we provide policy directions and harness the

awareness of policymakers in the region with regard to the interactive effects among the 12 pillars of GCI as well as their influence on logistics performance. Fourth, innovative approaches (TAN-BN and PLS-SEM) are applied in stages to address the research problem in the context of Sub-Saharan Africa.

The results of this investigation revealed that most of the GCI Pillars have a significant, positive relationship with one another. Additionally, it was discovered that the only GCI Pillar that significantly and directly positively correlates with logistics performance was technology readiness. On the other hand, a significant indirect association between logistics performance and higher education and training was found.

The remaining sections of the study are as follows: The theoretical basis in 3.2, the literature review in section 3.3, the methodology is presented in section 3.4, then section 3.5 shows a preliminary analysis of the results, analysis and discussion of the findings. Theoretical, practical and policy implications of the findings are contained in section 3.6, whereas the concluding part is contained in section 3.6.

3.1.1 Theoretical for the nexus between Pillar of Global Competitiveness and Logistic Performance

The Institutional Theory is selected as the best to establish the interaction among the pillars of global competitiveness and logistic performance in SSA. Institutional theory offers valuable insight into how a country's institutional environment influences logistic performance and, consequently, global competitiveness. Institutions encompass formal rules (e.g., laws and

regulations) and informal norms (e.g. cultural practices and social conventions) that govern economic activities within a society (North, 1990). Institutions such as transportation networks, ports, and warehousing facilities play a critical role in shaping logistic infrastructure development. Effective institutions can provide clear property rights, streamline regulatory processes, and ensure stable investment environments, which are essential for attracting private and public investments in logistic infrastructure (Hall & Thelen, 2009; Muturi, 2023). For example, countries with well-established legal frameworks and transparent regulatory systems are more likely to attract investment in logistic infrastructure projects, leading to improved logistic performance.

The regulatory environment significantly affects the efficiency of logistic operations. Institutions that promote transparency, predictability, and efficiency in regulatory processes can reduce bureaucratic delays, corruption, and red tape, thereby enhancing logistic performance (Acemoglu & Robinson, 2012). Conversely, weak institutions characterised by corruption, regulatory unpredictability, and political instability can hinder logistic efficiency, increasing business costs and delays. Again, high-quality institutions are essential for effective trade facilitation, which is critical for enhancing a country's global competitiveness. Institutions that support transparent customs procedures, efficient border management, and reliable infrastructure contribute to smooth cross-border trade flows and efficient logistic operations (Liang, Guo, Li, Zhang & Fei, 2021; Djankov et al., 2010). Countries with well-functioning institutions in trade facilitation are better positioned to integrate into global value chains and compete effectively in international markets.

Institutional frameworks shape the development and implementation of public-private partnerships (PPPs) in logistics, which can enhance logistic performance through collaboration between government agencies and private sector entities. Institutions that support PPPs by providing clear legal frameworks, risk-sharing mechanisms, and transparent procurement processes can facilitate investments in logistic infrastructure and services (Estache & Wren-Lewis, 2009; Trebilcock & Rosenstock, 2015). The PPPs can improve logistic performance by leveraging private sector expertise, innovation, and investment capital to address infrastructure gaps and enhance service quality. The preceding discussions show that institutional theory provides a comprehensive framework for understanding the relationship between global competitiveness and logistic performance. Effective institutions support logistic infrastructure development, promote regulatory efficiency, facilitate trade, and encourage logistics collaboration between the public and private sectors. By fostering an enabling institutional environment, countries can enhance their logistic performance and strengthen their competitiveness in the global economy (Ekici, Kabak, & Ülengin, 2019). Thus, the institutional theory clearly ties improved competitiveness and logistic performance to each other, which are much needed in SSA to increase the gains in global value chain participation.

3.2 Literature Review

To track a country's performance on 12 pillars of competitiveness, the World Economic Forum (WEF) publishes the Global Competitiveness Index (GCI) every year. The GCI evaluates the key elements and organisations that affect a country’s ability to grow and compete over the long term. As a result, this indicator tries to aid decision-makers in comprehending the complexity and variety of the development problem. Three sub-indices—basic prerequisites,

efficiency-improving factors, and innovation and sophistication factors—are created from these pillars.

Under the basic prerequisites, four pillars are considered: institutions, infrastructure, macroeconomic environment, health, and primary education. Higher education and training, good market efficiency, labour market efficiency, financial market development, technological readiness, and market size form the efficiency-improving factors. On the other hand, business Sophistication and innovation make up the key innovation-driven economies. Depending on each economy's stage of development, different weights are assigned to the three sub-indices when calculating the overall index. Hence, the influence of the 12 pillars of GCI on logistics performance might not be the same, which requires empirical investigation for policy decisions. Accordingly, examining the nexus between each of the 12 pillars of GCI and logistics performance is more practicable to decipher the relative importance of the pillars in enhancing LPI (Ekici, Kabak & Ülengin, 2019; Sergi et al., 2021).

Giving credence to each of the 12 pillars opens up a discussion as to whether the pillars of GCI in the sub-Saharan region are connected. The existence of linkages among the pillars in this regard may interrupt policy decisions if there is a concentration on what drives logistics performance alone. It is, therefore, problematic to investigate the improvement of logistics performance while there could be existing correlations among the 12 pillars themselves. For instance, good health and access to primary education are the foundation of higher education and training (Salmi & D'Addio, 2021). Again, the more people are educated and trained, the more efficient the labour market is (Oswald-Egg & Renold, 2021), and the need for

technological readiness (Goswami & Daultani, 2021). Furthermore, a sound macroeconomic environment contributes to financial market development (Asafo-Adjei et al., 2022).

From the series of events given among several others, the pillars of GCI do not operate in isolation but could be integrated. Hence, investigating the interactive effects among the 12 pillars is relevant in providing support for factors of GCI that could accurately capture the dynamics of LPI would enhance the awareness of policymakers (Jitmaneeroj, 2016; Ekici, Kabak & Ülengin, 2019). This is supported by the new trade theory, which enhances the globalisation of production and encourages extensive trading among similar nations to warrant global competitiveness among nations. The challenge is, therefore, how to efficiently move goods and connect manufacturers and consumers with international markets in the case of developing countries. The objective of this study is to examine the interactive relationships among the pillars of GCI and how they feed into logistics performance in the context of developing and emerging countries.

Research is typically conducted more frequently at the level of micro-logistics than at the level of global logistics, which contributes to the dearth of many significant instruments for measuring country-level logistics efficiency. It is important for governments to evaluate and compare their regional logistical and transport systems in order to appreciate the present challenges the region is facing, even if effective micro-logistics often result in a more successful country-level logistics system. The LPI is frequently used in global logistics research as a benchmarking and comparison tool for nations, as a starting point for the creation of new procedures and instruments, and as a method for assessing the performance of intra-national logistics (Beysenbaev & Dus, 2020; Göçer, Özpeynirci & Semiz, 2022).

The fundamental question for this study is, therefore, the extent to which a territory's (Sub-Saharan Africa) logistics performance can be improved using the pillars of GCI. For this reason, we prioritise the pillars of GCI toward the improvement of logistics performance to heighten the understanding of policymakers about the territory in relation to (i) the magnitude of effect each pillar has on logistics performance, (ii) important contributing factor(s) of logistics performance, and (iii) the interactive effects among the pillars of GCI.

Existing studies on GCI and LPI have concentrated on comparative and/or country-specific analyses (Ekici, Kabak & Ülengin, 2019; Beysenbaev & Dus, 2020; Khan et al., 2020; Karaman, Kilic & Uyar, 2020; Göçer, Özpeynirci & Semiz, 2022). However, studies that consider the interactive effects among GCI and LPI in the unique context of a particular region are missing. It must be noted that for businesses and regions, including continents, countries, regions, and districts, including urban/metropolitan areas, logistics has shown to be a competitive advantage (Sergi et al., 2021). A territory lacking effective supply logistics, such as infrastructure networks, might gravely jeopardise its economic development in an increasingly globalised world (Sergi et al., 2021). A more integrated living and working environment can be achieved by planning and designing the physical territory to function as a single context infrastructure that is both appealing and well-balanced. The idea of competition has expanded due to globalisation: Territories are impacted by competition, which is referred to as the operational systems that foster local economic and social development, promote small enterprises, and draw in new entrepreneurs.

Following the above, prior studies do not consider interactive effects among GCI and their influence on LPI, with much emphasis on a given territory. The closest study in this regard is that of Ekici et al. (2019), which concentrated on several countries with no particular concentration and employed the Tree-augmented Naïve Bayes and the Partial Least Square approaches. Sergi et al. (2021), on the other hand, laid emphasis on both descriptive and inferential statistics for three clusters of GCI – infrastructure, human factor and institutions – and LPI for regions including Africa, Asia and the European Union employing the ANOVA method.

We address important gaps through the 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 interactive effects of the pillars of GCI in a unique context of a territory rather than relying on a single country, as revealed in the study of Ekici et al. (2019). We recognise the indirect relation between the 12 pillars of GCI and LPI. The Tree-augmented Naïve Bayes (TAN-BN) and the Partial Least Square Structural Equation Modelling (PLS-SEM) approaches, as suggested by Ekici et al. (2019), are employed.

As a first step, the TAN-BN technique makes it easier to analyse the causal connections between the sub-Saharan African countries' GCI and LPI indicator values. The PLS-SEM technique is an additional step that uses the outcomes of this model as inputs. The main goal of employing the Bayesian network before the PLS is to cut down on the number of potential causal relationships between different variables. We assert that in addition to the direct impacts

resulting from the pillar scores, the indirect nexus resulting from the interactions between the pillars also has an influence on the overall LPI scores, as surmised by Ekici et al. (2019).

3.2.1 Method and Materials

3.2.2 Empirical Data

Sample data of the GCI and LPI for the years 2007, 2010, 2012, 2014, 2016 and 2018 based on consistent data availability was utilised in this study[7]. Unbalanced data were used due to missing data for some countries in a particular year. While missing data may cause some biases in the estimate of results, missing data handling, such as listwise and pairwise deleting, may lead to more biases in parameter estimates (Newman, 2014). Thus, we choose the safe route by not treating the missing data. The LPI employed in this study comprised six elements: Customs, international shipment, infrastructure, logistics services, timeliness and track and trace. The elements of LPI were measured on a scale of 1-5. Following Ekici et al. (2019), we formed a composite index of LPI using averaged scores from the six elements for the TAN-BN model. Conversely, LPI is identified and measured as a latent variable using the six indicators for the IPMA and PLS-SEM models, which easily accommodates latent variables, unlike the TAN-BN model.

Logistic performance is considered a latent variable because, by its construction, the elements are selected based on theoretical, empirical, and practical research as well as the practical expertise of logistics experts engaged in international freight forwarding (Ekici, 2019). The six LPI indicators are divided into two main groups: supply chain performance outcomes that correspond to the LPI time and reliability indicators (timeliness, international shipments, and

[7] For what of space, refer to summary statistics of Chapter Four (Table 4.1) for the preliminary insight to the data. Almost the same variables are used in these two chapters.

tracking and tracing), and areas for policy regulation, representing key inputs to the supply chain (logistics services, customs, and infrastructure). While the LPI combines the data into a single indicator using typical statistical methods, in this study, we maintain all the dimensions in order to investigate the influence of the GCI pillars on them at the national level. We obtained data for LPI and GCI from https://tcdata360, worldbank.org.

The scores of sub-Saharan countries in the 12 pillars were employed to denote competitiveness. The 12 pillars can be categorised into three sub-indexes—basic prerequisites, efficiency-improving factors, and innovation and sophistication factors. Under the basic prerequisites, four pillars are considered: institutions, infrastructure, macroeconomic environment, health, and primary education. Higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, and market size form the efficiency-improving factors. Additionally, business Sophistication and innovation make up the key innovation-driven economies. The 12 pillars of GCI are each measured on a scale of 1-7. The data on GCI were directly used for the estimations with no specific differences in data in the case of indicators for the TAN-BN and latent variables for the IPMA and PLS-SEM models. In other words, the latent variables were represented by the pillars of GCI. Table 3.1 shows the pillar number of GCI and corresponding explanations.

Table 3.1: Pillars of GCI and their explanations

Number	Explanations
Pillar 1	Institutions
Pillar 2	Infrastructure
Pillar 3	Macroeconomic environment
Pillar 4	Health and primary education

Pillar 5	Higher education and training
Pillar 6	Goods market efficiency
Pillar 7	Labour market efficiency
Pillar 8	Financial market development
Pillar 9	Technological readiness
Pillar 10	Market size
Pillar 11	Business Sophistication
Pillar 12	Innovation

3.2.3 Tree-augmented Naïve Bayes

We initially show the probabilistic nexus among the pillars of GCI and the effect of GCI on LPI using the Bayesian network (BN). The primary advantage of a BN is the reduced or absent need for strong statistical hypotheses regarding the conditional independence requirements among variables and their accompanying conditional probability distributions (Ekici, Kabak & Ülengin, 2019). The BN, therefore, demonstrates the causal directions among variables acting as a directed graph (Lauria & Duchessi, 2007). Accordingly, BN is ideal for the following reasoning: diagnostic, predictive and inter-causal within a well-classificatory system (Ekici, Kabak & Ülengin, 2019). Moreover, the BN is robust even when multicollinearity, autocorrelation, and endogeneity issues arise (Block, Miller & Wagner, 2014).

The BN displays a set of conditional independence constraints among a certain number of observed variables and their associated conditional probability distributions as a directed acyclic graph. The strength of these linkages is indicated in conditional probabilities, and the arcs show a direct nexus between the variables. As opposed to this, TAN-BN models do away

with the naïve Bayes assumption that all attributes are independent (Wu, 2010). In other words, TAN-BN models (Korb & Nicholson, 2011) permit a tree structure among the variables regardless of their direct nexus. Where variables are interrelated, this relaxation is especially crucial because TAN-BN models perform better than naïve Bayes models in these circumstances. The current study employs the TAN-BN model, whose algorithm can be located in the study of Friedman, Geiger and Goldszmidt (1997).

3.2.4 Partial Least Squares Structural Equation Modelling (PLS-SEM)

The PLS-SEM is based on maximizing the variance among the constructs that may be described, and this method makes the fewest assumptions possible about the statistical distribution of the datasets. With a limited sample size, the PLS-SEM can still be effective (Wu et al., 2012). In order to build theories, the PLS-SEM path model is frequently used to illustrate the variation of dependent variables with a focus on causal explanation. Rather than asserting equal weights for each category score, the PLS path model examines the consequences of individual scores. The PLS-SEM path model estimates the overall impact of each category score on the overall score and divides the total effect into direct and indirect effects.

However, a significant flaw in the PLS-SEM approach is that, due to a lack of background information or prior theoretical support, it can occasionally be challenging to determine causal relationships. The TAN-BN model and the PLS path model are connected in this study to first provide causal associations through the TAN-BN, while statistical significance is subsequently determined through the PLS-SEM. SmartPLS software is used to estimate the PLS path model and assess the statistical significance of the hypothesised causal relationships identified by BNTAN data mining.

Particularly, following a sequential methodology, a first-stage causal diagram, known as the TAN-BN, is used as a basis for building the PLS-SEM. The internal consistency, convergent validity, model fit, Adjusted R Square and variance inflation factor (VIF) values of the model are evaluated to ensure the robustness of the estimates. In line with the Smart PLS version 4.0, the normed fit index (NFI) should be more than 0.9 and the standardised root mean square residual (SRMR) should be less than 0.08. In a well-fitting model, the (R2) of the variables is anticipated to be more than 0.75. The Cronbach's Alpha and Composite Reliability values should be above 0.7 for internal consistency criteria to be met. The average variance extracted values of the constructs should be at least 0.5 for convergent validity to be adhered to. Furthermore, the VIF values should be less than 0.5 for the PLS-SEM model to depict the absence of multicollinearity. The inconsequential relationships in the diagram are removed if these conditions are not met, and the PLS model is then run again. This approach is done until a model with a good fit is produced. If a good-fitting model cannot be established, it is concluded that there is no significant sets of relationships in the given system of variables.

3.2.5 Importance-Performance Map Analysis (IPMA)

As an extension to the PLS-SEM, the IPMA estimates are provided to examine the performance of the pillars of GCI and LPI. The performance is evaluated by checking the most pertinent pillars of GCI influencing LPI. Constructs are therefore assessed through the importance–total effect within the PLS-SEM and the performance–averaged values of standardised scores to arrange the variables in order of primacy. The individual category scores are translated into an index value between 0 and 100 to determine the performance scores. By subtracting the category's lowest score from it and dividing the result by the difference between the category's

highest and lowest values, a score is normalised (Jitmaneeroj, 2016). The resultant value is multiplied by 100.

Regarding the overall score (the importance to performance ratio) calculated by dividing performance by total effects, the elements are ordered. Since improving the structures with relatively high importance but low performance is the main objective, the components with lower overall scores are more crucial. The elements are arranged in ascending order based on their overall scores.

3.3 Results and Discussion

3.3.1 Analysis with the Tree-augmented Naïve Bayes

Figure 1 shows the TAN-BN model on the interactive effects among the 12 pillars of GCI and logistics performance. A causal-effect graph is noticeable in Figure 3.1, in which Pillar 9 is treated as the only parent node of logistics performance coupled with major interactions among the pillars of GCI relevant to policy decisions and actions. Pillar 1 is seen not to be connected with any other variable. For interactions among the 12 Pillars of GCI, for instance, Pillar 3 and Pillar 8 have a causal effect on Pillar 4. Pillar 5 and Pillar 11 are treated as the greatest parent node of all the remaining pillars. Pillar 6 has a causal effect on Pillar 8 and Pillar 10. Also, Pillar 8 causes Pillar 7, whereas Pillar 9 has a causal effect on Pillar 2 and Pillar 7. Furthermore, Pillar 12 causes Pillar 3, Pillar 4 and Pillar 9. It can be observed that Pillar 2, Pillar 4, Pillar 7 and Pillar 10 are only on the receiving end, whereas Pillar 5 and Pillar 11 are persisting transmitters. The remaining Pillars have a causal effect and are also caused by other Pillars, which require further investigation for policy decisions. The outcome presented in Figure 3.1

provides a foundation upon which hypotheses can be proposed in the case of the PLS-SEM model.

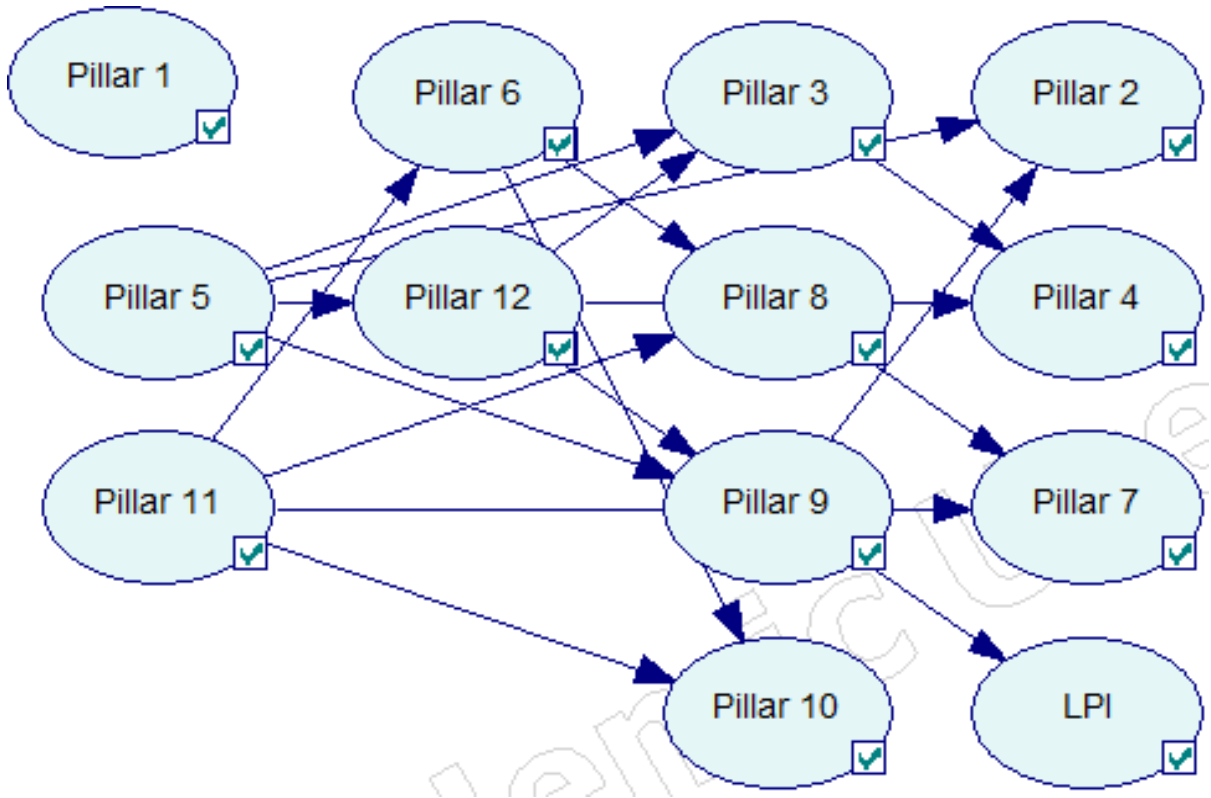


Figure 3.1: Tree-augmented Naïve Bayes for the pillars of GCI and LPI

3.3.2 Analysis with PLS-SEM

From the outcome of the TAN-BN, we formulate the following hypotheses for the PLS-SEM approach;

H_1: Macroeconomic environment has a significant relationship with Health and primary education (Pillar 3 → Pillar 4).

H_2: Higher education and training has a significant relationship with infrastructure (Pillar 5 → Pillar 2).

H_3: Higher education and training has a significant relationship with the macroeconomic environment (Pillar 5 → Pillar 3).

H_4: Higher education and training has a significant relationship with Health and primary education (Pillar 5 → Pillar 4).

H_5: Higher education and training has a significant relationship with technological readiness (Pillar 5 → Pillar 9).

H_6: Higher education and training has a significant relationship with innovation (Pillar 5 → Pillar 12).

H_7: Goods market efficiency has a significant relationship with financial market development (Pillar 6 → Pillar 8).

H_8: Goods market efficiency has a significant relationship with market size (Pillar 6 → Pillar 10).

H_9: Financial market development has a significant relationship with labour market efficiency (Pillar 8 → Pillar 7).

H_{10}: Technological readiness has a significant relationship with logistics performance (Pillar 9 → LPI).

H_{11}: Technological readiness has a significant relationship with infrastructure (Pillar 9 → Pillar 2).

H_{12}: Business sophistication has a significant relationship with goods market efficiency (Pillar 11 → Pillar 6).

H_{13}: Business sophistication has a significant relationship with labour market efficiency (Pillar 11 → Pillar 7).

H_{14}: Business sophistication has a significant relationship with financial market development (Pillar 11 → Pillar 8).

H_{15}: Business sophistication has a significant relationship with market size (Pillar 11 → Pillar 10).

H_{16}: Business sophistication has a significant relationship with innovation (Pillar 11 → Pillar 12).

H_{17}: Innovation has a significant relationship with the macroeconomic environment (Pillar 12 → Pillar 3).

H_{18}: Innovation has a significant relationship with Health and primary education (Pillar 12 → Pillar 4).

H_{19}: Innovation has a significant relationship with technological readiness (Pillar 12 → Pillar 9).

It is important to assess constructs' internal consistency and convergent validity for reliable and robust estimation in line with the application of the PLS-SEM following our methodological procedures. As shown in Table 3.2, Cronbach's Alpha and Composite Reliability values above 0.7 are indicative that internal consistency has been adhered to (Hair et al., 2019) in our PLS-SEM model. Additionally, the average variance extracted (AVE), indicating the average variance shared between individual indicators and the construct with a threshold of at least 0.5 (Hair et al., 2020), is presented in Table 3.2. Specifically for Logistics performance, AVE above 0.5 suggests that there is convergent validity between the construct and the indicators measuring it. Discriminant validity of the constructs measuring the degree to which a construct is different from the rest of the constructs in the structural model is

attached as an Appendix (Table 3.7) with a clear indication of ensuring discriminant validity as per the Fornell-Larcker criterion.

Table 3.2: Internal consistency and Convergent validity

	Cronbach's Alpha	Composite Reliability	AVE
Logistics Performance	0.942	0.954	0.775
Pillar 2	1.000	1.000	1.000
Pillar 3	1.000	1.000	1.000
Pillar 4	1.000	1.000	1.000
Pillar 5	1.000	1.000	1.000
Pillar 6	1.000	1.000	1.000
Pillar 7	1.000	1.000	1.000
Pillar 8	1.000	1.000	1.000
Pillar 9	1.000	1.000	1.000
Pillar 10	1.000	1.000	1.000
Pillar 11	1.000	1.000	1.000
Pillar 12	1.000	1.000	1.000

We proceed to examine the interactive relationships among the pillars of GCI and logistics performance, as shown in Figure 3.2 for the structural model assessment. The relationships in line with the research hypotheses can be found in Figure 3.2. The path diagram shown in Figure 3.2 reveals the magnitude and direction of the path coefficients depicting the relational dimension among GCI and LPI. Constructs are measured as latent variables rather than as a mere averaged composite index for the purpose of the PLS-SEM approach. A glance at the indicator loadings depicting values above 0.7 indicates that the items loaded well, ensuring the reliability of the indicators (Hair, Howard & Nitzl, 2020).

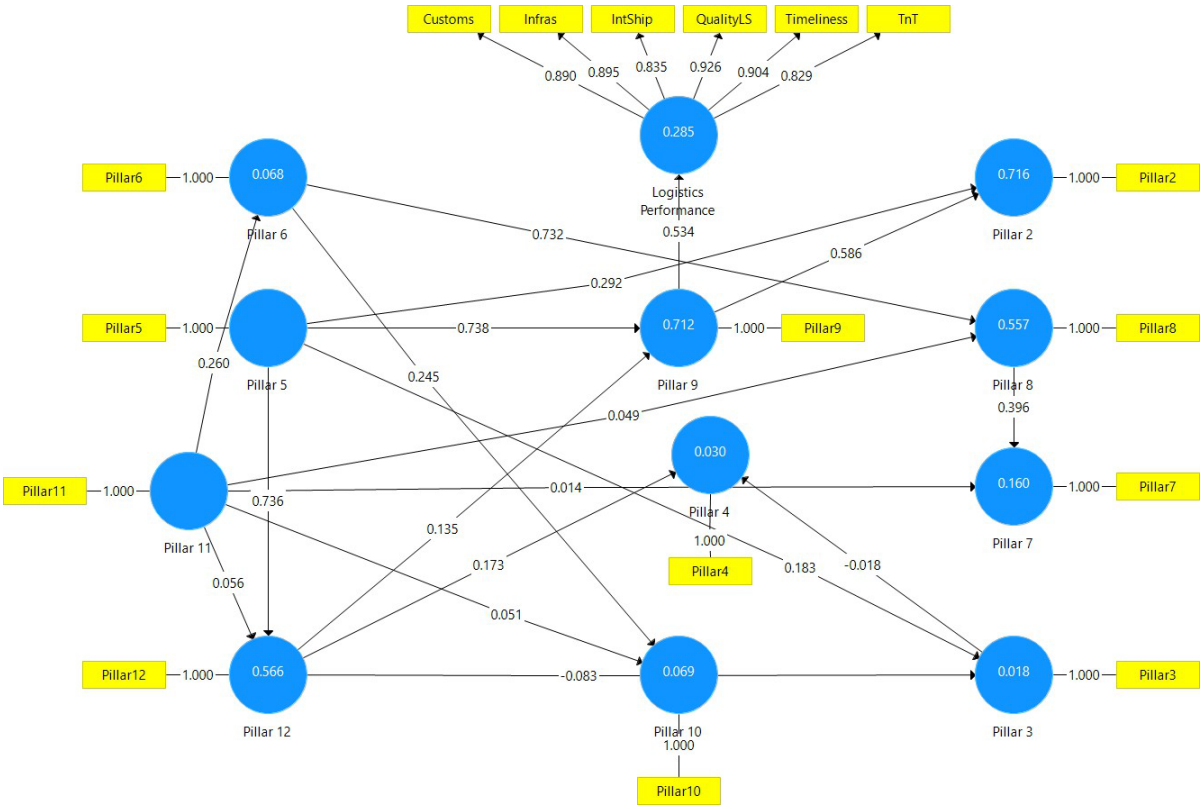


Figure 3.2: PLS algorithm showing interactive effects among the pillars of GCI and logistics performance

Furthermore, Table 3.3's Standardised Root Mean Square Residual (SRMR) values of 0.027 and 0.042 are below 0.08, which indicates a good model fit with few deviations from expected and observed correlations. Additionally, the NFI value is greater than the threshold of 0.8; as a result, the model is considered to have a marginal fit. The model's estimated Chi-Square, which is calculated by dividing the degrees of freedom (number of observations minus the number of independent variables) by the estimated value of the Chi-Square, should be less than 3 (Mantel, 1963). The model's Chi-Square evaluation is roughly 0.692 (i.e., 94.833/137), which is lower than the benchmark of 3, indicating that the model has a decent fit.

Table 3.3: Model Fit Summary

	Saturated Model	Estimated Model
SRMR	0.027	0.042
d_ULS	0.108	0.453
d_G	0.109	0.733
Chi-Square	90.366	94.833
NFI	0.961	0.840

As presented in Table 3.3, the R Square Adjusted values are explained by other variables in the interactive relationships among the 12 pillars of GCI and logistics performance. For instance, logistics performance is explained to about 28% by technological readiness (Pillar 9). Innovation (Pillar 12) is explained by business sophistication (Pillar 11) and higher education and training (Pillar 5) at about 56%. Also, variations in infrastructure (Pillar 2), financial market development (Pillar 8) and technological readiness (Pillar 9) are determined to a degree of about 71%, 55% and 71%, respectively. The remaining endogenous variables are explained as less than 15%. Comparatively, infrastructure (Pillar 2) and technological readiness (Pillar 9) have the greatest explanatory power in our PLS-SEM model. This is followed by financial market development (Pillar 8) and innovation (Pillar 12).

Table 3.4: Coefficient of determination (R Square Adjusted) of the endogenous variables

Endogenous Variables	R Square Adjusted
Logistics Performance	0.281
Pillar 2	0.712
Pillar 3	0.004
Pillar 4	0.017

Pillar 6	0.061
Pillar 7	0.148
Pillar 8	0.551
Pillar 9	0.708
Pillar 10	0.056
Pillar 12	0.560

A bootstrapping analysis was performed to assess the significance of the hypothesised associations using the PLS-SEM approach. The outcome of path coefficients, indirect effects, total effects and t-statistics are presented in Table 3.4. In addition, the variance inflation factor (VIF) relevant for multicollinearity assessment and the decision on the developed hypotheses are shown. The VIF values closer to 3 suggest the absence of multicollinearity, which might have biased the regression outcome (Hair et al., 2020).

The results in Table 3.4 show that out of 19 hypotheses, 13 of them were supported. The 13 supported hypotheses illustrate positive associations between related pairs. Particularly, the hypothesis on the significant relationship between higher education and training and infrastructure (Pillar 5 → Pillar 2) was supported by a positive and significant path coefficient (β = 0.292, t-statistics =3.332). Also, higher education (Pillar 5) related significantly with the following Pillars; Pillar 4 (β = 0.738, t-statistics =11.458), Pillar 9 (β = 0.245, t-statistics = 2.932), and Pillar 12 (β = 0.736, t-statistics =17.833). There was a significant connection between the goods market efficiency (Pillar 6) and Pillars such as; Pillar 8 (β = 0.732, t-statistics = 18.684), and Pillar 10 (β = 0.245, t-statistics = 2.932). The ninth hypothesis was supported by a positive and significant path coefficient (β = 0.396, t-statistics = 5.435) between

financial market development (Pillar 8) and labour market efficiency (Pillar 7). Moreover, technological readiness (Pillar 9) is related significantly to logistics performance (β = 0.534, t-statistics = 7.622) and infrastructure (Pillar 2) (β = 0.586, t-statistics = 7.211). Business sophistication (Pillar 11) is positively associated with Pillar 6 (β = 0.260, t-statistics = 5.967) and Pillar 12 (β = 0.056, t-statistics = 2.085). To end with, the eighteenth and nineteenth hypotheses were supported by positive and significant path coefficients between innovation (Pillar 12) and Pillar 4 (β = 0.173, t-statistics = 4.025), as well as Pillar 12 and Pillar 9 (β = 0.135, t-statistics = 1.978).

As revealed, there is no significant relationship between the four pillars representing basic prerequisites (institutions, infrastructure, macroeconomic environment and health and primary education); they are rather influenced by other subindexes, including efficiency-improving factors and innovation-driven aspects. The efficiency-improving factors are dominant in positively relating to the pillars of GCI and logistics performance. Hence, it is important for policymakers in the region to pay particular attention to efficiency-improving factors such as higher education and training (Pillar 5), good market efficiency (Pillar 6), financial market development (Pillar 8), and technological readiness (Pillar 9). This is followed by innovation-driven measures, including business sophistication (Pillar 11) and innovation (Pillar 12).

It must be noted that factors contributing significantly to logistics performance both directly and indirectly should be given much attention by policymakers. Such measures include technological readiness (Pillar 9) and higher education and training (Pillar 5), which have a direct and indirect significant relationship with logistics performance, respectively. It is also pertinent to observe factors that feed into these Pillars in enhancing logistics performance to

warrant a sustained improvement in logistics performance in the Sub-Saharan African region. Accordingly, for technological readiness (Pillar 9), credence should be given to influencers, including higher education and training (Pillar 5) and innovation (Pillar 12). On the other hand, for higher education and training (Pillar 5), it is crucial to pay particular attention to developing the Pillar itself and other possible external shocks since it has no direct or indirect contributing factor(s).

It is recommended that policymakers and governments make a more concerted effort to revamp insignificant enhancers, such as developing the need for higher education and training, which can be well captured in the macroeconomic environment. The region should welcome more innovative activities to improve other important areas such as labour market efficiency, financial market development and market size. It is important to restore a positive balance between the macroeconomic environment and health and primary education for the years ahead. This is because the macroeconomic environment in the region is touted to be susceptible to external shocks, including economic policy uncertainty (Adam, 2020; Adedoyin et al., 2021; Asafo-Adjei et al., 2020; Boateng et al., 2022), and other shocks (Adam, Henstridge & Lee, 2020; Agyei et al., 2022; Ajide & Alimi, 2019; Amu et al., 2021; Obeng et al., 2022). Furthermore, the scope of innovation should be widened to welcome improvement in the macroeconomic environment.

Table 3.5: Summary results of the PLS-SEM path models

Causal Relationship	Path Coeff. β	t-statistic	Indirect Effect	t-statistic	Total Effect	t-statistic	VIF	Decision
H_1: Pillar 3 → Pillar 4	-0.018	0.383			-0.018	0.383	1.003	Not Supported
H_2: Pillar 5 →Pillar 2	0.292*	3.332	0.491*	7.259	0.783*	18.881	3.381	Supported
H_3: Pillar 5 → Pillar 3	0.183	1.546	-0.061	0.652	0.122	1.572	2.288	Not Supported
H_4: Pillar 5 → Pillar 4	0.738*	11.458	0.125*	4.036	0.125*	4.036	1.003	Supported
H_5: Pillar 5 →Pillar 9	0.245*	2.932	0.099	1.940	0.837*	30.312	2.288	Supported
H_6: Pillar 5 → Pillar 12	0.736*	17.833			0.736*	17.833	1.076	Supported
H_7: Pillar 6 → Pillar 8	0.732*	18.684			0.732*	18.684	1.073	Supported
H_8: Pillar 6 → Pillar 10	0.245*	2.932			0.245*	2.932	1.073	Supported
H_9: Pillar 8 → Pillar 7	0.396*	5.435			0.396*	5.435	1.061	Supported
H_{10}: Pillar 9 → Logistics Performance	0.534*	7.622			0.534*	7.622	1.000	Supported
H_{11}: Pillar 9 → Pillar 2	0.586*	7.211			0.586*	7.211	3.381	Supported
H_{12}: Pillar 11 → Pillar 6	0.260*	5.967			0.260*	5.967	1.000	Supported
H_{13}: Pillar 11 → Pillar 7	0.014	0.374	0.095*	4.762	0.109*	2.657	1.061	Not Supported
H_{14}: Pillar 11 → Pillar 8	0.049	1.831	0.190*	5.587	0.239*	5.281	1.073	Not Supported

H_{15}: Pillar 11 → Pillar 10	0.0507	1.187	0.0637*	2.556	0.114*	2.102	1.073	Not Supported
H_{16}: Pillar 11 → Pillar 12	0.056*	2.085			0.056*	2.085	1.076	Supported
H_{17}: Pillar 12 → Pillar 3	-0.083	0.660			-0.083	0.660	2.288	Not Supported
H_{18}: Pillar 12 → Pillar 4	0.173*	4.025	0.002	0.197	0.175*	4.070	1.003	Supported
H_{19}: Pillar 12 → Pillar 9	0.135*	1.978			0.135*	1.978	2.288	Supported
ID*$_1$: Pillar 5 → Logistics Performance			0.447*	7.317	0.447*	7.317		
ID*$_2$: Pillar 11 → Logistics Performance			0.004	1.113	0.004	1.113		
ID*$_3$: Pillar 11 → Pillar 2			0.004	1.161	0.004	1.161		
ID*$_4$: Pillar 11 → Pillar 3			-0.005	0.586	-0.005	0.586		
ID*$_5$: Pillar 11 → Pillar 4			0.010	1.511	0.010	1.511		
ID*$_6$: Pillar 11 → Pillar 9			0.008	1.198	0.008	1.198		
ID*$_7$: Pillar 12 → Logistics Performance			0.072	1.800	0.072	1.800		
ID*$_8$: Pillar 12 → Pillar 2			0.079	1.917	0.079	1.917s		

Note: VIF shows Variance Inflation Factor. ID* denotes indirect relationships that are not hypothesised. * denotes significance at 5%.

3.3.3 Analysis with IPMA

In this section, the relative importance of the pillars of GCI to logistics performance is shown in Table 3.6, with pictorial representation illustrated in Figure 3.3. It can be noticed that Pillars 5, 9, 11 and 12 are variables that either have a direct or indirect relationship with logistics performance. The importance of these indicators is ranked in ascending order of magnitude on their effects to logistics performance. The lowest overall score is much preferred for policymakers to pay attention to. It is crucial for policymakers and governments in the Sub-Saharan region to focus attention on technological readiness (Pillar 9), higher education and training (Pillar 5), innovation (Pillar 12) and business Sophistication (Pillar 11) toward enhancing logistics performance.

Table 3.6: IPMA results for the logistics performance as the target variable.

	Total Effect (E)	Performance (P)	Overall score (P/E)	Importance rank
Pillar 9	0.387*	35.520	91.783	1
Pillar 5	0.288*	40.956	142.208	2
Pillar 12	0.071	52.482	739.183	3
Pillar 11	0.001	64.910	64910	4

** denotes significance at 5%.*

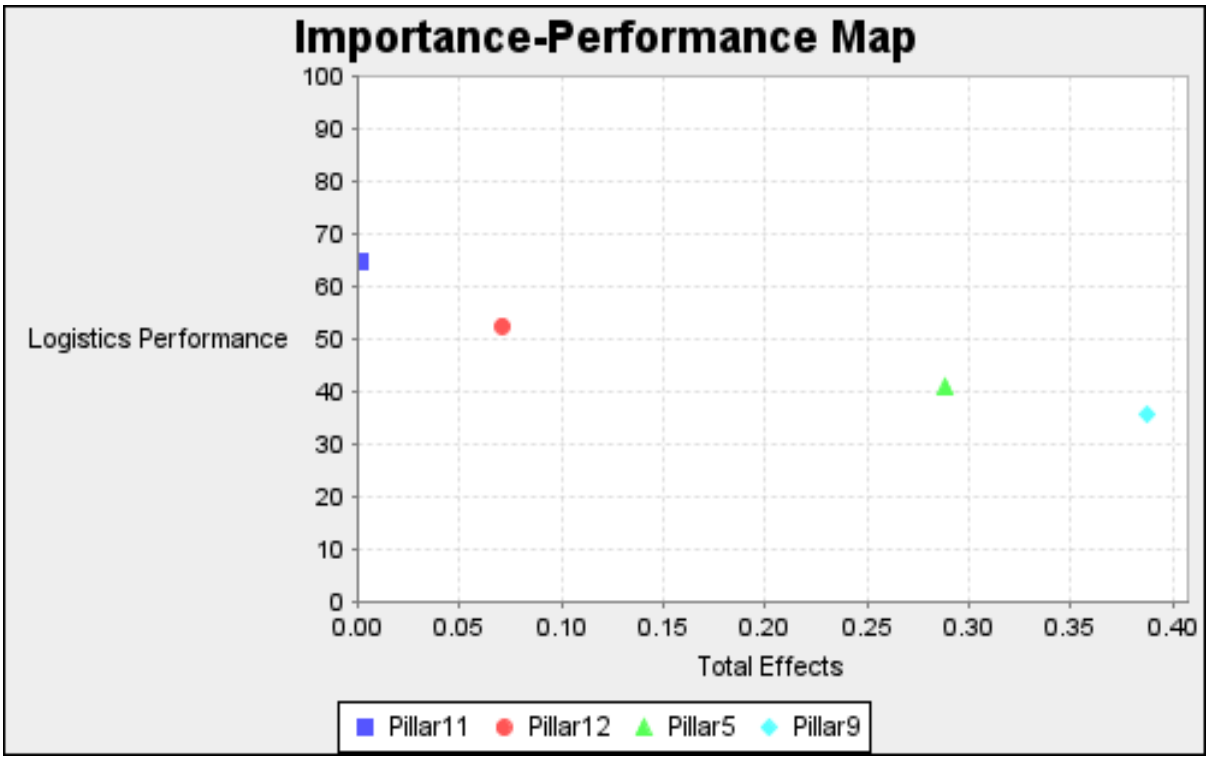


Figure 3.3: IPMA using logistics performance as the target variable.

3.4 Discussion

3.4.1 Technological readiness

Technological readiness (Pillar 9) demonstrated the most important influence on logistics performance, as found by Ekici et al. (2019) and Moldabekova et al. (2021). Although, technological readiness is directly associated with factors including internet usage, availability of up-to-date technologies, technology transfer and technology absorption at the firm-level. Technology readiness is anticipated to produce competitive advantages in a number of areas, including cost reduction, improved inventory efficiency, production timeliness and order, support for strategic planning, and information sharing among firms. Technological readiness at the organisational level denotes the capacity of the organization to adopt and utilise new technological resources (Ekici et al., 2019).

Technological readiness also feeds into infrastructure. This is not surprising because the availability of the latest technology is pertinent in enhancing infrastructural activities such as the quality of overall infrastructure, roads, railroad, port infrastructure, air transport infrastructure, and electricity supply, among others (Lamb & Weiner, 2021, Marusin, Marusin & Ablyazov, 2019; Rinne, 2004).

To enhance logistics performance and infrastructural development, it is pertinent for governments to handle or manage large-scale logistics and infrastructural data. Accordingly, automation of the entire logistical and infrastructural systems is crucial for improved digitalisation to facilitate logistics and infrastructure development.

3.4.2 Higher education and training

Higher education and training (Pillar 5) were found to be the second important variable in improving logistics performance, as revealed by Ekici et al. (2019). The higher education and training framework incorporate factors like the standard of the educational system, the calibre of math and science instruction, the standard of management programmes, the availability of the internet in classrooms, secondary and tertiary education, the availability of specialised training services, and the level of staff training (Schwab, 2017; Schwab & Zahidi, 2020). It is important that governments invest extensively in these dimensions for an enhanced improvement in logistics performance. This is not surprising because the current globalisation trend demands the nurturing of a pool of well-educated and trained individuals by nations to perform complex assignments and meet the evolving needs of the logistics system (Schwab, 2017).

Additionally, higher education and training require improvement in the quality of roads, railroads, port infrastructure, electricity supply, fixed-telephone lines, mobile-cellular telephone subscriptions, and the quality of overall infrastructure. In other words, the greater the quality of education and training, the greater the quality of infrastructure in countries. Higher education and training promote the need for health and primary education, technological readiness and innovation. This suggests that investing in higher education and training increases awareness of issues such as people's health, access to cutting-edge technology, capacity for innovation, the calibre of institutions supporting scientific research, the availability of scientists and engineers, and research and development.

3.4.3 Financial market development

It must also be noted that the development of the financial market is crucial for labour market efficiency. For instance, the accessibility and affordability of financial services, the simplicity of obtaining loans, the availability of venture capital, the soundness of banks, the regulation of securities exchanges, legal rights, and financing through the equity market are important in promoting the efficiency of the labour market (Schwab, 2017). The ability of a country to attract and retain talent, reliance on professional management, flexibility in wage determination, and hiring and firing practises, which are strongly reliant on the stability of the financial system, are just a few examples of the many ways that the efficiency of the labour market can be improved (Stiglitz, 2019).

3.4.4 Innovation

The ability to innovate, the calibre of scientific research institutes, the amount of money corporations spend on R&D, the amount of cutting-edge technology that governments buy, and the availability of scientists and engineers are all elements that contribute to innovation. These dimensions of innovation are relevant to the macroeconomic environment. This is because as countries innovate, governments are able to rectify their budget deficit, enhance gross national savings, correct inflation, plummet government debt and correct and improve credit rating in the long term. This is so that the same input can produce more output thanks to innovation, which can raise productivity. The economy expands as productivity increases because more goods and services are produced. Growth in the economy leads to proper improvements in macroeconomic indicators. Innovation, according to Ahmed and Farah (2022), causes co-movement in important macroeconomic variables, such as production, labour hours, consumption, and investment in IT and non-IT industries. Innovation is also seen as a significant contributor to health and primary education as well as technological readiness.

However, a significant relationship was found between innovation and logistics performance. The study contradicts the outcome of Ekici et al. (2019), Gabriela-Lucia and Cristian-Gabriel (2015) and Moldabekova et al. (2021), who found that innovation is significantly related to logistics performance. The point of departure could be the sample selection and size as well as the technique used. Although, we used similar techniques as Ekici et al. (2019), but their sample included a wide range of countries with a particular year having a maximum of 132 countries and without restriction to Sub-Saharan Africa. Additionally, Gabriela-Lucia and Cristian-Gabriel (2015) limited the sampl to 24 European countries whereas Moldabekova et al. (2021)

employed a mix of four income level countries, including high-, upper-middle-, lower-middle-, and lower-incomes.

Nonetheless, innovation plays a critical role in achieving success in a rapidly changing environment and creating a competitive advantage (Banmairuroy et al., 2022; Ekici et al., 2019). Logistical innovations are underappreciated and receive less attention in Sub-Saharan Africa (Schwab & Zahidi, 2020). However, cutting-edge logistics services can offer fresh approaches to commerce and industry, as well as a base for expansion into new markets (Ekici et al., 2019). Innovation is no longer just a priority for the most developed economies; it is also crucial for developing nations as well. Innovation capability is the weakest pillar of most economies (Schwab & Zahidi, 2020). The ability to innovate is still severely constrained, highly confined, and/or restricted to a very small number of industries in the great majority of countries. For the majority of economies, an innovation formula is yet unknown. A nation's superior logistics performance is correlated with its strong innovation performance.

Governments should do a better job of promoting funding possibilities at the national and regional levels, especially for small and medium-sized enterprises (SMEs), to foster innovation. They should consider expanding the scope of funding and tax credits to suit the demands of the SMEs involved in developing and implementing innovations. They should consider extending financial support and tax breaks to cutting-edge services and business models in addition to technology. They ought to stimulate cooperation, awareness of, and the spread of new techniques in addition to fostering tighter international cooperation. The high cost of electricity for firms in Sub-Saharan Africa hinders innovative decisions and activities

of firms (Hussain et al., 2022). Hence, it is crucial that governments promote renewable energy with a policy design to mitigate the unintended price effect of supporting renewable energy.

3.4.5 Goods market efficiency

Goods market efficiency is significantly related to financial development and market size. The goods market efficiency is responsible for local competition intensity, market dominance, the effectiveness of the anti-monopoly policy, incentives to invest due to tax, the timing of business start-ups, agricultural policy costs, and business influence of rules on FDI, among others (Schwab, 2019). These factors are necessary for enhancing the need for the availability of financial services, affordability of financial services, and ease of access to loans, and eventually, for improving financial development. Furthermore, local competition intensity, market dominance, the effectiveness of the anti-monopoly policy, incentives to invest due to tax, the timing of business start-ups, agricultural policy costs, the business influence of rules on FDI intensify the domestic market size, global market size, economic growth and drives export activities (Abukumail, Alrashidi & Atta, 2018).

Given their specific supply-and-demand dynamics, nations with developed goods markets are in a good position to both produce the ideal mix of goods and services and make sure that these goods can be traded as efficiently as possible (Schwab, 2017; Schwab & Zahidi, 2020). Healthy domestic and international market competition is crucial for promoting market efficiency and, consequently, business productivity by ensuring that the most productive businesses, those that produce the goods that the market wants, are those that succeed. Demand factors like buyer sophistication and customer orientation have an impact on how efficiently a market operates. Customers are more demanding in Sub-Saharan African countries due to cultural or historical

factors (Ortega & Tschirley, 2017). As a result, companies are forced to be more innovative and customer-focused, which imposes the discipline needed to achieve market efficiency. This can give them a significant competitive advantage, which intensifies access to financial services to meet their demand with an eventual surge in market size. Sub-Saharan African countries are noted for the supply of the majority of global raw materials, which support exports for improved market size.

3.4.6 Business sophistication

Business sophistication was found to have a significant positive relationship with goods market efficiency and innovation. Business sophistication examines local supplier quantity and quality, state of cluster development, nature of competitive advantage, value chain breadth, international distribution control, production process sophistication, degree of marketing, and the zeal to delegate authority. These indicators contribute to intense local competition, degree of market dominance, and degree of customer orientation, to name a few. Also, a well-developed business sophistication strategy is relevant to firms' innovation (Gokhberg & Roud, 2016; Kesting & Günzel-Jensen, 2015; Klingebiel, Joseph & Machoba, 2022).

3.5 Theoretical, Practical and Policy Implications

The results of this investigation revealed that most of the GCI Pillars have a significant, positive relationship with one another, addressing the new trade theory which promotes the globalisation of production, the need for government support such as subsidies for improved industrialisation and helps local firms to compete with international ones, and ensures trade competition among similar countries. It was also discovered that the only GCI Pillar that significantly and directly positively correlates with logistics performance was technology

readiness. It is not surprising that the Pillars of GCI contribute less to logistics performance in Sub-Saharan Africa, given the region's severe lack of global competitiveness. In order to ensure lean and agile logistics, the high logistical cost is crucial to Sub-Saharan Africa, which is borne with less capacity (Kuupiel, Bawontuo & Mashamba-Thompson, 2017). Based on its abundant resources, growing wealth, and expanding middle class, which has a higher purchasing power, the current body of literature shows that the African markets represent a continent that is strategically emerging as a significant trading bloc, particularly for Asia and parts of Europe (Adewole & Struthers, 2019).

Policymakers in the Sub-Saharan region will be able to make the most of their limited resources to improve the logistical competitiveness of their nations by taking into account these connections and focusing on the most crucial competitiveness pillars, such as technological readiness and higher education and training. In order to ensure a sustained improvement in logistics performance in the Sub-Saharan African region, it is also important to consider the variables that feed into the pillars that enhance logistics performance. As a result, factors like innovation and higher education and training (Pillar 5) should be given credit for influencing technological readiness (Pillar 9). (Pillar 12). On the other hand, because higher education and training (Pillar 5) do not have any direct or indirect contributing factors, it is crucial that special attention be paid to developing the Pillar itself and other potential external shocks (s).

Governments and policymakers should work harder to improve minor enhancers that can be successfully incorporated into the macroeconomic environment, such as the rising demand for higher education and training. More innovative initiatives should be welcomed in the sector to improve other crucial aspects like market size, financial market development, and labour

market effectiveness. It is critical to strike a good balance between the macroeconomic environment, health, and primary education in the upcoming years. Additionally, it is necessary to broaden the scope of innovation to incorporate developments in the macroeconomic environment. Governments in the Sub-Saharan region should invest heavily in technology, higher education, and training in order to improve logistics performance.

Even though the African Continental Free Trade Area (AfCFTA) exists to enhance intra-African trade, governments should concentrate on signing trade agreements with nations on other continents. For instance, the AfCFTA is in charge of ensuring the free flow of people, capital, goods, and services—all of which are essential for furthering economic integration—as well as advancing industrialisation, agricultural development, food security, and structural economic transformation. It is evidenced that the recently adopted African Continental Free Trade Area (AfCFTA) enhances the capacity of the continent. Free trade agreements will make it possible to lower taxes and duties in this way. Additionally, because there won't be any taxes to pay to the government, trade will become more flexible, and exports and imports will rise.

In fact, as global trade expands, it is more crucial than ever to coordinate flows through an efficient logistics system, as well as to enhance terminals, local, long-distance, and infrastructure connections, including enlarging and upgrading ports and airports, as well as building wider access roads to logistics nodes. As a result, logistical performance will improve. In actuality, all of these advancements will greatly facilitate the trade of goods and, over time, result in a significant decrease in costs. A nation's international trade will increase if it can gain a competitive edge in terms of logistics performance.

3.6 Conclusion

The study investigated interactive effects among the 12 pillars of GCI and logistics performance covering the years 2007, 2010, 2012, 2014, 2016 and 2018 based on consistent data availability. Unbalanced data were used due to missing data for some countries in a particular year. While missing data may cause some biases in the estimate of results, missing data handling, such as listwise and pairwise deleting, may lead to more biases in parameter estimates (Newman, 2014). Thus, we choose the safe route by not treating the missing data. We used innovative approaches, including – TAN-BN, PLS-SEM and IPMA. As a first step, the TAN-BN technique makes it easier to analyse the causal connections between the Sub-Saharan countries' GCI and LPI indicator values. The PLS-SEM approach is an additional step that uses the outcomes of this model as inputs. The main goal of employing the Bayesian network before the PLS is to cut down on the number of potential causal relationships between different variables. The IPMA approach was subsequently used to assess the performance of the pillars toward logistics performance.

Hence, in this study, four unique contributions to prior studies were obtained. To begin with, we investigated the interactive effects of the 12 pillars of GCI in Sub-Saharan Africa as a territory or region in support of policies and concepts relating to international trade and integration. Also, we examined the pertinent pillars that relate to logistics performance while deciphering pillars that have indirect effects on logistics performance. Additionally, we provided suggestions for policy directions that harness the awareness of policymakers in the region with regard to the interactive effects among the 12 pillars of GCI as well as their influence on logistics performance. To end with, innovative approaches (TAN-BN and PLS-SEM) were used in stages to address the research problem in the Sub-Saharan Africa context.

It was revealed that out of 19 hypotheses, 13 were supported, illustrating positive relationships. For instance, the hypothesis on the significant relationship between higher education and training and infrastructure was supported by a positive and significant path coefficient. Also, higher education and training (Pillar 5) related significantly to the following Pillars; health and primary education (Pillar 4), technological readiness (Pillar 9) and innovation (Pillar 12). There was a significant connection between the goods market efficiency (Pillar 6) and Pillars such as; financial market development (Pillar 8) and market size (Pillar 10). The ninth hypothesis was supported by a positive and significant path coefficient between financial market development (Pillar 8) and labour market efficiency (Pillar 7). Moreover, technological readiness (Pillar 9) is related significantly to logistics performance and infrastructure (Pillar 2). Business sophistication (Pillar 11) was positively associated with goods market efficiency (Pillar 6) and innovation (Pillar 12). To end with, the eighteenth and nineteenth hypotheses were supported by positive and significant path coefficients between innovation (Pillar 12) and health and primary education (Pillar 4), as well as innovation (Pillar 12) and technological readiness (Pillar 9).

It is recommended that governments and policymakers make a more determined effort to overhaul minor enhancers, such as the growing demand for higher education and training, which can be effectively incorporated into the macroeconomic environment. More creative initiatives should be welcomed in the sector to enhance other crucial aspects, including market size, financial market development, and labour market effectiveness. For the upcoming years, it is crucial to achieve a favourable balance between the macroeconomic environment, health, and primary education. Moreover, the reach of innovation needs to be expanded to embrace

advancements in the macroeconomic environment. To improve logistics performance, governments should invest extensively in technology and higher education and training in the Sub-Saharan region.

As a suggestion for further studies, the Pillars of GCI can be categorised based on the three subindexes – basic prerequisites, efficiency-improving factors, and innovation and sophistication factors due to their homogeneous dynamics in terms of having a significant influence on other Pillars to provide a general idea on the integration of the Pillars of GCI and logistics performance in the Sub-Saharan African region. The study is limited to the application of a unidirectional relationship; hence, the tendency for a bi-directional nexus between the variables is ignored by the current study. The two-way interaction is important because improvement in logistics performance by the advancement in the Pillars of GCI, and logistics performance can, in turn, enhance the Pillars of GCI due to the role of logistics performance as a major determinant of growth and development (Beysenbaev & Dus, 2020; Ekici, Kabak & Ülengin, 2019; Sergi et al., 2021). Additionally, the two-way interaction between the Pillars of GCI can act as mediators for the improvement of specific Pillars for sustained competitiveness. In this regard, further studies can explore the bi-directional relationship between the Pillars of GCI and logistics performance for further policy decisions and actions. Findings from this study were crucial to the Sub-Saharan region; hence, as a suggestion for further studies, other regional blocs can be investigated to facilitate comparison for global policy decisions.

APPENDIX

Table 3.7: Discriminant Validity -Fornell-Larcker Criterion

	Logistics Performance	Pillar 2	Pillar 3	Pillar 4	Pillar 5	Pillar 6	Pillar 7	Pillar 8	Pillar 9	Pillar 10	Pillar 11	Pillar 12
Logistics Performance	0.880											
Pillar 2	0.378	1.000										
Pillar 3	0.058	0.180	1.000									
Pillar 4	0.332	0.192	-0.008	1.000								
Pillar 5	0.453	0.784	0.121	0.220	1.000							
Pillar 6	0.441	0.705	0.109	0.213	0.831	1.000						
Pillar 7	0.138	0.251	-0.047	0.168	0.275	0.378	1.000					
Pillar 8	0.498	0.710	0.165	0.145	0.751	0.745	0.400	1.000				
Pillar 9	0.534	0.831	0.173	0.192	0.839	0.768	0.219	0.709	1.000			
Pillar 10	0.515	0.130	0.201	-0.015	0.334	0.258	-0.056	0.407	0.472	1.000		
Pillar 11	0.425	0.217	0.018	0.924	0.265	0.260	0.109	0.239	0.244	0.114	1.000	
Pillar 12	0.519	0.541	0.055	0.172	0.750	0.766	0.361	0.647	0.689	0.409	0.250	1.000

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CHAPTER FOUR

THE CAUSAL RELATIONSHIP BETWEEN GLOBAL COMPETITIVENESS AND GVC PARTICIPATION IN SUB-SAHARAN AFRICA: A NETWORK APPROACH

4.1 Introduction

The emergence of the global value chain (GVC) (Amador & Cabral, 2017; Kowalski et al., 2015a), upending Adam Smith's division of labour, has come to stay as the standard for 21st-century trade (Baldwin & Evenett, 2012). Amador and Cabral (2017) attribute this to advances in technology, reduction in transportation and communication costs, and political and economic liberalisation across the globe. For instance, the Organisation for Economic Co-operation and Development (OECD) estimates that global value chains constitute over 70% of all international trade (OECD, 2020). This comes after an estimate from around ten years ago that more than half of imported manufactured items (basic goods, parts and components, and semi-finished products) are intermediate goods, and more than seventy percent of imported services are intermediate services (Backer & Miroudot, 2013).

It is worth noting that the acceleration in the GVC is riding on the back of the liberalisation and openness of economies. The benefits from liberalisation and the increased varying participation in GVC are unmistakable. These benefits can be summed up into growth and productivity (Del Prete et al., 2017; Montalbano et al., 2018; Frankel & Romer, 2009; Kose et al., 2003, etc.), from which all subsequent advantages emanate. Liberalisation of the global economy has fostered the opportunity for, especially developing countries, to improve upon their comparative competitive advantage. It has also afforded developed and industrialised nations the opportunity to exploit their varied advantages in the global marketplace. That is to

say, liberalisation, by default, engenders fierce competition among economic agents for spoils on the battlefield of GVC (Slany, 2019). Hence, developing countries, such as those in sub-Saharan Africa (SSA), which are largely open, need to be wary of being on the right side of the consequences of trade liberalisation. Apart from being endowed with large deposits of natural resources and a strong labour force, SSA is one of the most open continents in the world (Mensah & Fofana, 2018). Among other things, one of the challenges facing the sub-region and lowering their benefits from the GVC is a strong competitive front (Rodrik, 2018). This accounts for unenviable feats such as the share of West Africa in international trade, standing at 0.7% of exports as against 0.5% of imports (Mensah & Fofana, 2018), for one of the most open regions in the world.

Since the 1980s, the supply chain management literature has developed competitiveness as the main business analytical framework for firms to enhance their performance. However, in the context of global trade, competitiveness is defined as the indicator of a nation's advantage or disadvantage when marketing goods or services abroad (OECD, 2014). In the GVC, competitiveness is considered both a driver and a product of GVC (Jones et al., 2019). However, a large body of literature deems competitiveness as an antecedent to the levels of GVC participation and the gains therefrom (Asian Development Bank, 2021). Therefore, in nations deeply ingrained in GVCs, like those in SSA, increased competitiveness could directly enhance GDP growth and trade (Marín-Odio, 2014). Among other things, non-competitiveness has been blamed for the low level of participation in the GVC African countries as well as marginalised trade integration (Ahmad & Primi, 2017). It is also partly due to non-competitiveness that the participation of African countries in the GVC is largely limited to forward upstream (Ofori et al., 2021). The difference is obvious in that the effects of GVCs on national economies are nearly entirely different for countries that specialise in upstream

activities than for those that specialise more in downstream activities, such as the final assembly of products (Backer & Miroudot, 2013).

One way to upgrade to downstream GVC participation in the GVC is through efficiency in production. Productivity results, among other things, from the efficiency-improving effects of global competition, accessibility to foreign knowledge and technology, the ability to specialise, and economies of scale. For instance, Sergi et al. (2021) examined the pillars of GCI on the composite index of LPI in 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. As already indicated, logistic efficiency is essential to increased GVC participation. Webber and Labaste (2009) opine that one simple approach to increase the competitiveness of an industry or product on the global market is to produce more efficiently.

Further, competitiveness is driven by innovation (European Investment Bank, 2022). It is clear that improved global competitiveness is deemed essential to increase inflow through participation in the global value chain. Due to the largely upstream participation of African countries, improving competitiveness can be deemed to be even more vital. Perhaps Backer and Miroudot (2013) explain the role of competitiveness in the best way. They show that there are more interdependencies GVC ecosystem; national competitiveness represents the embodied technology and relative endowments on a specific country's domestic production endeavours as well as the technology and factor endowments of nations from whom the country in question buys intermediate goods.

To understand the plight of countries in SSA in terms of global competitiveness in the GVC framework, we need some perspective as to how we fare compared to other countries. While the GCI 4.0 in 2019 indicate that most economies are far from the competitive frontier (Schwab, 2019), the case for SSA deserves special attention because of its need to upgrade to downstream participation in the GVC. The GCI 4.0 proffers perceptions of economic prospects (national competitiveness) of 141 countries. Schwab (2019) defines national competitiveness as the set of institutions, policies, and factors that determine the level of productivity. These are expanded into twelve (12) factors of competitiveness, referred to as Pillars of GCI: 1) Institutions, 2) Infrastructure, 3) Macroeconomic environment, 4) Health and primary education, 5) Higher education and training, 6) Goods market efficiency, 7) Labour market efficiency, 8) Financial market development, 9) Technological readiness, 10) Market size, 11) Business sophistication, and 12) Innovation (Arvis et al., 2018). Both the pillars and overall performance of countries per GCI are reported on 0-100 scale, where 100 denotes the ideal state (frontier) of zero constraints on productivity growth. It is the aim of every country to reach this frontier score.

However, the region contends with several challenges concerning the factors that augment competitiveness (Slany, 2017). The competitiveness of the Southern African Customs Union (SACU) nations is largely contingent on issues such as port congestion, accessibility to rail and port services, and governmental support for standard compliance as suggested by Farole (2016). Also, production capacity, infrastructure, services, trade, and investment policies are widely regarded as principal elements influencing a country's competitiveness and its ability to engage in GVC (Slany, 2017; Lwesya, 2022). These factors, along with related concerns, account for the unfavourable rankings on the GCI league table (Kowalski et al., 2015b).

Nonetheless, there is a dearth in the empirical literature on the influence of GCI on GVC. It is reasonable to propose that the different facets of Global Competitiveness Index (GCI) levels have distinct impacts on various factors within Global Value Chains (GVC). This necessitates a careful empirical analysis to facilitate tailored policy interventions that can be suitable applied. As per the literature, the GVC comprises the four (4) main indicators: domestic valued-added (DVA) in exports, foreign valued-added (FVA) in exports, indirect domestic valued-added (DVX) in exports, and value-added (VA) (Arvis et al., 2018). It is also clear that these indicators are at the vagaries of the competitive abilities of the countries, as indicated in many studies (see Farole, 2016; Slany, 2017; Lwesya, 2022; etc.)

The purpose of this chapter is to examine the causal relationship between GCI and GVC participation in SSA countries. Understanding the effects of the GCI on the indicators of GVC is critical for the national agenda on GVC participation. Particularly, since each indicator of GVC relates to a different area of policy concern, it is even more compelling to examine the causal relations of GCI on these indicators of GVC of the countries. According to Backer and Miroudot (2013), empirical data on GVC positioning and participation enables the identification of the foundational elements (pillars) of national competitiveness as well as the difficulties in creating new markets for competitive goods and services. Further, to generate growth and reduce the rural poverty that is prevalent in SSA, Webber and Labaste (2009) argue that enhancements in value chain competitiveness are highly recognised as an effective approach. This is timely and even more compelling because the empirical literature has not paid attention to the same.

The empirical literature on the relationship between the GCI and GVC mostly takes an indirect approach, investigating the influence on logistics and economic development. For instance,

Sergi et al. (2021) examine the pillars of GCI on the composite index of LPI for Africa, Asia and the EU regions. Önsel Ekici et al. (2019) argue that logistic performance has a direct impact on economic development. Nevertheless, these studies analyse the pillars of GCI on the LPI in order to infer the effect on the economy. This study addresses the gaps in the literature by directly investigating the causal connection between GCI and GVC, including its four indicators. While previous studies focus on LPI and the role of GCI in efficiency, the direct nexus between GCI and GVC is important for informing policy actions, especially in Sub-Saharan Africa.

The study examines the generic drivers of competitiveness among trade partners rooted in the new trade theory, which emphasises factors influencing production location and the role of government in enhancing efficiency. It supports recent developments advocating an active role for governments in trade policy, highlighting that gains from trade can be more significant under imperfectly competitive markets (Asad & DEC, 2010). The study also draws on the GVC Initiative's definition of GVC at Duke University, underlining the full range of activities involved in bringing a product or service from conception to end-use and its geographical distribution across borders. This perspective highlights the classical determinants of comparative advantage, accentuating the impact of competitiveness on GVC participation, particularly in the imperfectly competitive African market (Jones & Kierzkowski, 1990).

There is no doubt that the GVC ecosystem is a complex one. Hence, in examining the causal role of GCI in the determination of the levels of GVC participation, the study adopts a method that recognises the complex nature of the GVC framework as well as speaks to the theoretical foundations of international trade. We employ the regularised partial correlation network to estimate a parsimonious and interpretable complex network structure of international trade in

light of GCI and GVC interplay. This is the most popular network model for exploratory studies (Epskamp et al., 2018). Network analysis provides a source of hypotheses about causal links among variables in a system (Taylor et al., 2020), as described in this discourse.

This study makes important contributions to literature. First, we contribute to the discourse on the role of competitiveness in the global value chain and international trade. The discussion has, hitherto, been silent on this specific link but rather on the nexus with GCI and LPI. As a consequence, the direct role of competitiveness in the economic development of countries through their participation in the GVC is lacking. More importantly, the paucity in this literature is more pronounced for the African context, where much information is needed to improve competitiveness in order to upgrade the global value chain. The study fills this gap for policy-makers and traders alike to understand the direct actions to take in order to expand domestic value-added in exports and foreign value-added in exports, among others. Second, the chapter is the first in the African context to examine the complexity of the GVC system in a parsimonious way. While complex, the regularised partial correlation network, as used in the chapter, simplifies the relationship between GCI and GVC (and its indicators) for a deeper insight into policy and action plans in the selected SSA economies. Third, while many studies have alluded to the causation among LPI, GCI, and GVC, a few have examined their causality. In this study, the technique assumes a direct relation in lieu of latent variables approaches such as structural equation modelling. Thus, in the absence of a latent construct, this network approach allows us to examine the bi-directional as well as indirect relationship between GCI and GVC in SSA. In this case, impactful policy and action plans are better implemented based on the deeper insights gained from the findings.

Our empirical findings suggest that in the complex network of the 12 pillars of GCI and 4 indicators of GVC, there is a dichotomy of clusters for constructs. The two clusters are connected by thin positive and negative links. However, connections are strong in within each of the two clusters. Hence, it is better that each indicator is isolated to see its interaction with the GCI pillars to reveal more useful insights. The market size (GCI10) was the most important positive pillar for the SSA region's composite GVC index (overall GVC) as well as the for individual GVC indicators (sub-indicators). It was also disclosed that the dynamics of value-added in exports (VA) and indirect domestic value-added in exports (DVX) with the 12 pillars of GCI are similar. The results have important policy and investment implications for SSA governments and trading partners alike.

The remainder of the study is as follows: section 4.2 is the theoretical basis of the chapter, 4.3 presents the literature review, section 4.4 describes the materials and methods, followed by a preliminary analysis of the data in Section 4.5. Sections 4.6 and 4.7 entail analysis and discussion of findings and conclusions, respectively.

4.1.1 Theoretical basis of the Causal nexus among Global Competitiveness, Logistic Performance, and GVC Participation

In choosing the theories that can explain the causality between global competitiveness and global value chain participation, we recognise the 12 pillars of GCI and how together they fit into the comparative advantage, human capital, technology, trade policies, and institutional frameworks of participating countries. These factors interact and bolter each other to subsequently drive GVC participation and hence, causality.

4.1.2 Institutional and Regulatory Frameworks

Strong and good quality institutions and regulatory frameworks are deemed to play critical roles in shaping diverse economic outcomes. North (1990) argues that due to unpredictable behaviour of human interactions and diverse consequences on economic performance, institutions are built to constraint them. Thus, institutions can be built to either produce growth or stagnation. To be competitive and deepen participation in the GVC, SSA countries need institutions that produce growth rather than stagnation. The pillar 1 – institutions, pillar 3 – macroeconomic environment, pillar 6 – goods market efficiency, pillar 7 – labour market efficiency, and pillar 8 – financial market efficiency directly relate to institutional and regulatory frameworks that need to be strengthened to cause a competitive edge in the GVC space.

4.1.3 Comparative Advantage and Specialisation

Comparative advantage and specialisation are two closely related neoclassical trade concepts where countries concentrate in the production of goods and services where they have a relatively higher advantage over their trading partners. Competitive advantage can arise from either technology or factor endowment (Costinot, 2009a). The ability to utilise these leads to efficiency gains and increased competitiveness in the long-term. The competitive pillar of many SSA countries in the size of their market (i.e. pillar 10). The SSA region also has a larger and cheaper workforce than advanced countries, which indirectly offers a competitive advantage. Improved health and primary education (pillar 4) and higher education and training (pillar 5) can serve to increase competitiveness to drive GVC participation, especially in more complex industries (Costinot, 2009b).

4.1.4 Technology and Innovation

The definitions of technology and innovation are varied but there is a consensus on their usefulness in business and everyday life. Grübler et al. (1999) have touted the advancement of technological knowledge as the single most important contributing factor to long-term productivity and economic growth. Innovation is also considered crucial to deal with the negative side effects of the outcome of technological advancement, especially is a sustainable manner (Greenacre et al., 2012; Hekkert & Negro, 2009). Advanced technologies and innovative approaches to in production and services can enable SSA countries participate strongly in the GVC. In recent times, technology has been identified as a driving force for economic growth and international competitiveness (Archibugi & Michie, 1995). To upgrade in the GVC, technology and innovation are seen as strategic management tools in product-process, meta-learning, and technological interdependence concepts (Butler, 1988). The GCI pillars that relate the theory of technology and innovation are pillar 9 – technological readiness, pillar 11 – business sophistication, and pillar 12 – innovation. The firms and governments in SSA countries that adopt and invest in advanced technologies and innovate continuously will increase global competitiveness and strengthen their place in the global value chain.

4.1.5 Human Capital and Skills Development

Becker (1964) formalised the concept of human capital and skill development from the initial ideas of Adam Smith (Spengler, 1977) and Alfred Marshall (Blandy, 1967). Becker (1964) stressed the need to invest in education, training, and skills development to improve individual productivity and productivity, economic growth,

and overall socio-economic upgrading. According to Blundell et al.(1999), human capital theory assumes that investment in education is essential to acquire skills and training to subsequently increase individual capital.

By examining Becker's (1964) human capital and skills development theory, the key elements are 1) investment in education, 2) skills acquisition, 3) economic returns, 4) labour market dynamic, and 5) societal and economic development. These align with a number of the pillars of GCI, namely, pillar 2 – infrastructure, pillar 4 – health and primary education, and pillar 5 – higher education and training. We emphasise the SSA region's large and cheap youthful population as a potential workforce. Investment in education and skills training will go a long way to increase competitiveness through increased labour productivity. These features will ultimately result in increased GVC participation and attendant benefits to the SSA region and its firms.

On the other hand, we want to explain how participation in the GVC improves competitiveness in the future. Two theories that can address this are the Upgrading and Trade Policy.

4.1.6 Trade Policy Theory

Bowen et al. (2023) define trade policy as a set of domestic political bargaining between globalists and protectionists, representing owners of factors specific to export and import-competing sectors, respectively. Thus, the direction of policies from extreme trade ideologies will result in policies and investments that can hinder participation in the GVC. A taste of the benefits of the current level of participation can be a source of motivation to adopt liberal and coherent policies which reduce trade costs and barriers, attract foreign direct investment, and enable countries to integrate into GVCs more effectively and efficiently. This also ties in with

Pillar 1 (institutions) of GCI, in which the quality of institutions can drive increased participation in the GVC.

4.1.7 Upgrading Theory

Hobday (1995) first applied upgrading to "latecomer" firms from developing countries to the global economy. These face competitive disadvantages due to their distance from the technological frontier and from global markets and consumers (Humphrey, 2004). Upgrading can be defined as the dynamic movement within the value chain from one stage of production to another with higher value activities and increased benefits. Humphrey (2004) argues that upgrading is the best long-term strategy for preserving a country's participation in GVCs and maximising the benefits of participation in the GVC. To improve competitiveness and increase income and welfare, as well as aim at the socio-economic upgrading of its citizens, SSA countries can access new technologies, skills, and markets and move up the value chain to higher-value-added activities. We can link the pillars of GCI to the four path of upgrading in the GVC identified by (Humphrey & Schmitz, 2002). These are process upgrading (pillar 1 – institutions, pillar 3 – macroeconomic environment, pillar 6 – goods market efficiency, pillar 8 – financial market efficiency); product upgrading (pillar 11 – business sophistication, pillar 12 - innovation); functional upgrading (pillar 7 – labour market efficiency, pillar 5 – higher education and training; and chain or inter-sectoral upgrading (pillar 9 – technological readiness, pillar 12 - innovation) (see also, Humphrey, 2004).

4.2 Literature Review

Given a pause in the comparative ranking of the countries in terms of GCI due to the COVID-19 pandemic (Schwab & Zahidi, 2020), we take insight from the 2021 rankings. The first ten (10) slots are taken by Singapore, USA, Hong Kong, Netherlands, Switzerland, Japan,

Germany, Sweden, UK, and Denmark scoring between 85.0 and 81.0. The top-ranking country in SSA is South Africa at 60, with a score of 62.4, having moved up seven from the previous year. Then Seychelles (76th, 59.6), Botswana (91st, 55.5), Namibia (94th, 54.5), Kenya (95th, 54.1), Rwanda (100th, 52.8), Ghana (111th, 51.2), and Cape Verde (112th, 50.8). The bottom 27 (from 114 to 141) slots are dominated by SSA countries (save Venezuela – 133, Haiti – 138, and Yemen - 140), with Chad taking the last position. Many of the North African countries captured performed better than those from SSA. For instance, Morocco (75th, 60.0), Tunisia (87th, 56.5), Algeria (89th, 56.3), and Egypt (93rd, 54.5) (Schwab, 2019). Venezuela (133rd, 41.8), Haiti (138th, 36.3), and Yemen (140th, 35.5) are the only countries that SSA beat beyond the 113th position. But these are struggling economies by many counts. This data paints a clear picture that the competitiveness of SSA countries is not encouraging and, hence, should be on the priority list of policymakers. Like South Asia, many African countries face challenges in sustaining exports for long periods, albeit with slight improvements in competitiveness. For example, only one of ten export dealings in the West and Central Africa (WCA) region lasted for more than three years. However, it is worth noting the improvement in GCI for Eastern and Southern Africa (ESA) (Schwab, 2019), which is reflected in their stable trade relationships (Kowalski et al., 2015b).

The sub-region faces a number of challenges in terms of the factors that enhance competitiveness (Slany, 2017). The competitiveness of Southern African Customs Union (SACU) countries is mainly dependent on port congestion, access to rail and port services, and governmental assistance for standard compliance, according to Farole (2016). Furthermore, many believe that the most important factors influencing a country's competitiveness and capacity to participate in GVC are its production capacity, infrastructure, and services, as well

as trade and investment policies (Slany, 2017; Lwesya, 2022). These and related issues explain the abysmal rankings on the GCI league table.

Despite this condition, research in the field has largely ignored the impact of GCI on GVC. It is natural to hypothesise that these levels of GCI affect the various factors of GVC in diverse ways. This calls for a critical empirical examination so that bespoke policy actions can be applied appropriately.

While a number of studies have examined the important role of GCI in the GVC ecosystem and its impact on economic development and prosperity, many take an indirect approach to infer these. For instance, Sergi et al. (2021) examine the pillars of GCI on the composite index of LPI for 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. Önsel Ekici et al. (2019) argue that logistic performance has a direct impact on economic development. Nonetheless, they analyse the pillars of GCI on the LPI in order to infer the effect on the economy. Önsel Ekici et al. (2016) make a similar argument but use the composite GCI for analysis for Turkey to develop strategies for policy. It is not only obvious that GVC is left out of the studies, but for a direct impact on the economic development of nations, the effect of GCI on the GVC can be deemed as an appropriate approach. It stands to reason that the ramifications of LPI may have already been reflected in the level of participation of countries in the GVC. Thus, the direct linkage between GCI and GVC will proffer more direct policy actions for respective countries, especially those in SSA, where participation is largely upstream and minimal. Further, the literature seems to be skewed towards LPI and the role of GCI in logistic performance, with GVC and its indicators being left out. This is an

important omission which has to be addressed. This study addresses these gaps by examining the causal nexus between GCI and GVC (and its four indicators).

The study is rooted in the new trade theory. The theory postulates that the location of production units is influenced by factors, including government roles that motivate efficiency in production. These factors can be seen as the generic drivers of competitiveness among trade partners. This also connotes recent developments in trade theory, which include suggesting an activist role for government in trade policy (Asad & DEC, 2010). While this could be seen as a threat to trade liberalisation, empirical evidence points to gains from trade being much bigger under imperfectly competitive markets – a strengthening for trade liberalisation (Asad & DEC, 2010). The Global Value Chain Initiative at Duke University states, *"A global value chain describes the full range of activities undertaken to bring a product or service from its conception to its end use and how these activities are distributed over geographic space and across international borders"*[8]. This definition conjures the classical determinants of comparative advantage which international trade theorists call "fragmentation" (Jones & Kierzkowski, 1990). This implies that the competitiveness of economies can influence GVCs participation and the possibility of upscale in the imperfectly competitive African market.

4.3 Method and Materials

For an insightful exploration of the relationship between GCI and GVC, a method that speaks to both the causal and complex nature of the global value chain system has been carefully selected. Amador & Cabral (2014) attest to the complex nature of the ecosystem. They further attribute the difficulty in measuring GVC in a singular manner to this complexity. Hence, the

[8] https://www.international.gc.ca/trade-commerce/economist-economiste/state_of_trade-commerce_international/special_feature-2011-article_special.aspx?lang=eng

Chapter employs the regularised partial correlation network. This network is based on the concept of the complex interplay of various components, and it has recently become the most popular network model for exploratory studies (Epskamp et al., 2018). It is also chosen over other methods, such as SEM, because it assumes causal links among variables in a system (Taylor et al., 2020), as explained in the interaction between GCI and GVC. Another benefit is the opportunity to study the entire network of connections under the axiom of observational interdependence rather than only concentrating on the unique traits of each component (Amador & Cabral, 2017). Further, this network analysis is capable of estimating a parsimonious and interpretable complex network. In recent years, several large-scale statistical properties in the form of graphs and summaries have been developed to make analysis more insightful (Amador & Cabral, 2017). Therefore, we explore the causal interconnection between GCI and GVC for SSA countries using network analysis.

In this study, GCI is taken as the independent variable and the causal variable. This is informed by the theoretical definition, discussions, and empirical literature. The export performance index (Diamantopoulos, 1999; Love, 1982), for which proximity to important markets, availability of natural resources, physical and human capital, institutional quality, logistics/connectivity, and wage competitiveness (Rodrik, 2018) were regressed on, is a similar measurement of GVC. We find that these factors overlap with the pillars of GCI, and the export performance index can be proxied for GVC participation. Ruzekova et al. (2020) also assert that competitiveness can be studied using single- and multi-factor indicators that contribute to the quantification of the concept (Ruzekova et al., 2020). This has been echoed by Cellini & Soci (2002) and Nevima (2014), among others.

4.3.1 Estimation procedure

The typical psychometric network analysis comprises two steps. In the first step, a statistical model is estimated on the data and parameters are interpreted as a weighted network between observed variables. In the second step, an analysis of the weighted network structure is performed with a measure from graph theory (Epskamp, Borsboom, et al., 2018; Epskamp, Maris et al., 2018a; Newman, 2018). However, a third step has become important due to the small sample size that can render estimates and interpretations unreliable. Epskamp, Borsboom, et al. (2018) suggest an additional step which assesses the accuracy of the network parameters and measures. All three steps are used in the study. A unique and important feature of this network is that "the strength of the connection between two nodes is a parameter estimated from data" (Epskamp, Borsboom et al., 2018, pg.196). It does not rely on latent variable effects but on elements that affect one another.

After adjusting for all other factors in the dataset, the network employed in this study is based on the Gaussian graphical model, where nodes identify observed variables and edges represent partial correlation coefficients between two variables (Lauritzen, 1996). In this case, the nodes represent the GCI and GVC indicators (as seen in Figure 1, for instance) connected by edges/links as the statistical relationships of the partial correlations. The transmission mechanism between GCI and GVC allows for this network interaction and a broader conceptualisation, such as GVC ecosystem. We are then able to answer how are all the factors in GVC ecosystem interrelated with one another with this comprehensive network.

There are three centrality indices for a network of interconnectedness (strength, closeness, and betweenness), and a measure of model accuracy (stability) are estimated from the R packages

qgraph and *bootnet* (Epskamp et al., 2012; Epskamp, Maris, et al., 2018b; Epskamp & Fried, 2018). Strength is a metric for how well a node is connected to other nodes directly. It is calculated as the total of the regularised partial correlations (weights) connecting that node to all other nodes. A central node is one that connects the most other nodes in the network in a statistically significant quantity (Taylor et al., 2020). How well a node is indirectly related to other nodes is determined by its closeness. The importance of a node in the typical path connecting two other nodes is likewise determined by betweenness. It refers to how frequently a specific network node is the quickest (and most efficient) route between other nodes, indicating how crucial that node is for tying other nodes together (Taylor et al., 2020).

We use the correlation stability coefficient to examine the stability of centrality indices in the manner of Epskamp, Borsboom, et al. (2018). This evaluates the accuracy of the nodes' and edges' edges' strength values. Additionally, a bootstrapped difference test for edge-weights and centrality indices is used to determine whether network connections and centrality estimates for certain variables differ from one another. In all of these, it is worth noting that the regularised partial correlation is used in this study for good reasons. Regularisation comes with an extra penalty for model complexity to ensure the sparsity of the model. Regularization eliminates edges that are likely to be erroneous for networks (parameters are estimated to be exactly zero). Therefore, regularisation accomplishes model selection and parameter estimates simultaneously (Hastie et al., 2015). As a method of dimensionality reduction, this technique has gained popularity in a variety of analytical approaches, including principal component analysis and regression analysis.

We approach the estimation of the network in this study in three ways. First, we take the composite GVC index and check the relationship with the pillars of GCI. This helps to ascertain the effect of the pillars of GCI on the composite GVC index. Second, we take each indicator for GVC and check the relationship with the pillars of GCI. This allows for delineating the effect of the pillars of GCI on the individual indicators of GVC so that directed efforts can be made. Third, we take all the indicators of GVC and check their relationship with the pillars of GCI. This provides a more comprehensive view of the relationship.

4.3.2 Data Description and Preliminary Analysis

All data used in this study span 2007, 2010, 2012, 2014, 2016, and 2018. These are the years for which data is available for GCI and GVC. We use the composite and constituents of the indices for each of the variables. As per the literature, the GVC comprises the four (4) main indicators: domestic valued-added (DVA) in exports, foreign valued added (FVA) in exports, indirect domestic valued-added (DVX) in exports, and value-added (VA). There are twelve (12) Pillars for the GCI: 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 (Arvis et al., 2018).

Table 4.1: Summary statistics and correlations between indicators of GVC and pillars of GCI

	DVA	DVX	FVA	GCI	GCI1	GCI2	GCI3	GCI4	GCI5	GCI6	GCI7	GCI8	GCI9	GCI10	GCI11	GCI12	GVC	VA
Obs.	150	150	150	150	150	150	142	142	142	142	142	142	142	142	142	142	142	142
Median	40.5571	938000	535500	1940000	253500	1520000	3.7102	2.7645	4.3295	4.1693	3.051	4.0142	4.208	3.7222	2.9005	2.7882	3.5435	3.0024
Mean	35.0692	4191514	3078423	7951335	1113536	6836951	3.7352	2.9243	4.218	4.1311	3.0986	3.9963	4.2393	3.7456	2.9416	2.7933	3.5844	2.9829
Variance	268.6155	1.39E+14	6.83E+13	4.31E+14	1.31E+13	2.98E+14	0.3913	0.6126	0.6664	0.6654	0.3407	0.1762	0.1191	0.4933	0.2729	0.7754	0.1908	0.1351
Std. Dev	16.3895	11792170	8262735	20752558	3617134	17265576	0.6256	0.7827	0.8163	0.8157	0.5837	0.4197	0.3451	0.7023	0.5224	0.8805	0.4368	0.3675
Skewness	-1.4618	4.2384	4.0013	3.9967	4.6342	3.8181	0.3724	0.6336	-0.4903	0.4637	0.2685	-0.5508	0.5266	0.2016	0.7325	0.4993	0.1225	-0.1153
Normtest.W	0.709***	0.3529***	0.3826***	0.3861***	0.2866***	0.4051***	0.98	0.9444***	0.9684***	0.9657***	0.9864	0.9604***	0.9704***	0.9923	0.9634***	0.951***	0.9918	0.9948
	DVA	**DVX**	**FVA**	**GCI**	**GCI1**	**GCI2**	**GCI3**	**GCI4**	**GCI5**	**GCI6**	**GCI7**	**GCI8**	**GCI9**	**GCI10**	**GCI11**	**GCI12**	**GVC**	**VA**
DVA	1.000																	
	- - - ·																	
DVX	0.998	1.000																
	0.000	-----																
FVA	0.965	0.973	1.000															
	0.000	0.000	-----															
GCI	0.253	0.247	0.267	1.000														
	0.005	0.007	0.003	-----														
GCI1	-0.067	-0.071	0.005	0.018	1.000													
	0.465	0.442	0.953	0.841	-----													
GCI2	-0.074	-0.075	-0.019	0.002	0.739	1.000												
	0.424	0.416	0.839	0.980	0.000	-----												
GCI3	0.010	0.019	0.036	-0.076	0.171	0.207	1.000											
	0.912	0.835	0.698	0.409	0.061	0.024	-----											

GCI4	-0.055	-0.052	0.002	-0.081	0.517	0.561	0.021	1.000										
	0.552	0.570	0.982	0.380	0.000	0.000	0.816	-----										
GCI5	-0.047	-0.043	0.048	-0.053	0.650	0.776	0.144	0.662	1.000									
	0.611	0.639	0.603	0.568	0.000	0.000	0.117	0.000	-----									
GCI6	0.031	0.029	0.112	0.171	0.741	0.666	0.091	0.542	0.779	1.000								
	0.733	0.752	0.222	0.063	0.000	0.000	0.324	0.000	0.000	-----								
GCI7	-0.251	-0.250	-0.161	0.028	0.608	0.372	0.035	0.297	0.353	0.532	1.000							
	0.006	0.006	0.078	0.761	0.000	0.000	0.708	0.001	0.000	0.000	-----							
GCI8	-0.111	-0.107	-0.019	-0.059	0.705	0.658	0.164	0.349	0.680	0.694	0.605	1.000						
	0.227	0.244	0.838	0.522	0.000	0.000	0.073	0.000	0.000	0.000	0.000	-----						
GCI9	0.095	0.092	0.130	0.049	0.610	0.829	0.191	0.625	0.859	0.730	0.299	0.600	1.000					
	0.301	0.319	0.156	0.597	0.000	0.000	0.036	0.000	0.000	0.000	0.001	0.000	-----					
GCI10	0.075	0.074	0.051	0.049	-0.215	-0.166	0.134	-0.230	0.011	0.061	0.071	0.246	0.092	1.000				
	0.416	0.421	0.582	0.591	0.018	0.070	0.144	0.012	0.905	0.509	0.442	0.007	0.317	-----				
GCI11	0.053	0.057	0.149	0.107	0.609	0.658	0.001	0.472	0.812	0.863	0.533	0.748	0.734	0.164	1.000			
	0.562	0.536	0.105	0.244	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.000	0.000	0.073	-----			
GCI12	0.132	0.140	0.215	0.044	0.538	0.474	0.010	0.415	0.672	0.737	0.498	0.588	0.585	0.212	0.818	1.000		
	0.152	0.127	0.018	0.635	0.000	0.000	0.917	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	-----		
GVC	0.994	0.998	0.987	0.255	-0.048	-0.058	0.024	-0.036	-0.016	0.055	-0.224	-0.081	0.104	0.067	0.085	0.163	1.000	
	0.000	0.000	0.000	0.005	0.602	0.527	0.791	0.695	0.864	0.554	0.014	0.380	0.259	0.464	0.355	0.075	-----	
VA	0.999	0.999	0.976	0.257	-0.055	-0.065	0.015	-0.045	-0.031	0.046	-0.236	-0.096	0.102	0.071	0.070	0.147	0.998	1.000
	0.000	0.000	0.000	0.005	0.551	0.484	0.874	0.624	0.741	0.619	0.009	0.299	0.268	0.441	0.445	0.110	0.000	-----

*Note: *** denote Shapiro-Wilk test of normality at 1% significance level.*

To start with, summary statistics and the ordinary Pearson Product Moment correlation (with p-values underneath) among all the variables are presented in Table 4.1[9]. For the summary statistics, large deviations from the mean are indicative of instability in these pillars and variables. These are also reflected in the negative skewness for DVA, GCI5, GCI8, and VA. Further, they point to asymmetry in the values as confirmed by the Shapiro-Wilk test of normality adjudge all the variables as deviating from the normal distribution at the 1% confidence level, except for GCI3, GCI7, GCI10, GVC, and VA. Since the distributional properties do not have any bearing on the substantive techniques used in the analysis (i.e. this applies to Chapter Three), we do not dwell on this. Two things are clear in the correlations: 1) There are different magnitudes and directions of correlations among the variables. This suggests some level of relationships among the variables that can be further investigated. The relationships also point to the connected nature of GVC ecosystem, which is ubiquitous in the literature. However, among other things, these correlations do not imply causality. Also, by their bivariate nature, they do not divulge the complex interrelation among the variables. 2) there are several correlations that are statistically insignificant. These reasons provide a justification to investigate the causal and multi-dimensional relationship among the variables further using the regularised partial correlation network to estimate a parsimonious and interpretable complex network structure in this system.

[9] The GCI components are GCI1 (institutions), GCI2 (infrastructure), GCI3 (macroeconomic development), GCI4 (health and primary education), GCI5 (higher education and training), GCI6 (goods market efficiency), GCI7 (labour market efficiency), GCI8 (financial market development), GCI9 (technological readiness), market size (GCI10), GCI11 (business sophistication), and GCI12 (innovation).

4.4 Analysis, Discussion and Results

In this section, we submit the results and findings from the investigation of complex interconnectedness among the pillars of GCI and GVC. We do so by delineating the results into pillars of GCI with the composite GVC index, pillars of GCI with the individual indicators of GVC, and finally, the 12 pillars of GCI with the four indicators of GVC, as seen in the subsequent sections.

4.4.1 Pillars of GCI and composite GVC index

In this section, the 12 pillars of GCI are combined with the GVC composite index to ascertain the causal interconnectedness among them, especially with the focus on which pillar affects the GVC index the most. In this case, there are 13 nodes and possibly 78 edges (i.e. $^{13}C_2$). Figure 1a (left panel) is the regularised partial correlation network structure of this system of nodes and edges. The network structure is parsimonious, showing 26 non-zero edges out of 78 edges. This is made possible by the *least absolute shrinkage and selection operator* (LASSO)[10] (Tibshirani, 1996) employed in the regularisation technique and can result in parameter estimates of exactly zero.

There are notable strong connections (positive in blue colour) in the network structure; among GCI11 (business sophistication) and GCI12 (innovation), GCI8 (financial market development) and GCI11 (business sophistication), GCI9 (technological readiness) and GCI12 (innovation), and

[10] Limits the sum of absolute partial correlation coefficients by shrinking all estimates so some become exactly zero (Epskamp, Borsboom, et al., 2018; Friedman et al., 2008).

GCI9 (technological readiness) and GCI5 (higher education and training). There are also absent connections, such as between GCI3 (macroeconomic development) and GCI4 (health and primary education) and between GCI3 (macroeconomic development) and GCI12 (innovation). It implies that these pillars can be significantly independent when conditioned on all other pillars or there was not sufficient power to detect an edge between these pillars.

But the important and strongest is the connection between GCI10 (market size) and GVC (composite GVC index). This implies that market size is the pillar that causes the most movement in the GVC in SSA countries. This revelation is consistent with the facts about the African plight in international trade where value-addition is largely lacking. It is apparent that challenges in advancing competitiveness are still persisting despite improvements (Schwab, 2019; Kowalski et al., 2015b). We see from Figure 1a (left panel) that the pillars that enhance efficiency (GCI6) do not influence GVC as much as the market size. This corroborates the findings of Farole (2016), Slany (2017), and Lwesya (2022) in which port congestion and rail and port service accessibility (akin to GCI9 and GCI12), productive capacity (akin to GCI), infrastructure and services (akin to GCI2), and trade and investment policy (akin to GCI12) are inhibiting competitiveness and eventually GVC participation.

While not surprising, it is interesting to find negative (green colour) interconnections among the nodes, as seen in Figure 1a (left panel). However, these are not as strong as the notable positive interconnections. Note the edges GCI10 (market size) and GCI12 (innovation), GCI10 (market size) and GCI11 (business sophistication) as negative and moderate. We further take cognisance of the fact that GCI4 (macroeconomic environment) and GCI7 (labour market efficiency) have a

negative causal influence on the composite GVC index in order of magnitude. While these confirm, in part, the findings in the literature above, they send an essential signal that the macroeconomic environment and labour market efficiency should be given particular attention in order to ameliorate the negative impact on SSA's participation in the global value chain. Also, there should be tailor-made policy actions to avoid competitive pillars influencing each other negatively.

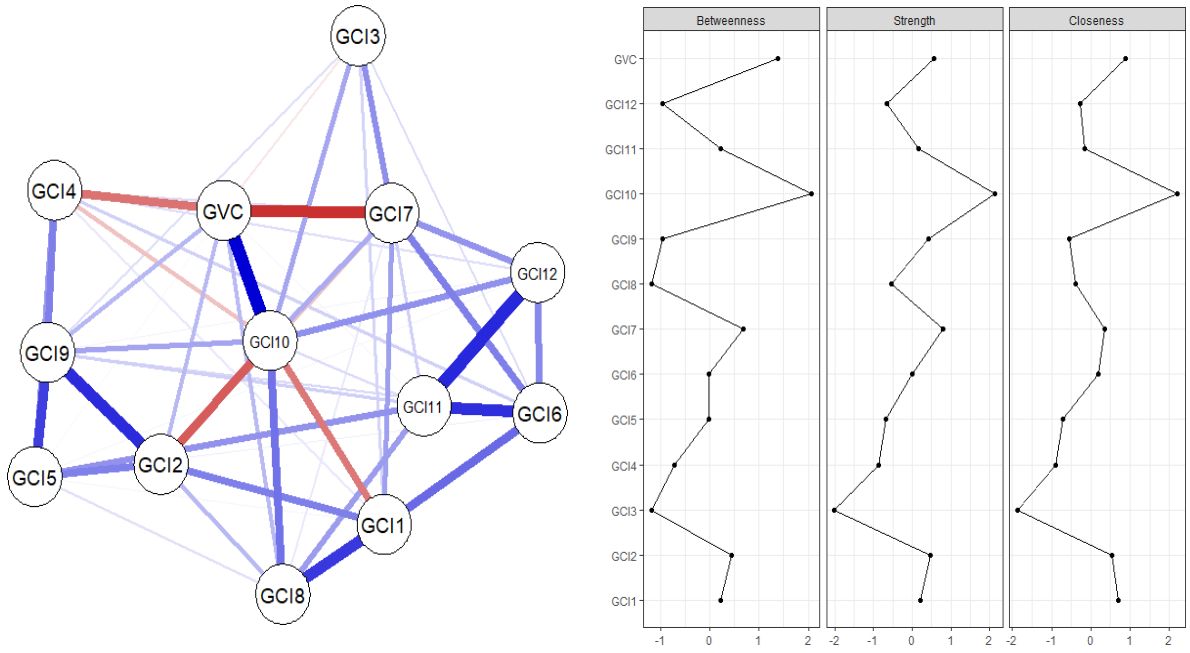


Figure 4.1: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and composite GVC index in SSA countries. *Note: Green = positive and Red = negative connections. Stronger connections are indicated by shorter and thicker lines. Only significant (p < .01) connections are shown (left panel)*[11].

In terms of centrality indices, Figure 4.1 (right panel) presents how the nodes differ according to their centrality estimates. We see a substantial difference in the centrality indices (betweenness,

[11] This applies to all plots of the same type in this chapter.

strength, and closeness) among the nodes. The pillar GCI10 has the highest betweenness, strength, and closeness. Other notable are GVC (betweenness), GCI7 (strength), and GCI1 (closeness). These results imply that the importance of market size (GCI10) is confirmed by the centrality indices as it was by the network structure in Figure 4.1 (left panel). Thus, the main competitive pillar is the market size in SSA countries because it is best connected directly to every pillar and the composite GVC index (strength). It is also the variable that is most indirectly connected to all other variables (closeness), and it is the most important variable in the average path between two other variables (betweenness).

However, to confirm the interpretability of the centrality estimates above, we need to confirm the accuracy of the edge-weight. The method checks the variability of edge-weights by estimating a 95% confidence interval (CI) to contain the true edge-weight, by bootstrap (Efron, 1979). From Figure 1b (left panel), it is clear that the bootstrapped CIs around the estimated edge-weights are thin. This indicates that the estimated edge-weights likely do not differ from one another. Thus, the interpretations and their policy and practical implications may be considered valid.

Lastly, we investigate the stability of the strength index (as representative of the centrality estimates). This is accomplished by averaging the correlations between the original sample and the network centrality indices sampled with data omitted (subset). The areas show the range from the 2.5th quantile to the 97.5th quantile, and the line shows the means (Epskamp, Borsboom, et al., 2018). From Figure 1a (right panel), we find that the stability of strength is relatively steady within the range and thus desirable to support the interpretability edge-weight estimates.

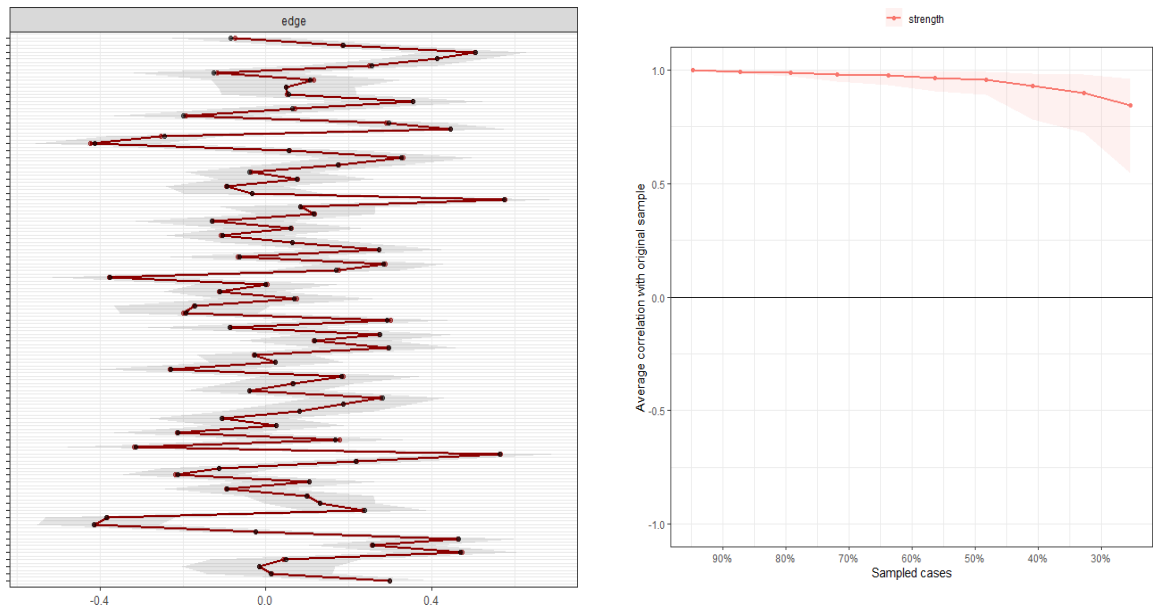


Figure 4.2: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network 12 GCI pillars and composite GVC index

4.4.2 Causal Relation between Pillars of GCI and Indicators of GVC

In this section, we endeavour to isolate the causal interconnection between the pillars of GCI and the individual indicators of GVC. Given the generally low participation of SSA countries in the GVC, it is important to identify which specific indicators are contributing the most and which competitive pillars are driving them. Another case in point is that the global supply chain has drastically reduced the proportion of domestic value-added in gross exports (Johnson, 2014). Consequently, this has reduced the contributions of the domestic labour force to gross exports, an issue of critical concern for economic prosperity. The knowledge from this can help policy actions and directions for the implication of fragmentation on a myriad of concerns in order to work towards an overall upgrade in international trade. This is especially essential in light of the negative causal nexus among some competitive pillars, as depicted in Figure 4.1 (left panel). The

decomposition of the GVC index into various indicators is well-established and has far-reaching importance, as indicated in the extant literature (Amador & Cabral, 2014). Among other things, the fragmentation allows for studying the developments in income structure in GVCs (Timmer et al., 2014). Investigating the relationship between global outsourcing and the skill structure of labour demand in the local economy is also beneficial (Foster-McGregor et al., 2013). These network structures, while the interconnections between the GCI pillars are important, focus on their relationship with the specific GVC indicator in question.

4.4.3 Pillars of GCI and Domestic Value-Added (DVA) in Exports

In Figure 4.2 (left panel), the network structure shows almost the same central importance for both GCI10 (market size) and DVA, and the two share the strongest positive nexus. The positive causal relations with DVA are as follows, in order of magnitude: DVA-GCI10 (market size), DVA-GCI9 (technological readiness), DVA-GCI8 (financial market development), and DVA-GCI11 (business sophistication). Negative causal links are DVA-GCI1 (institutions), DVA-GCI7 (labour market efficiency), DVA-GCI2 (innovation), DVA-GCI5 (higher education and learning). Similar to the composite GVC index, the most important competitive factor to domestic value-added is the market size in SSA countries, which consistently conforms to the extant literature as the practical dynamics in the region. There should be more improvements in technological readiness, financial market development, and business sophistication, which have a strong potential to upgrade international trade for SSA countries. Not only should there be an improvement in benign pillars for DVA, but governments should also be wary of those pillars that are malignant towards domestic value-added, such as institutions, labour market efficiency, innovation, and higher education and training in SSA. At the least, efforts need to be made to reverse the negative play of these pillars

on the domestic value-added. All these revelations bear witness to what other researchers have argued to be improved upon in order to advance in the international trade ecosystem (see Farole, 2016; Slany, 2017; Schwab, 2019; Kowalski et al., 2015b; Lwesya, 2022; etc.).

In Figure 4.2 (right panel), the dominance and importance of market size (GCI10) are confirmed by the centrality metrics of betweenness, strength, and closeness. For all three, market size is the most important variable in the complex system of variables. It is worth noting that the key place of the market size (GCI10) is maintained in all the interactions with the individual GVC indicators, as seen in Figures 4.3, 4.4, and 5.5. This further supports the role of the market size in positively determining the composite GVC index. The right panel of Figure 2a also confirms the next important variable DVA. This corroborates the dependency of DVA on the pillars of competitiveness.

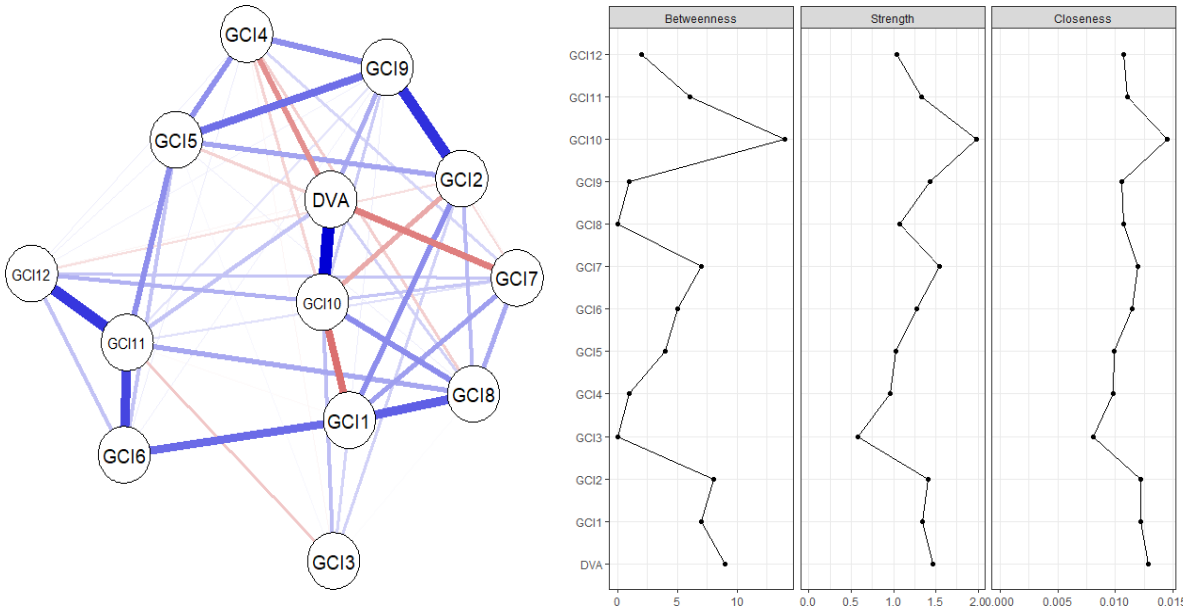


Figure 4.3: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and DVA in SSA countries

From Figure 4.2 (left panel), there is enough evidence to interpret the centrality indices as well as the network structure. This can be seen from the thin bootstrapped CIs around the estimated 95% confidence interval (CI) for the edge-weights, suggesting robust estimates. In the right panel, the stability of strength is relatively steady within the range and thus desirable to support the interpretability edge-weight estimates.

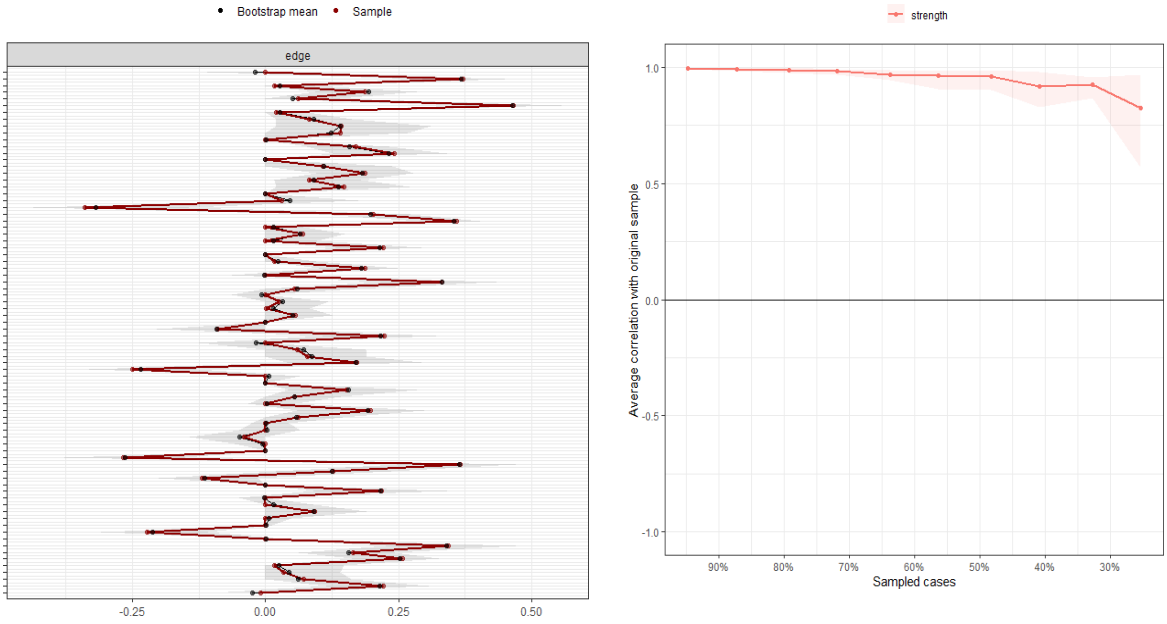


Figure 4.4: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network 12 GCI pillars and DVA

4.4.4 Pillars of GCI and Foreign Value-Added (FVA) in Exports

In Figure 3a (left panel), we note the equally essential negative and positive causal links between FVA and GCI7 (labour market efficiency) and FVA and GCI10 (market size), respectively. Other positive links are FVA-GCI2 (innovation), FVA-GCI9 (technological readiness), FVA-GCI3 (macroeconomic development), and FVA-GCI11 (business sophistication). Additional inverse

relationships are FVA-GCI4 (health and primary education), and FVA-GCI3 (macroeconomic development), in order of importance. It should also be noted that the remaining pillars have neither direct nor indirect connections with FVA. This suggests that when it comes to FVA, resources should be channelled into the market size, innovation, technological readiness, macroeconomic development, and business sophistication, especially the adverse-impacting ones (i.e. GCI7, GCI2, GCI3, and GCI4). The reason why the latter pillars are crucial is that, for instance, GCI4 (health and primary education) saw an improvement by two more points from 2018 to 2019 for 14 SSA countries (Schwab, 2019).

Figure 4.3 (right panel) endorses the strong place of market size and is rightly followed by foreign value-added as depicted by their high betweenness, strength, and closeness scores. Further, the confidence interval (Figure 4.3 (left panel)) and stability (Figure 4.3 (right panel)) attest to the interpretability of the finding on the link between FVA and the 12 pillars of competitiveness.

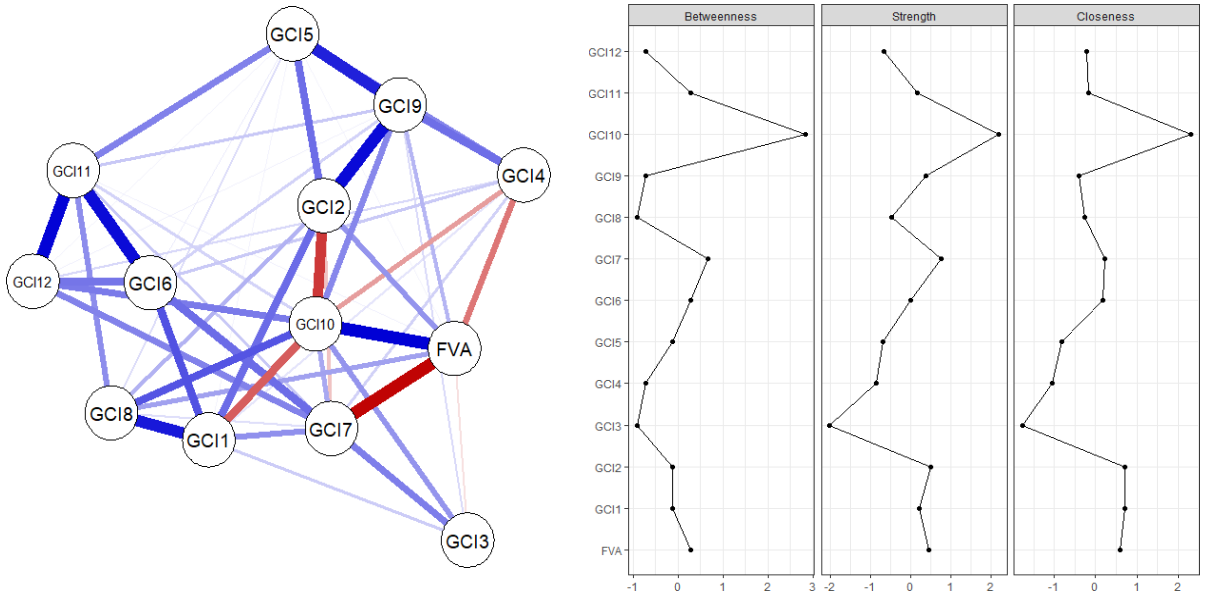


Figure 4.5: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and FVA in SSA countries

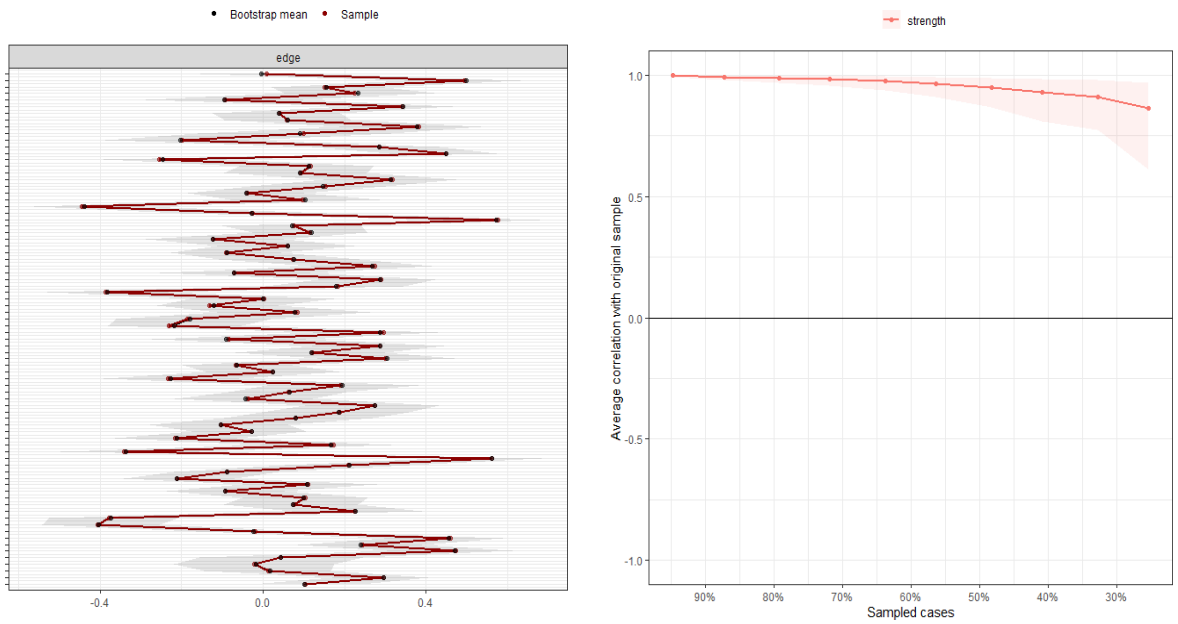


Figure 4.6: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network 12 GCI pillars and FVA

4.4.5 Pillars of GCI and Indirect Domestic Value-Added (DVX) in Exports

Unlike domestic value-added (DVA), indirect domestic value-added is not close to the central node, GCI10 (market size), in Figure 4.4 (left panel). The most positive nexus is with GC10, following that is with GCI9 (technological readiness), GCI8 (financial market development), and thinly with GCI12 (innovation). Comparatively, negative connections (DVX-GCI7 (labour market efficiency), DVX-GCI4 (health and primary education), and DVX-GCI3 (macroeconomic development)) outweigh the positive links. Given that indirect domestic value-added constitutes the contributions contained in domestically produced inputs incorporated into exports (Fujii-

Gambero & Cervantes-Martínez, 2016), the adverse impact of labour, health, and macroeconomic development is even more debilitating for participation in international trade. It is also clear that the huge impact of the market size cannot subsume the weaknesses in these pillars. Our findings are in line with what is known that largely indirect domestic value-added in SSA falls short of developed regions' contributions due to factors such as lower levels of technological development and a lack of integration into global supply chains (Morrison et al., 2008). As expected, the place of market size is seen in Figure 4.4 (right panel) as the central node. The further diagnostics plots in Figure 4.4 (left and right panels) support the validity of the results in the network structure.

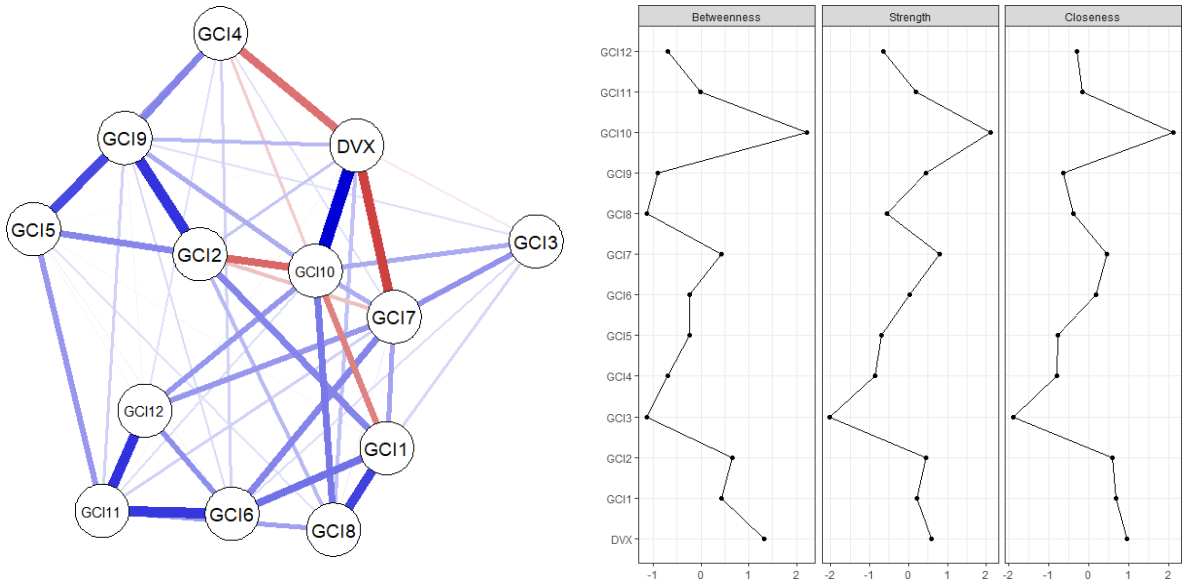


Figure 4.7: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and DVX in SSA countries

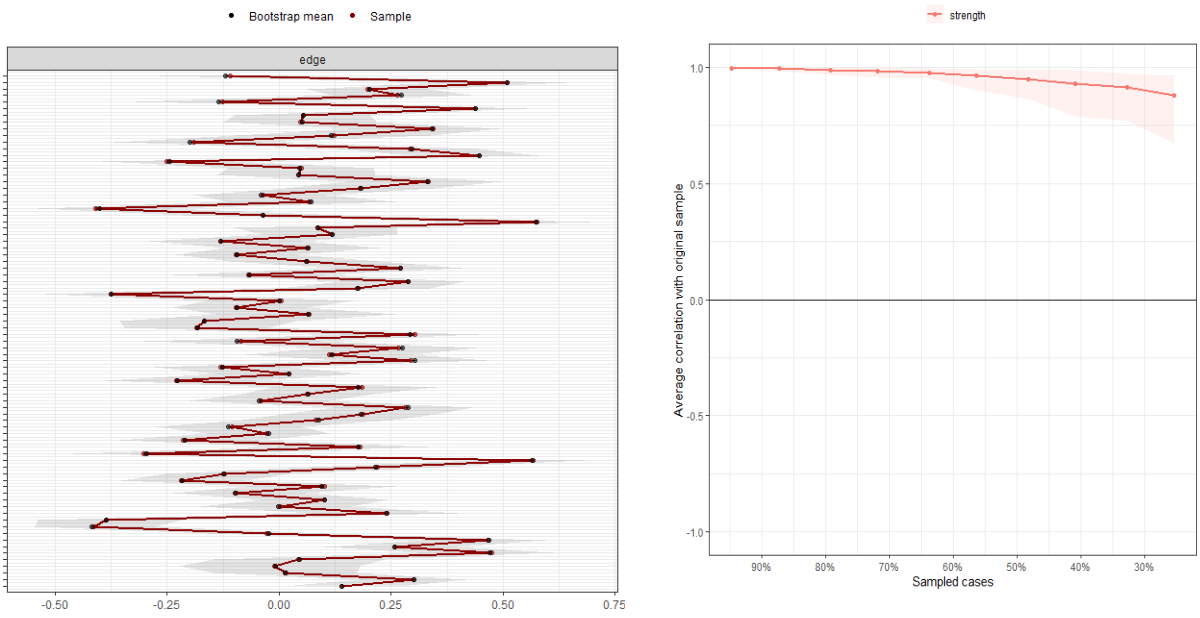


Figure 4.8: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network 12 GCI pillars and DVX

4.4.6 Pillars of GCI and Value-Added (VA) in Exports

The results for value-added (VA) in Figures 4.5 (left and right panels) and 4.5 (left and right panels) are almost the same as those for DVX. It does imply that the role played by the competitiveness pillar on DVX is the same for VA. It also denoted that the components making up DVX cannot be distinguished from those making up VA for the selected SSA countries. Thus, all inferences and interpretations for DVX are applicable to VA. A crucial point to make here is that the SSA countries are short-changed in the number of indicators for GVC. In effect, only three indicators make the composite GVC index since VA and DVX are intrinsically the same. This can be a contributing factor to the low participation levels in international trade and global value chain framework (see Amendolagine et al., 2019; Hofstetter et al., 2022; Tefera et al., 2020).

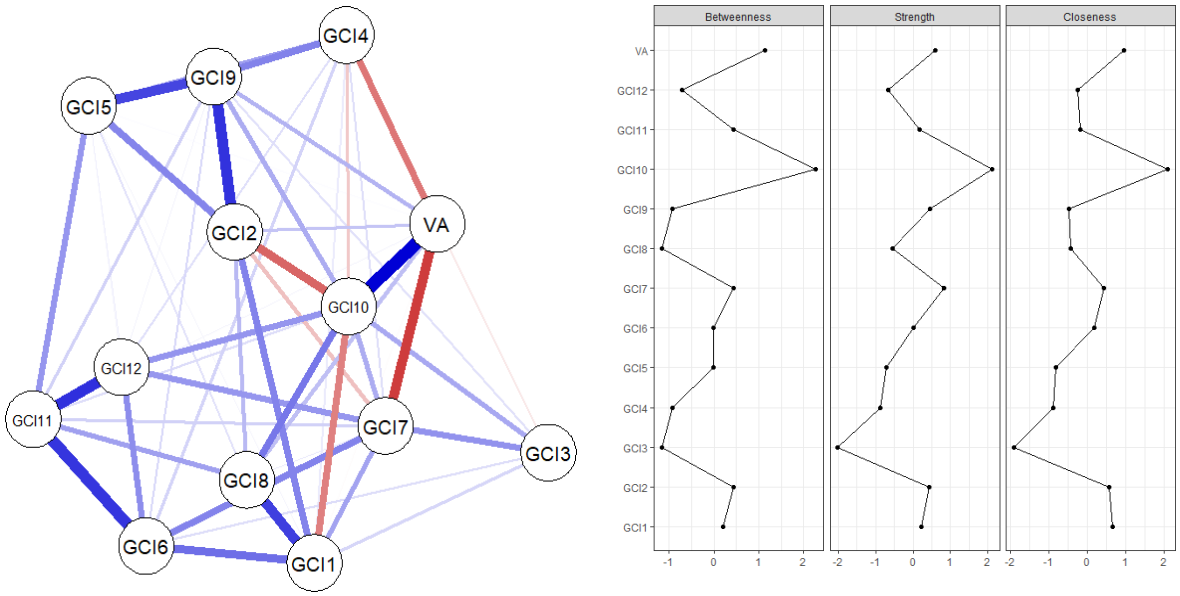


Figure 4.9: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and VA in SSA countries

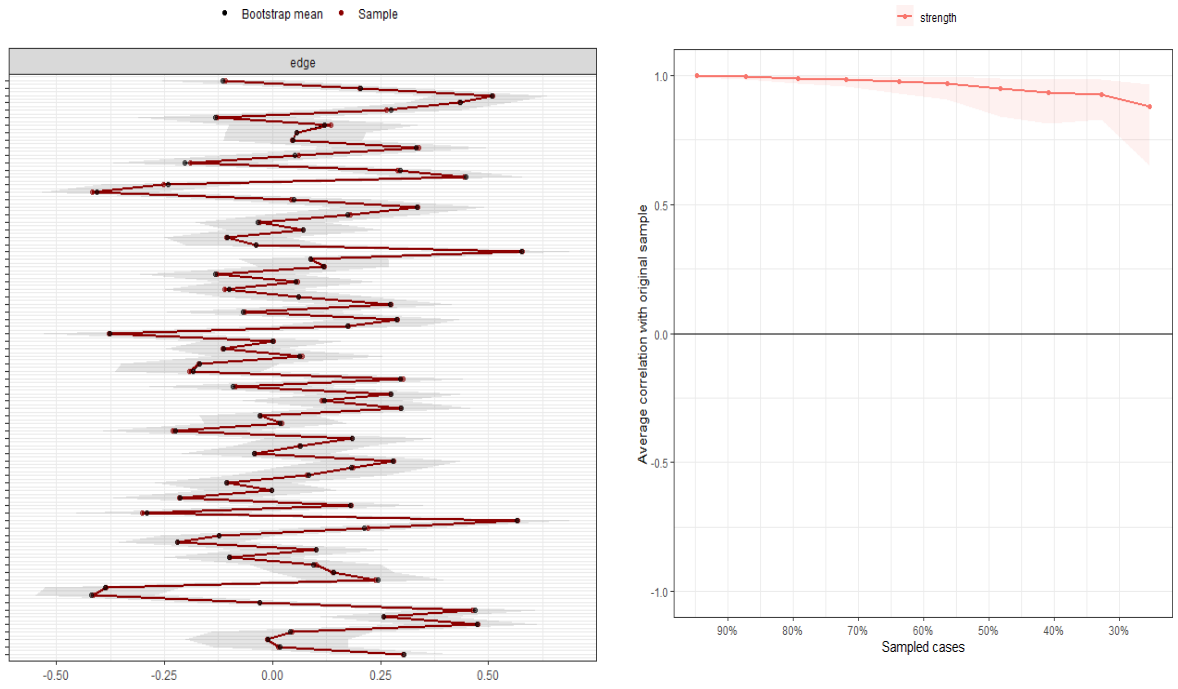


Figure 4.10: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network 12 GCI pillars and VA

4.4.7 Causal Relation between Pillars of GCI and all indicators of GVC

As a climax to this, we present the results of the causal interconnections among all pillars of GVC and all the indicators of GVC, as presented in Figure 4.6 (right panel). The dynamics resulting from this network structure are different from the preceding findings. To start with, we find two main clusters, which are for the 12 pillars GCI on the one hand and the four indicators GVC on the other hand. The two clusters are connected by very weak positive and negative vertices (FVA-GCI12, FVA-GCI7, DVX-GCI2, DVA-GCI8, and DVA-GCI9).

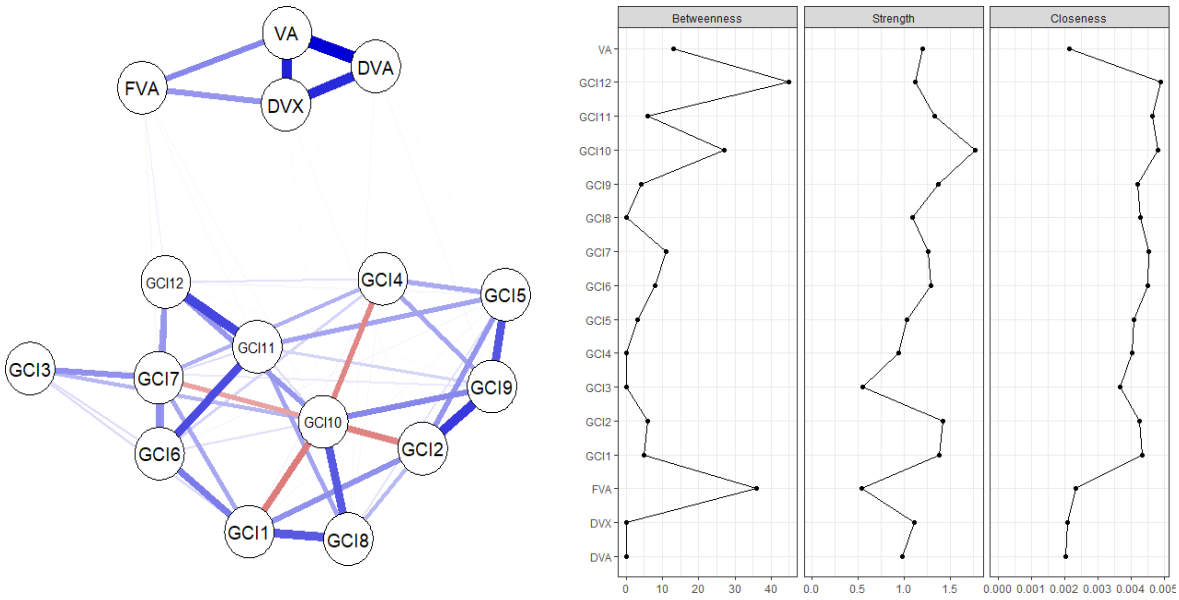


Figure 4.11: Estimated network structure (left panel) and centrality indices (right panel) of 12 GCI pillars and the four indicators of GVC in SSA countries

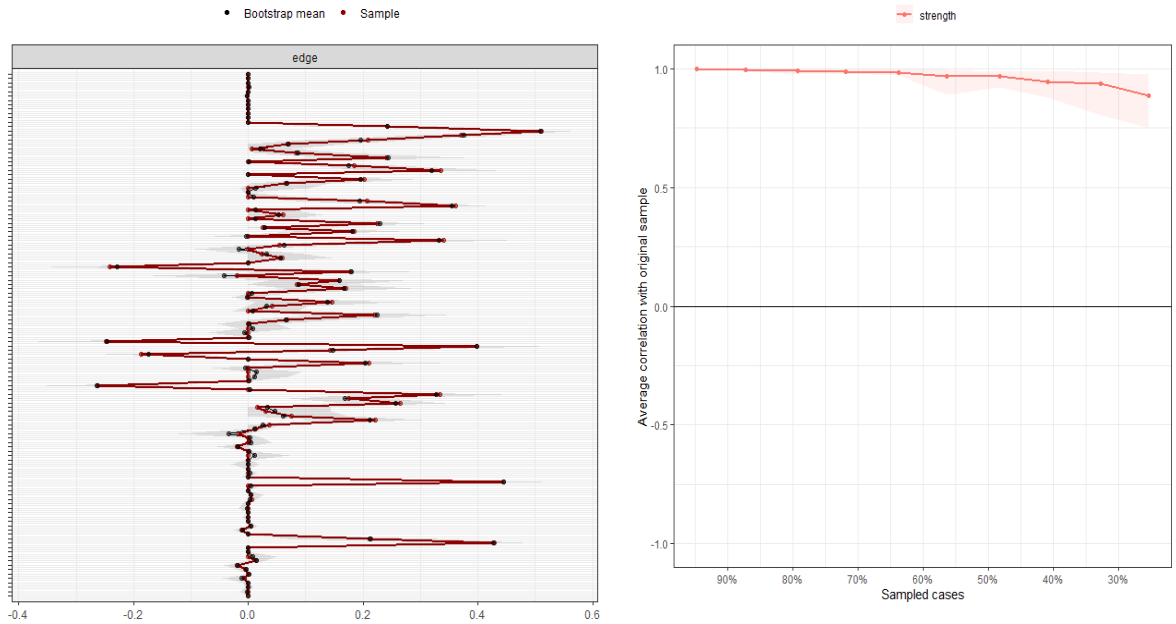


Figure 4.12: Bootstrapped confidence intervals of estimated edge-weights (left panel) and stability (right panel) for the estimated network of 12 GCI pillars and four indicators of GVC

In the GVC cluster, we see only positive causal relations. In order of strength, VA-DVX, VA-DVA, DVX-DVA, FVA-DVX, and FVA-VA. The VA-DVX link corroborates the finding that the dynamics of the two separately in the midst of the 12 pillars are indistinguishable, as divulged in the last two sub-sections. The wholly positive interactions of the GVC cluster tell of their importance, and that policy actions need to look at them in concert so that the symbiotic connections can be maintained for better GVC participation in the region.

On the other hand, we have the GCI cluster, which bears both negative and positive associations, with the latter dominating. It is also interesting to note that the central node, market size (GCI), is the only one sharing adverse relations with GCI2 (infrastructure), GCI1 (institutions), GCI4 (health and primary education), and GCI7 (labour market efficiency), in order of magnitude. This may be surprising for another region, but in SSA, where many countries rank very low in the global

competitiveness league table, it is rather revelatory. It can be inferred that the most prominent pillar (market size) is not able to scale the region's GVC participation because weaknesses in infrastructure, institutions, health and primary education, and labour market efficiency do not only support it but rather work against it. In practical terms, the scenario makes a lot of sense because these pillars are needed to propel the market size into a lucrative pillar. In the absence of a supportive ecosystem, the large market size is a liability rather than an asset. As emphasised earlier, it is not enough for governments to invest in the pillars that support each other (i.e. GCI5-GCI9, GCI2-GCI9, GCI1-GCI8, GCI11-GCI12, GCI6-GCI11, etc.), further action should be taken to reverse those situations that are counteractive.

In Figure 4.5 (right panel), the importance of the pillars and indicators in the network structure are ranked based on betweenness, strength, and closeness. In terms of the pillar/indicator that mediates the most between two other variables (betweenness), that will be GCI12 (innovation), followed by FVA (foreign value-added), and GCI10 (market size). Market size is the pillar that is directly connected to most of the pillars and indicators and hence ranked first in strength, followed by GCI12 and GCI11. Being indirectly connected to other pillars (closeness), in order of magnitude, are GCI12, GCI10, and GCI1. All these light on the importance of these particular pillars so that they can be used as catalysts for upgrading the SSA region in the global value chain participation. Last, the diagnostics in Figure 4.5 confirm the validity of the results above.

The interplay of the 12 pillars of GCI and four indicators of GVC in one complex network structure in this sub-section has justified why we delineated each indicator and 12 pillars in separate network structures. It is clear that combining all the variables does not reveal the impact of the pillars on

the stand-alone indicators. By circumventing this problem, we have provided more insights for both policy and practice so that directed efforts can be channelled to the needed pillars for specific indicators.

4.5 Conclusion and Recommendations

In this study, we examined the complex causal relationship among the 12 global competitiveness pillars and the four global value chain indicators as they pertain to the SSA region. The literature in the area argues for the crucial nature of competitiveness in upgrading and participating in international trade and the global value chain. However, the causal linkages of this with the indicators of GVC have not been known in the region hitherto. In addressing this matter, we recognise the complex nature of the GVC ecosystem and the theoretical foundations of international trade (Amador & Cabral, 2014) and apply an appropriate technique. Nonetheless, this has the tendency to veil the influence of the GCI pillars on the GVC indicators. Hence, in addition, we isolate each indicator and investigate the interconnections with the 12 pillars of GVC. This framework reveals interesting findings for both policy and practice for the region. The study is situated in the product fragmentation theory and the new trade theory. The latter suggests an activist role for the government in trade policy (Asad & DEC, 2010). The advocacy role of government is needed to enhance efficiency in the processes of production and trade through which countries gain competitive advantage in the global value chain, which is imperfect and competitive.

We employed data on 25 sub-Saharan African countries for the years 2007, 2010, 2012, 2014, 2016, and 2018. We employ the regularised partial correlation network to estimate a parsimonious

and interpretable complex network structure of international trade and to divulge the causal non-linear interplay of the 12 pillars of GCI and four indicators of GVC. The technique was chosen it is the most popular network model for exploratory studies (Epskamp et al., 2018) and speaks to the theories and objective of this study, as advocated by Taylor et al. (2020). The findings support both the theoretical literature on the importance of competitiveness in international trade (Rodrik, 2018) and the empirical evidence (Slany, 2017; Lwesya, 2022) for the pillars of GCI influencing the indicators of GVC.

This study has contributed to the discourse on the role of competitiveness in the global value chain and international trade. This provokes policy-makers and traders alike to understand and take direct actions to improve competitiveness in order to expand domestic value-added in exports and foreign value-added in exports to upgrade the region in international trade. As the first in the SSA context to examine the complexity of GVC system in a simplified approach, deeper insight into policy and action plans in the selected SSA economies is fostered. Further, this study has examined and confirmed the non-linear and causal interrelationship between global competitiveness and the global value chain in the SSA region. The exposed causal links sound a strong warning to governments to be more proactive in their advocacy actions in the era of trade liberality and fragmentation of products than a mere correlation or connection informs.

Our empirical findings reveal that in the complex network of the 12 pillars of GCI and four indicators of GVC, there is a dichotomy of clusters for constructs. The two clusters are connected by thin positive and negative links. However, connections are strong within each of the two

clusters. Hence, it is better that each indicator is isolated to see its interaction with the GCI pillars to reveal more useful insights. The market size (GCI10) was the most important positive pillar for the SSA region's composite GVC index as well as for individual GVC indicators. It is important to note the thin links for the clusters indicate that they form a complex system of the value chain but are distinct in specific ways. This also explains why cluster connections are stronger because they are parts of a composite (i.e. pillars of GCI) and indicators of GVC. Further, negative and positive links should be taken seriously because their impacts are close and swift by way of their proximity in the clusters.

An interesting revelation is that there are negative causal relationships between some GCI pillars, notably with the market size. Further, there are other pillars that also have a negative influence on GVC's indicators. These findings are disturbing, to say the least, but they are also telling of the need for governments to intensify their activist duties in order to improve competitiveness, especially those that enhance efficacy and productivity (see, Backer & Miroudot, 2013). To a large extent, those are also factors, except for market size, so that benefits can flow to GDP and economic growth and development (Marín-Odio, 2014). In line with Schwab (2019) and Kowalski et al. (2015b), the results also show that challenges in advancing competitiveness are still persistent despite improvements over the years in SSA countries. It was also disclosed that the dynamics of value-added in exports (VA) and indirect domestic value-added in exports (DVX) with the 12 pillars of GCI are similar. For these two, the negative influence of some pillars is more pronounced than positive links. Altogether, positive interconnections are stronger than negative ones which

should be used as springboards for scaling competitiveness and ultimately enhancing and upgrading in the global value chain for economic gains.

Given that the central node, market size (GCI10), shares adverse relations with GCI2 (infrastructure), GCI1 (institutions), GCI4 (health and primary education), and GCI7 (labour market efficiency) is not surprising but worrisome. It is recommended that since the most prominent pillar (market size) is not able to scale the region's GVC participation because weaknesses in infrastructure, institutions, health and primary education, and labour market efficiency do not only support it but rather work against it, the governments have a bigger task. Governments need to focus on strategic actions in order to use the market size fully for GVC participation. Reforms to build institutions, improve the health and education systems, and promote labour market efficiency are all included in this. Governments may foster an environment that is conducive to effective and long-lasting GVC engagement by carefully addressing these fundamental components. This approach is in line with the interconnectedness of variables that are essential for innovation and economic activity in the region.

Moreover, they need to provide a supportive ecosystem so that the large market size is an asset rather than a liability. As emphasised earlier, it is not enough for governments to invest in the pillars that support each other (i.e. GCI5-GCI9, GCI2-GCI9, GCI1-GCI8, GCI11-GCI12, GCI6-GCI11, etc.), further action should be taken to reverse those situations that are counteractive. This is of prime importance because non-competitiveness has been blamed for the low level of participation in the GVC African countries as well as marginalised trade integration (Ahmad &

Primi, 2017). It is also partly due to non-competitiveness that the participation of African countries in the GVC is largely limited to forward upstream (Ofori et al., 2021).

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the study's summary, conclusions and key findings. It further shows recommendations found and areas for further studies. Particularly, this chapter, as the last chapter of the study, first highlights a summary of the study indicating the purpose, significance, existing literature, contribution to prior studies, and the research questions. The study's conclusions and findings are subsequently presented in line with the research objectives. The chapter provides recommendations to key stakeholders, whereas limitations of the study, providing the need for further studies, are captured in the areas for further research.

5.2 Summary

The study examines the interconnectedness of global competitiveness, logistics performance and global value chain participation in SSA. The evidence from the literature on GVCs, as well as the theoretical underpinnings of fragmentation and new trade theories, demonstrate that the logistic performance and competitiveness of countries have an impact on their ability to participate in GVCs, either individually or in combination with other countries. There hasn't been much systematic research done yet to explore this potential link. Understanding this interconnection may help policymakers choose what actions to take to encourage businesses and nations to join the GVCs, which will boost economic growth.

Moreover, because African countries have long played a significant role in global trade and the value chain, the study of the connections between global competitiveness, logistical performance, and participation is crucial for African nations. The following roles are only a few examples of those that are important. First off, since the middle of the 1990s, the area has strengthened its trade openness and formed alliances with developing nations like China and India. However, if they are not competitive in the global market, their integration into the global economy leaves them exposed to external shocks. Also, African nations still need to make progress toward greater integration into GVCs and reap the benefits of GVC involvement. Improved trade facilitation characteristics have also been linked to increased global trade competitiveness, according to studies. Last but not least, there are glaring gaps in the literature about the connections between global competitiveness, logistical performance, and GVC participation.

Studies have examined the potential determinants that affect GVC participation based on reviews of related literature and have found elements such as institutions, infrastructure, tariffs, trade openness, economic diversity, economic complexity, human capital development, and technology. The global competitive index, divided into 12 pillars, serves as an annual barometer for decision-makers to look beyond immediate actions and responses to policy and instead evaluate their participation in GVCs and advance to the upstream level. Therefore, by using techniques that reveal pertinent information for traders and policy-makers regarding the network of global competitiveness, logistic performance, and GVCs participation and upgrade in Africa for purposes of enhancing economic prosperity, this study contributes to the limited existing literature.

The interrelationships between dimensions of global competitiveness, logistical performance, and GVC participation in Africa are explored in this thesis. For 37 African nations with a complete data set for global competitiveness, logistic performance, and GVCs participation, the study concentrated on GVCs data rather than trade data. Specifically, the study intends to answer the following questions:

1. is there a mediator role of logistic performance in the link between the global value chain (GVC) and global competitive index (GCI) in the selected SSA countries?
2. what is the nature of the interactive effect among the pillars of global competitiveness and logistics performance in sub-Saharan Africa in the selected SSA countries?
3. what are the magnitudes and directions of the complex non-linear causal network among the pillars of global competitiveness and indicators of GVC participation in the selected SSA countries?

5.3 Conclusion and Findings

5.3.1 Mediator role of logistics performance

In this study, we first 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 logistic efficiency in the global value chain and the subsequent gains from which it 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 also mediated by logistic performance.

Our study is situated in the product fragmentation theory and supported by the new trade theory. We employed data from 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 logistic efficiency in the global value chain for the African participants.

5.3.2 Interactive effect among the pillars of global competitiveness and logistics performance

We investigated interactive effects among the 12 pillars of GCI and logistics performance. Innovative approaches were employed, including – TAN-BN, PLS-SEM and IPMA. As a first step, the TAN-BN technique makes it easier to analyse the causal connections between the Sub-Saharan countries' GCI and LPI indicator values. The PLS-SEM approach was an additional step that used the outcomes of this model as inputs. The main goal of employing the Bayesian network before the PLS is to cut down on the number of potential causal relationships between different variables. The IPMA approach was subsequently used to assess the performance of the pillars toward LPI.

Hence, in this study, four unique contributions to prior studies were obtained. To begin with, we investigated the interactive effects of the 12 pillars of GCI in Sub-Saharan Africa as a territory or region in support of policies and concepts relating to international trade and integration. Also, we examined the pertinent pillars that relate to logistics performance while deciphering pillars that have indirect effects on logistics performance. Additionally, we provided suggestions for policy

directions that harness the awareness of policymakers in the region with regard to the interactive effects among the 12 pillars of GCI, as well as their influence on logistics performance. To end with, innovative approaches (TAN-BN and PLS-SEM) were used in stages to address the research problem in the Sub-Saharan Africa context.

It was revealed that out of 19 hypotheses, 13 were supported, illustrating positive relationships. For instance, the hypothesis on the significant relationship between higher education and training and infrastructure was supported by a positive and significant path coefficient. Also, higher education and training (Pillar 5) related significantly to the following Pillars; health and primary education (Pillar 4), technological readiness (Pillar 9) and innovation (Pillar 12). There was a significant connection between the goods market efficiency (Pillar 6) and Pillars such as financial market development (Pillar 8) and market size (Pillar 10). The ninth hypothesis was supported by a positive and significant path coefficient between financial market development (Pillar 8) and labour market efficiency (Pillar 7).

Moreover, technological readiness (Pillar 9) is related significantly to logistics performance and infrastructure (Pillar 2). Business sophistication (Pillar 11) was positively associated with goods market efficiency (Pillar 6) and innovation (Pillar 12). To end with, the eighteenth and nineteenth hypotheses were supported by positive and significant path coefficients between innovation (Pillar 12) and health and primary education (Pillar 4), as well as innovation (Pillar 12) and technological readiness (Pillar 9).

5.3.3 Causal relationship between global competitiveness and GVC participation

In this study, we examined the complex causal relationship among the 12 global competitiveness pillars and the four global value chain indicators as they pertain to the SSA region. The literature in the area argues for the crucial nature of competitiveness in upgrading and participating in international trade and the global value chain. However, the causal linkages of this with the indicators of GVC have not been known in the region hitherto. In addressing this matter, we recognise the complex nature of the GVC ecosystem and the theoretical foundations of international trade (Amador & Cabral, 2014) and apply an appropriate technique. Nonetheless, this has the tendency to veil the influence of the GCI pillars on the GVC indicators. Hence, in addition, we isolate each indicator and investigate the interconnections with the 12 pillars of GVC. This framework reveals interesting findings for both policy and practice for the region. The study is situated in the product fragmentation theory and the new trade theory.

We used data from 25 sub-Saharan African countries for the years 2007, 2010, 2012, 2014, 2016, and 2018. We employ the regularised partial correlation network to estimate a parsimonious and interpretable complex network structure of international trade and to divulge the causal non-linear interplay of the 12 pillars of GCI and four indicators of GVC. The findings support both the theoretical literature on the importance of competitiveness in international trade (Rodrik, 2018) and the empirical evidence (Slany, 2017; Lwesya, 2022) for the pillars of GCI influencing the indicators of GVC.

This study has contributed to the discourse on the role of competitiveness in the global value chain and international trade. This provokes policy-makers and traders alike to understand and take

direct actions to improve competitiveness in order to expand domestic value-added in exports and foreign value-added in exports to upgrade the region in international trade. As the first in the SSA context to examine the complexity of the GVC system in a simplified approach, deeper insight into policy and action plans in the selected SSA economies is fostered. Further, this study has examined and confirmed the non-linear and causal interrelationship between global competitiveness and the global value chain in the SSA region. The exposed causal links sound a strong warning to governments to be more proactive in their advocacy actions in the era of trade liberality and fragmentation of products than a mere correlation or connection informs.

Our empirical findings reveal that in the complex network of the 12 pillars of GCI and four indicators of GVC, there is a dichotomy of clusters for constructs. The two clusters are connected by thin positive and negative links. However, connections are strong within each of the two clusters. Hence, it is better that each indicator is isolated to see its interaction with the GCI pillars to reveal more useful insights. The market size (GCI10) was the most important positive pillar for the SSA region's composite GVC index as well as for individual GVC indicators.

An interesting revelation is that there are negative causal relationships between some GCI pillars, notably with the market size. Further, there are other pillars that also have a negative influence on GVC's indicators. These findings are disturbing, to say the least, but they are also telling of the need for governments to intensify their activist duties in order to improve competitiveness, especially those that enhance efficacy and productivity (see Backer & Miroudot, 2013). To a large extent, those are also factors, except for market size, so that benefits can flow to GDP and

economic growth and development (Marín-Odio, 2014). In line with Schwab (2019) and Kowalski et al. (2015b), the results also show that challenges in advancing competitiveness are still persistent despite improvements over the years in SSA countries. It was also disclosed that the dynamics of value-added in exports (VA) and indirect domestic value-added in exports (DVX) with the 12 pillars of GCI are not distinguishable. For these two, the negative influence of some pillars is more pronounced than positive links. Altogether, positive interconnections are stronger than negative ones which should be used as springboards for scaling competitiveness and ultimately enhancing and upgrading in the global value chain for economic gains.

5.4 Recommendations

The results on the mediating role of LPI have important policy and investment implications for African governments and trading partners alike. The implication is that the pursuit of logistic 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 logistic efficiency to improve performance, other areas, such as the competitiveness of downstream export of production, need attention.

Furthermore, it is recommended from the outcome on the interactive effect among the 12 pillars of GCI and logistics performance that governments and policymakers make a more determined effort to overhaul minor enhancers, such as the growing demand for higher education and training, which can be effectively incorporated into the macroeconomic environment. More creative initiatives should be welcomed in the sector to enhance other crucial aspects, including market

size, financial market development, and labour market effectiveness. For the upcoming years, it is crucial to achieve a favourable balance between the macroeconomic environment, health, and primary education. Moreover, the reach of innovation needs to be expanded to embrace advancements in the macroeconomic environment. To improve logistics performance, governments should invest extensively in technology and higher education and training in the Sub-Saharan region.

Given that the central node, market size (GCI10), shares adverse relations with GCI2 (infrastructure), GCI1 (institutions), GCI4 (health and primary education), and GCI7 (labour market efficiency) is not surprising but worrisome. It is recommended that since the most prominent pillar (market size) is not able to scale the region GVC participation because weaknesses in infrastructure, institutions, health and primary education, and labour market efficiency do not only support it but rather work against it, the governments have a bigger task. They need to provide a supportive ecosystem so that the large market size is an asset rather than a liability.

5.5 Areas for Further Research

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 logistic performance of a country. Second, while all dimensions are important, they affect GVC in a

different and heterogeneous manner. Thus, lumping up all the dimensions by using the composite logistic 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.

Additionally, the Pillars of GCI can be categorised based on the three subindexes – basic prerequisites, efficiency-improving factors, and innovation and sophistication factors due to their homogeneous dynamics in terms of having a significant influence on other Pillars to provide a general idea on the integration of the Pillars of GCI and logistics performance. The study is limited to the application of a unidirectional relationship. Hence, the tendency for a bi-directional nexus between the variables is ignored by the current study. The two-way interaction is important because improvement in logistics performance by the advancement in the Pillars of GCI, and logistics performance can, in turn, enhance the Pillars of GCI due to the role of logistics performance as a major determinant of growth and development (Beysenbaev & Dus, 2020; Ekici, Kabak & Ülengin, 2019; Sergi et al., 2021).

Also, the two-way interaction between the Pillars of GCI can act as a mediator for the improvement of specific Pillars for sustained competitiveness. In this regard, further studies can explore the bi-directional relationship between the Pillars of GCI and logistics performance for further policy decisions and actions. Moreover, as emphasised earlier, it is not enough for governments to invest in the pillars that support each other (i.e. GCI5-GCI9, GCI2-GCI9, GCI1-GCI8, GCI11-GCI12, GCI6-GCI11, etc.), further action should be taken to reverse those situations that are counteractive.

This is of prime importance because non-competitiveness has been blamed for the low level of participation in the GVC African countries as well as marginalised trade integration (Ahmad & Primi, 2017). It is also partly due to non-competitiveness that the participation of African countries in the GVC is largely limited to forward upstream (Ofori et al., 2021). Findings from this study were limited to the Sub-Saharan region; hence, as a suggestion for further studies, other regional blocs can be investigated to facilitate comparison for global policy decisions.

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