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AFRICA INTEGRATION INTO GLOBAL VALUE CHAINS ANDTHE RAMIFICATIONS FOR DOMESTIC LABOUR MARKETS

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Abstract: **This paper examines the implications of Africa's integration into global value chains (GVCs) and its impact on domestic labor markets. Using secondary data from 1990 to 2024 on unemployment, GVCs, secondary school enrollment, GDP growth, population growth, and foreign direct investment, the study method of moments quantile regression, and panel quantile autoregressive distributed lag models to analyze short-term and long-term effects. The Dumitrescu-Hurlin causality test was used to determine the aggregate level direction of causality. The findings indicate that Africa's integration into GVCs reduces unemployment, with a more pronounced effect in the long run at the upper quantile. The causality test results show that unemployment drives GVCs in Africa and there is no feedback effect. Based on these findings, the study recommends that Africa should embrace GVC integration and mitigate short-term unemployment disruptions by implementing social safety nets and unemployment benefits. Furthermore, the educational system should be strengthened to enhance school enrollment and vocational training programs, equipping the labor force with skills needed for GVC integration. Additionally, foreign direct investment should be promoted through investor-friendly policies, infrastructure improvement, political stability, and support for local industries to become competitive in GVCs, thereby maximizing the benefits of integration.**

Keywords: **Labour market, unemployment, global value chains, panel quantile ARDL, Africa, Integration.**
JEL Classification: F15, F63, J2, O55.

I. INTRODUCTION

The world economy has been fundamentally altered due to globalization with the rapid development of communication systems, innovation of technology and the falling costs of transportation. The progressive liberalization of trade policies has strengthened these structural changes, which have greatly increased the speed with which goods, services, and capital move across the borders. It is on this context that the United Nations Sustainable Development Goals (SDGs) especially SDGs 7, 8, and 9 emphasize the need to develop resilient infrastructure, ensure inclusive and sustainable industrialization, and decent work and economic growth to everyone. At the centre of these goals is dramatic reconfiguration of the global systems of production with the most prominent being the emergence and consolidation of global value chains (GVCs). In turn, an increasing amount of literature has investigated whether further penetration into GVCs is a feasible and sustainable way toward meeting these development goals (Archie-Acheampong, 2024; Pinjaman, 2026).

Global value chains were initially coined by Porter (1986) and it is a series of sequential activities that are performed by firms starting with the design of a product up to its ultimate consumption. GVCs are a globally spread manufacturing process where various phases of production and service provision are spread among various countries, and each plays its part according to its resource endowments, factor prices, and logistic abilities (Carneiro et al., 2024). Such organisational model is based on the realisation that modern goods and services pass through various processes and participants before being delivered to final consumers with value being added at every point of the chain. The ability to manage these phases, in terms of timeliness and cost-

effectiveness has now become a hallmark of competitive strategy in the contemporary global economy. Essentially, GVCs not only shed light on the deep interconnectedness of national economies but also support the utmost importance of optimisation of each production stage to maximise value creation (Jegede, 2025).

The development of GVCs has been mostly attributed to the increasing competitive demands caused by globalisation and technological change (Garbellini et al., 2026). Companies have reacted by further enhancing cross-border alliances and linking their production systems with those of other nations, thus tapping into economies of agglomeration, specialisation of skills, economies of scale, and innovation hubs. The strategic dispersion of production has thereby facilitated multinational companies to achieve their competitiveness through locating every step of the value chain in a manner that it could be most effectively and profitably carried out (Cuervo-Cazurra & Pananond, 2023).

The growth of GVCs is mainly motivated by the increasing competition in the global sphere and technological transformation whereby firms are using cross-border production integration as a way of exploiting agglomeration economies, specialization, and network of innovations. In the case of African economies, joining GVCs provide them with a chance to receive foreign direct investment, improve the transfer of technologies, and open access to global markets (Ketu &Wirajing, 2024; Ajide, 2023). Nonetheless, despite minor improvement especially in North Africa, overall contribution to trade is very low at only 3% of the global trade compared to much higher proportions in Asia, Europe, and North America, which is indicative of structural limitations.

The problem is further complicated by the long-standing labour market underperformance, such as high unemployment rates and a new so-called japa syndrome, when skilled employees leave their homeland and take up lower-skilled jobs in other countries as domestic employment and wages fail to meet their demands (Nwaeze, 2024). The phenomenon poses important questions regarding the quality, not just the number of jobs created in the African economies.

The correlation between being a participant in GVC and employment is inconclusive empirically. Although certain research states that the GVC integration increases employment and economic well-being (Viegelahn et al., 2023; Capello et al., 2024; Sani et al., 2026), some scholars believe that the integration process can amplify the labour market weaknesses, especially among unskilled workers in less developed economies (Yulianti & Fitriansyah, 2024; Abdulrazaq & Lambe, 2024; Okwuchukwu, 2025).This divergence highlights an important policy quandary on the net benefits of GVC integration to African labour markets.

It is against this context that the current research paper will add to the literature by applying the wavelet coherence analysis to study the time-frequency dynamics between GVC participation and unemployment as well as the panel quantile autoregressive distributed lag (PQARDL) model to explain the asymmetric short- and long-run effects throughout the distribution of unemployment. The rest of the paper is divided into literature review, methodology, empirical findings, and policy recommendations.

II. LITERATURE REVIEW

Global Value Chain

Global value chains (GVCs) are the internationalisation of the production process, in which various parts of the product life cycle are performed in many countries: design, manufacturing, assembly, distribution (Antras, 2020). The technological advances, the lowering of trade barriers and the strategic choices of multinational corporations to make them efficient and to reduce costs all enable this internationalization of production. Distributing value-added activities worldwide, the firms can take advantage of the comparative benefits in different regions, thus enhancing productivity and gaining cost efficiency (Xing, 2023).

Becoming members of GVCs presents significant opportunities to developing countries, especially in terms of integration into the global economy, access to advanced technologies, and industrial upgrading (Li &Goerzen, 2024; Liao, 2023). This integration may contribute to productive powers and facilitate the process of going up the value chain. Nevertheless, the advantages of GVC membership are not spontaneous; they require the existence of favorable institutional settings, effective policies, and human capital and infrastructure investments (Yan, 2023).

In spite of these advantages, GVC participation also has a number of obstacles. It can result in economic reliance on multinational companies and become more susceptible to external shocks (Yu et al., 2023). Moreover, the GVCs cost-minimization strategies may lead to labor exploitation, low working conditions, and labor protection. Environmental considerations are as well a major concern since the focus on production efficiency may lead to pollution and resource exhaustion (Chen & Zhang, 2023). Moreover, the local innovation and the development of local companies can be inhibited due to competitive pressures (Guschanski & Onaran, 2023). However, these issues can be mitigated with the help of efficient collaboration between governments, companies, and global institutions, which can facilitate more inclusive and sustainable results (Li et al., 2023).

Employment, in its turn, is a wide concept that includes various types of working arrangements, in which people

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receive income. Although traditionally related to the concept of formal and full-time employment, the process of globalization and technological progress has transformed it, introducing a variety of options: part-time, temporary, freelance, and gig jobs. These types vary regarding job security, benefits, and rights of workers (Pritvorova et al., 2020; Zhumabayeva & Nurmagambetov, 2023).

III. THEORETICAL FRAMEWORK

This study anchor on the modernization theory. The theory was developed in the mid-20th century by several scholars. Two of the key figures in the development of the theory was Talcott Parson an American sociologist who laid the theoretical groundwork in the 1950s and W.W. Rostow who outlined his stages of economic growth model in his 1950 book. According to this theory, societies progress through similar stages of development from traditional to modern stages. In the developing countries however, economic and social progress could be achieved by following the developmental pathways of Western industrialized nations. This can be achieved through adopting advanced technologies from developed countries as well as changes in social, economic and political institutions. Integration into the global value chain (which may be in the form of global markets) can lead to economic development that subsequently improves the domestic labour market. This is because integration has the tendency to create jobs in new industries, especially in manufacturing and high-tech sectors.

The modernization stages are of the form:

$$M = g(Y, K, L, A) \quad (1)$$

Where g represents the progression through modernization stages based on output, capital, labour, and technology. Meanwhile, the production function takes the form of Hicks-neutral:

$$Y_t = A_t f(K_t, L_t) \quad (2)$$

The production function is re-stated explicitly as Equation (3):

$$Y_t = A_t \cdot K_t^{\alpha} \cdot L_t^{\beta} \quad (3)$$

Where Y_t represents output at time t, $K_t$represents capital stock at time t, L_t represents labour input at time t, A_t represents technology level at time t, αrepresents output elasticity of capital and β represents output elasticity of labour. Also, technology level is made up of domestic innovation and technology transfer such that

$$A_t = A_o e^{T_t^{\theta}} \quad (4)$$

Substituting Equation (4) into Equation (3), it yields Equation (5).

$$Y_t = A_o e^{T_t^{\theta}} \cdot K_t^{\alpha} \cdot L_t^{\beta} \quad (5)$$

Taking the natural log of both sides of Equation (5),

$$\ln Y_t = \ln A_o + \theta \ln T_t(\ln e) + \alpha \ln K_t + \beta \ln L_t \quad (6)$$

Since lne is equal to 1, Equation (6) becomes Equation (7)

$$\ln Y_t = \ln A_o + \theta \ln T_t + \alpha \ln K_t + \beta \ln L_t \quad (7)$$

Differentiating Equation (7) with respect to time, it yields Equation (8)

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_o}{A_o} + \theta \frac{\dot{T}_t}{T_t} + \alpha \frac{\dot{K}_t}{K_t} + \beta \frac{\dot{L}_t}{L_t} \quad (8)$$

At the balances growth path, output growth rate is the same as the capital growth rate, that is, $\frac{\dot{Y}_t}{Y_t} + \frac{\dot{K}_t}{K_t}$. Hence,

$$\frac{\dot{Y}_t}{Y_t} = \alpha \frac{\dot{Y}_t}{Y_t} + \beta \frac{\dot{L}_t}{L_t} + \frac{\dot{A}_o}{A_o} + \theta \frac{\dot{T}_t}{T_t} \quad (9)$$

Re-arranging Equation (9) by making labour growth rate the subject,

$$\beta \frac{\dot{L}_t}{L_t} = \frac{\dot{Y}_t}{Y_t} - \alpha \frac{\dot{Y}_t}{Y_t} - \frac{\dot{A}_o}{A_o} - \theta \frac{\dot{T}_t}{T_t} \quad (10)$$

$$\beta \frac{\dot{L}_t}{L_t} = (1 - \alpha) \frac{\dot{Y}_t}{Y_t} - \frac{\dot{A}_o}{A_o} - \theta \frac{\dot{T}_t}{T_t} \quad (11)$$

Recall that the growth rate of initial technology $\frac{\dot{A}_o}{A_o}$ is denoted by g, meaning that the growth rate of information technology is growing at a constant rate. Therefore,

$$\beta \frac{\dot{L}_t}{L_t} = (1 - \alpha) \frac{\dot{Y}_t}{Y_t} - g - \theta \frac{\dot{T}_t}{T_t} \quad (12)$$

Dividing both sides by β, Equation (12) becomes Equation (13).

$$\frac{\dot{L}_t}{L_t} = \left(\frac{1-\alpha}{\beta}\right) \frac{\dot{Y}_t}{Y_t} - \frac{g}{\beta} - \frac{\theta}{\beta} \frac{\dot{T}_t}{T_t} \quad (13)$$

Since technology transfer is a function of the country's integration into the global value chain and its absorption capacity, such that:

$$T_t = f(I_t, E_t, G_t) \quad (14)$$

Where I_t is infrastructure quality at time t,E_t is education level at time t, and G_t is governance quality at time t. By substituting Equation (14) into Equation (13), it becomes;

$$\frac{\dot{L}_t}{L_t} = \left(\frac{1-\alpha}{\beta}\right) \frac{\dot{Y}_t}{Y_t} - \frac{g}{\beta} - \frac{\theta}{\beta} \left(\frac{\dot{I}_t}{I_t}, \frac{\dot{E}_t}{E_t}, \frac{\dot{G}_t}{G_t}\right) \quad (15)$$

IV. EMPIRICAL REVIEW

The existing empirical literature about the association between global value chain (GVC) involvement and labour market outcomes gives contradictory and ambivalent results in various countries and approaches. Employing the method of a meta-analysis, Carneiro et al. (2024) discovered that GVC participation has a harmful effect on the employment of all types of workers low, medium, and high-skilled workers, but the harmful effect is stronger in the case of low-skill workers. Their analysis also ensued that GVC integration benefits the developed economies more than the developing ones, which points to structural disparities in the world production networks.

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In the same manner, Jithin (2024) used a non-linear panel ARDL model to investigate the asymmetric impacts of GVC membership on 29 economies, 2004-2018. The results show that in the long-term GVC participation contributes significantly to income inequality. Negative shocks, especially by means of backward participation, only increase inequality, whereas forward participation always adds to an increasing tendency of income inequality. Conversely, Yue et al. (2024) concentrated on China and identified that GVC participation, in particular, robust inter-firm connections, boosts employment stability and leads to a general growth in employment, indicating country-specific advantages of GVC integration.

In an analysis of 10 ASEAN countries, 1999-2018 with the Generalised Method of Moments (GMM) and panel causality tests, Samuda (2023) found that GVC participation has a positive impact on economic growth but at the same time also leads to a rise in unemployment. The causality findings also show that unemployment is a determinant of GVC participation whereas economic output is not an important determinant. Guha-Khasnobis et al. (2023) discovered an inverse relationship between increased value-added activities and job creation in the case of India. They also find that the stronger the backward linkages, the lower the employment but the stronger the forward linkages, the higher the employment although this is majorly to the unskilled workers. Also, downstream industries were discovered to provide more employment opportunities compared to upstream industries, which are highly skill intensive.

Rohit (2023) examined 40 third world economies and had no significant correlation between GVC involvement and structural transformation. The study however, indicates that GVC integration can put workers at the trap of low-productivity industries, which in turn prevents the real structural change. The study by Obeng et al. (2022) on Sub-Saharan Africa, in its turn, concluded that the employment created due to the involvement in the GVC leads to a positive impact on inclusive growth. They further noted that, even though the level of foreign value addition is relatively low relative to the domestic value addition, it has better contribution to inclusive growth results.

In a study by Ndubuisi and Owusu (2022), the GVC involvement was found to positively impact wages in the developed nations, especially when it is upstream specialization, but negatively affected the low-income earners in the developing economies. To reinforce this difference, Kouton and Amonle (2021) have discovered that upstream GVC involvement has a strong positive effect on labour productivity in Africa and downstream involvement has a positive but negligible effect. Lastly in their analysis of OECD countries, Yanikkaya and Altun (2020) found that in earlier times (1995 to 2011) GVC participation increased sectoral productivity and output growth, but in later times (2005-2015) GVC participation was found to have decreasing returns, suppressing the benefits of GVC participation on sectoral growth.

V. METHODOLOGY

Data requirement and source

The time frame of the study is 1990-2024, comprising 40 African nations, that includes Algeria, Egypt, Morrocco, Sudan, Tanzania, Cameroon, Central African Republic, Chad, Congo Dem.Rep, Gabon, Sao Tome and Principe, Angola, Botswana, Lesotho, Mozambique, Namibia, South Africa, Zambia, Burundi, Djibouti, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Somalia, Tunisia, Uganda, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sieria Leone and Togo. The data used were unemployment, total (% of total labour force) (modeled ILO estimate), the Global Value Chain participation index, school enrollment, secondary (% gross), foreign direct investment, net inflows (% of GDP), GDP growth (annual %), population growth (annual %). The World Bank World Development Indicators (WDI) was used to source all the variables and the data on Global Value Chain participation index was found at https://worldmrio.com/unctadgvc/.

Model Specification and econometric methodology

Emanating from the theoretical framework, we specify out model in the form;

$$UEM_{it} = f(GVC_{it}, GDPgr_{it}, EDU_{it}, POPgr_{it}, FDI_{it}) \quad (16)$$

Where:

UEM_{it} = Unemployment rate of country i in period t

GVC_{it} = Global value chains of individual country i in period t

$GDPgr_{it}$= Gross Domestic Product of individual country i in period t

EDU_{it} = Education measure by secondary school enrollment of individual country i in period t

$POPgr_{it}$ = Population growth of individual country i in period t

FDI_{it} = Foreign direct investment of individual country i in period t

In econometric form, equation 16 is respecified as follows

$$UEM_{it} = \beta_0 + \beta_1 GVC_{it} + \beta_2 GDPgr_{it} + \beta_3 EDU_{it} + \beta_4 POPgr_{it} + \beta_5 FDI_{it} + \varepsilon_{it} \quad (17)$$

Where β_0 represent the constant, $\beta_1 - \beta_5$ represents the coefficient of the independent variables, i stands for individual African countries selected (1-40), t represents the time (1990 to 2022) and ε_{it} is the error term. Although, the objective of the paper is to determine the effect of global value chains on

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domestic labour markets in Africa, GDP growth, education, population growth and foreign direct investment are added as control variables.

Equation 17 is respecified in its logarithm form as

$$logUEM_{it} = \beta_0 + \beta_1 logGVC_{it} + \beta_2 logGDPgr_{it} + \beta_3 logEDU_{it} + \beta_4 logPOPgr_{it} + \beta_5 logFDI_{it} + \varepsilon_{it} \quad (18)$$

Estimation Techniques

Method of Moment quantile regression (MMQR)

Ordinal least square and other conditional mean-based regressions typically assume that the conditional means which are typically at the center of the distribution are enough to establish relationships among variables. Nevertheless, this method will only provide a partial picture of the whole conditional distribution, which may result in unreliable outcomes, particularly when the effect is in the distributions tails (Ike et al, 2020). Thus we use a quantile regression model based on method of moments quantile regression (MMQR) with Fixed Effects model by Machado and Silva (2019). The Fixed Effects MMQR model is the model that takes into account the information at various points of the conditional distribution and determines distributional asymmetry. It has a few benefits compared to the quantile regression methods of Koenker (2004), Canay (2011) and Powel (2016). Firstly, it uses Fixed Effects using location parameters, implying that their effect is not felt as location shifters but across the whole conditional distribution. Secondly, the method is robust to outliers, giving strong estimates by considering heterogeneity and asymmetry both in terms of location and scale. The model of machine quality and reliability as postulated by Machado and Silva (2019) is given as:

$$Y_{it} = \alpha_i + K_{it}^{'}\beta + \varphi(\pi_i + V_{it}^{'}\delta)\mu_{it} \quad (19)$$

Where unknown parameters are $\alpha, \beta^{'}, \pi, \delta^{'}$and $(\alpha_i, \pi_i), i, \dots, n$ captures the individual ifixed effects. $V^{'}$shows a x-vector of known differentiable transformations of the components of K_{it} with element n defined by $V_n = V_n(K_{it})$ where $n = 1 \dots, x$. The probability, $P(\pi_i + V_{it}^{'}\delta > 0) = 1$, and μ_{it} is the unobservable error term which is strictly independent of K_{it}.

Following the work by Machado and Silva (2019), the density function, $F_u(\cdot)$ is bounded away from 0 and hence normalized so as to satisfy the moment conditions given as $H(U_{it}) = 0$ and $H(|U_{it}|) = 1$. Therefore, Equation (1) becomes:

$$Q_Y(\tau|K_{it}) = (\alpha_i + \pi_i g(\tau)) + K_{it}^{'}\beta + V_{it}^{'}\delta g(\tau) \quad (20)$$

Where $g(\tau) = F_U^{-1}(F_u(\cdot)$and $P(U < g(\tau)) = \tau$. The scaler parameter implies that $\alpha_i(\tau) \equiv \alpha_i + \pi_i g(\tau)$ and is indicative of the quantile-τfixed effects for individual i. Unlike the Ordinary Least Square Fixed Effects, the distributional effects of MMQR is allowed to have varying impacts across the entire quantiles of the conditional distribution of the dependent variable.

Quantile Autoregressive Distributed Lagged

The Quantile Autoregressive Distributed Lagged QARDL is better than the linear modes on various dimensions as suggested by the work by Shahbaz et al. (2018).. First, it can support the cases of locational asymmetry when parameters can be based on the locations of the dependent variables. Second it provides the problems of both short-term and long-term relationships between the variables at different quantiles of the conditioning distribution of the dependent variable. Third, it can tell the presence of quantile varying cointegration in the short term that could not be covered by the traditional method (Xiao, 2009). Fourth, it can address problems of short-term coefficient variations. The data driven process is also applied in the model, which makes it superior. The method is also a strong test to use in the study due to its superiority. The simple quantile autoregressive distributed lagged (QARDL) (p, q) that allow changes by quantile are provided following the work by Cho et al (2015) as follows:

$$Q_{logUEM_t} = \beta(\gamma) + \sum_{i=1}^{p} \alpha_i(\gamma) logUEM_{t-1} + \sum_{i=0}^{q1} \partial_i(\gamma)\, logGVC_{i=1} + \sum_{i=0}^{q2} \delta_i(\gamma) logGDPgr_{i=1} + \sum_{i=0}^{q3} \rho_i(\gamma)\, logEDU_{i=1} + \sum_{i=0}^{q4} \emptyset_i(\gamma) logPOPgr_{i=1} + \sum_{i=0}^{q5} \sigma_i(\gamma) logFDI_{i=1} + \varepsilon_t(\gamma) \quad (21)$$

Here, $\varepsilon_t(\gamma)$ equals $logUEM_t$ - $Q_{logUEM_t}[\gamma/F_{t-1}]$ and $Q_{logUEM_t}[\gamma/F_{t-1}]$ refers to the γ_{th} quantile of $logUEM_t$ conditional on the information set F_{t-1} as supported by (Kim & White, 2003). The short-run form is then specified as

$$Q_{logUEM_t} = \beta(\gamma) + \sum_{i=1}^{qi-1} \alpha_{logUEM}(\gamma) \Delta\, logUEM_{t-1} + \tau_{logUEM}(\gamma) logUEM_t + \sum_{i=1}^{qi-1} \partial_{logGVC}(\gamma) \Delta\, logGVC_{t-1} + \tau_{logGVC}(\gamma) logGVC_t + \sum_{i=1}^{qi-1} \delta_{LREC}(\gamma) \Delta GDPgr_{t-1} + \tau_{logGDPgr}(\gamma) logGDPgr_t + \sum_{i=1}^{qi-1} \rho_{logEDU}(\gamma) \Delta logEDU_{t-1} + \tau_{logEDU}(\gamma) logEDU_t + \sum_{i=1}^{qi-1} \emptyset_{logPOPgr} \Delta(\gamma) logPOPgr_{t-1} + \tau_{logPOPgr}(\gamma) logPOPgr_t + \sum_{i=1}^{qi-1} \sigma_{logFDI} \Delta(\gamma)\, logFDI_{t-1} + \tau_{logFDI}(\gamma) logFDI_t + \varepsilon_t(\gamma) \quad (22)$$

The long run effect is computed using the equation below

$$Q_{logUEM_t} = \mu(\gamma) + X_t^{'}\alpha(\gamma) + M_t(\gamma) \quad (23)$$

Where X represents the vector of the independent variable along with the control variables (logGVC, logGDPgr. logEDU. logPOPgr. logFDI).

Therefore, the QARDL estimated incorporating the short-run and long run is specified as:

$$Q_{\Delta logUEM_t} = \alpha(\gamma) + \beta_1(\gamma) logUEM_{t-1} - \beta_2(\gamma) logGVC_{t-1} - \beta_{3(\gamma)} logGDPgr_{t-1} - \beta_4(\gamma) logEDU_{t-1} + \beta_5(\gamma) logPOPgr_{t-1} - \beta_6(\gamma) logFDI_{t-1} + \sum_{i=1}^{p-1} \alpha_i(\gamma)\, \Delta logUEM_{t-1} +$$

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$$\sum_{i=0}^{qi-1} \partial_i(\gamma)\Delta\, logGVC_{t-1} + \sum_{i=0}^{qi-1} \delta_i(\gamma)\Delta logGDPgr_{t-1} + \sum_{i=0}^{qi-1} \rho_i(\gamma)\Delta logEDU_{t-1} + \sum_{i=0}^{qi-1} \emptyset_i(\gamma)\Delta logPOPgr_{t-1} + \sum_{i=0}^{qi-1} \sigma_i(\gamma)\,\Delta logFDI_{t-1} + \varepsilon_t(\gamma) \quad (24)$$

VI. EMPIRICAL RESULTS

Descriptive statistics

Table 1 presents the descriptive statistics of the variables to be used in the analysis and indicates that there is a significant difference in the African countries selected. The mean rate of unemployment is 9.57 with a standard deviation of a relatively high 7.09, meaning that there is a wide range of unemployment rates among the countries, with a low of 0.32 and high of 33.2. This implies that there are economies that keep the level of unemployment low whereas others encounter serious labour market problems. Likewise, the Global Value Chain (GVC) participation has a high level of skew with the mean of 2,139,031 as opposed to a significantly smaller median of 209,000, and a wide range of 3,970 to 48,116,667 showing a large disparity in the global integration of economies.

There is also significant volatility in economic performance in terms of GDP growth, with an average of 3.71% and a standard deviation of 5.12 with a maximum -50.25% decrease and a maximum growth of 35.22. This implies disproportional growth experiences among the countries. The average school enrollment rate stands at 40.10 with a high standard deviation (27.12) and a wide range, which show high disparities in access and achievement of education. The average population growth is 2.40, although there is obvious variation, with some negative growth rates and some high growth rates indicating different demographic trends in the region.

Lastly the Foreign Direct Investment (FDI) has a mean of 3.58% with a high standard deviation of 6.87 and a range of negative inflows (-11.19) to very high inflows (103.34) which means that there are countries that are attractive investment destinations and there are countries that experience capital flight. In general, the descriptive statistics indicate that there is a high degree of inequality in the economic performance, demographic trends, and the global integration of African countries.

Table 1: Descriptive statistics of the variables used

	UEM	GVC	GDPgr	EDU	POPgr	FDI
Mean	9.574	2139031	3.712	40.098	2.402	3.578
Median	7.556	209000	4.033	35.171	2.565	2.054
Maximum	33.2	48116667	35.224	186.279	16.626	103.337
Minimum	0.32	3970	-50.248	34.433	-16.881	-11.192
Std. Dev.	7.092	6412810	5.123	27.123	1.497	6.865

Source: Computed using EViews from data retrieved from WDI

Correlation

Wavelet coherence technique is used to explain the relationship between GVC and unemployment that is measured in terms of labour market dynamics. The cold (blue) areas on the plot indicates periods of no correlation, while the hot (red) areas show period of high correlation. The black lines represent 5% significance level. The figure reveals that there is a high degree of short-term coherence between UEM and GVC at smaller scale (2 to 4 years) between 1993 to 1997, 2002 to 2005 and between 2007 to 2011. The implication of this finding is that the higher the African economies were integrated in the Global value Chain in this period, the higher the rate of unemployment was. This could be due to the growth in labour force exceeding employment linked to the GVC involvement. The correlations were however only significantly positive between 1993 and 1997 This suggests that during this period, positive movements in the GVC were closely followed by similar movements in UEM. Based on the figure, there is weak correlation between UEM and GVC in both long term and medium term at all scales. The weak correlation was indicated by the cold blue spots on the medium- and long-term scales. Therefore, in the long-term, GVC and EUM are less correlated.

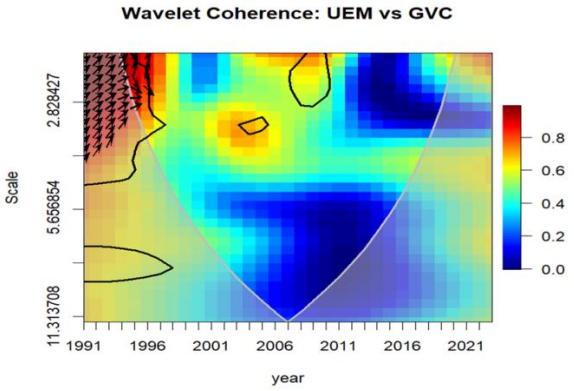

Figure 1: Correlation between unemployment and global value chain.

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Cross sectional dependence tests results

Cross-section dependence test is an essential part of analysing panel data because it determines how observations of various countries or entities are independent of each other. We performed the cross-sectional dependence test in order to determine the dependence between observations across the diverse African countries that we picked. This was necessary because failure to do this may result in a biased estimation of the parameters and misleading inferences because of the violation of the assumption of independent observations thus putting our findings at risk of reliability and validity. Table 2 results confirmed the rejection of the null hypotheses of no cross-sectional dependence on the four test statistics. We can, therefore, conclude that in the chosen African countries, the variables are indeed interdependent.

Table 2: Cross Section Dependence Test

	Test Statistics			
Variables	Breusch-Pagan LM	Pesaran Scaled LM	Bias-Correlated Scaled LM	Pesaran CD
UEM	5485.247***	118.117***	117.492***	13.396***
	(0.000)	(0.000)	(0.000)	(0.000)
GVC	22594.41***	551.295***	550.670***	148.936***
	(0.000)	(0.000)	(0.000)	(0.000)
GDPgr	1577.902***	19.189***	18.564***	22.667***
	(0.000)	(0.000)	(0.000)	(0.000)
EDU	14197.78***	338.705***	338.080***	110.962***
	(0.000)	(0.000)	(0.000)	(0.000)
POPgr	4495.233***	93.051***	92.426***	6.379***
	(0.000)	(0.000)	(0.000)	(0.000)
FDI	2715.696***	47.996***	47.372***	31.752***
	(0.000)	(0.000)	(0.000)	(0.000)

Note: *** denotes significance at 5%. Number in parentheses are the p -values.

Slope Homogeneity

Since we have established the existence of cross-sectional dependence between the series we go ahead to establish whether the relation existing between the dependent and independent variables are homogeneous across various cross-sectional units of the panel as a consequence, we ran a slope homogeneity test. This test is essential because it can be used to determine whether only one model can be used to describe the data at all the units or whether the association is different and needs more sophisticated modeling. Table 3 present the outcome of the result for the variables, the four tests were conducted, and the result ensures the robustness and accuracy of our econometric models. The delta tests for all the variables used were significant indicating the rejection of the null hypotheses of no presence of slope homogeneity among the variables.

Table 3. Test for Slope homogeneity

Delta Tests	Test Statistics and Probability					
	logUEM	logGVC	;logGDPgr	logEDU	logPOPgr	logFDI
Delta tilde	4.154***	6.682***	3.561***	3.412***	5.061***	5.024***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Delta tilde adj	3.435**	2.756***	4.341***	3.344***	3.946***	3.348***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: *** denotes significance at 5%

Unit root test results

With the presence of the cross-sectional dependence between the variables, we then used the unit root test to test the stationarity property of the variables. The traditional first-generation panel unit root tests cannot be effectively used when there is cross-sectional dependence. Thus we used the CIPS unit root test by Im, Pesaran, and Shin, which is specially created to deal with panel data and is cross-

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sectionally dependent. The output of the CIPS unit root test is shown in Table 4. Although the null hypothesis of unit root cannot be rejected in the case of logGDPgr, logPOPgr, and logFDI at the 5 percent level in level series, the null hypothesis can be rejected in the case of logUEM, logGVC, and logEDU at the first difference, indicating non-stationarity. The research therefore concludes that all the variables are stationary meaning that there is no spurious regression.

Table 4: Im, Pesaran, Shin Unit Root Test

Variables	Level	First Difference	Order of Integration
logUEM	-2.768	-13.929***	I(1)
	(0.997)	(0.000)	
logGVC	1.903	-17.848***	I(1)
	0.971	(0.000)	
logGDPgr	-11.835		I(0)
	(0.000)		
logEDU	3.531	-13.239***	I(1)
	(0.999)	(0.000)	
logPOPgr	-8.336		I(0)
	(0.000)		
logFDI	-4.692		I(0)
	(0.000)		

Note:*** denotes significance at 1%

Westerlund Cointegration

Once we established the existence of cross-sectional dependence and homogeneity of slope, we went ahead to establish whether there is a long-run relationship among the variables. Empirical research has indicated that econometric methods of the first generation might not be very effective in addressing such cases. We thus used the cointegration test of Westerlund (2007) that can help us overcome these problems. The findings, which are presented in Table 5, indicate that all the test values indicate that there is a long-term relationship between the variables. Depending on the result we have come to the conclusion that there exists a long run relationship between the variables.

Table 5. Test for cointegration

Test Statistics	Coefficient	asymptotic ρ-value	bootstrap ρ-value
g-tau	-6.413***	0.020	0.000
g-alpha	-5.703***	0.000	0.000
p-tau	-3.012***	0.000	0.000
p-alpha	-6.453**	0.010	0.000

Note: ***,** denote significance at 1% and 5% respectively

Method of moment quantile Regression

The result from the method of moments quantile regression (MMQR) with fixed effects and robust standard errors, along with a panel quantile autoregressive distributive lag model are reported below in Table 6 and Figure 2. Conventional mean-based regressions based on conditional means, like OLS, generally assume that the relationship between variables is defined in the middle of the distribution. Nevertheless, to allow the short and long run effects at various points of the conditional distribution, we used the panel quantile autoregressive distributive lag model. Findings of these analyses are given in Tables 7 that report the panel quantile regression and the panel quantile autoregressive distributive lagged (QPARDL) results respectively.

The outcome of the quantile regression method by moments of different quantiles (lower, 20th, and 30th), middle (40th, 50th, and 60th), and upper (70th, 80th, and 90th) reveals that global value chain (GVC) influences unemployment in Africa in a consistently negative way. This adverse effect is felt more in the higher quantiles (80th and 90th) where the effect is between 0.073 to 0.083 percentage points. Economically, this implies that the more participation in the global value chain, the lower the unemployment levels, with the largest changes in unemployment being experienced in areas or at times where

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unemployment is high, highlighting the importance of global economic integration in alleviating unemployment in Africa.

The impact of the GDP growth rate on unemployment is not always significant but mostly negative in most of the quantiles. It demonstrates a significant negative relationship at the 50th quantile (-0.226, ρ<0.1) or at the 80th quantile (-0.142, ρ<0.05), thus showing that an increase in GDP growth can decrease unemployment, especially in middle and higher quantiles. Interestingly, the 90th quantile indicates a positive impact (0.067, ρ<0.05) indicating that, at extremely high amounts of unemployment, GDP growth may not necessarily be directly reflected in job creation, possibly because of structural problems in the economy.

Education, in terms of secondary school enrollment, has a negative and significant impact on unemployment in all quantiles. The coefficients have a range of -0.384 at the 10th quantile to -0.221 at the 90th quantile all significant at the 0.001 level. This uniformity of negative effect suggests that the higher levels of education will help reduce unemployment in all groups. The greater impact at the lower quantiles indicates that in areas or time-periods where unemployment is less, greater education may greatly decrease unemployment, presumably because it provides the necessary people with skills that are relevant in the labour market. The better education one has, the more job opportunities he/she will have, and unemployment will be reduced more in general.

Unemployment is significantly and positively associated with the population growth rate in most of the quantiles. The coefficients vary between 0.072 (20th quantile) to 0.330 (30th quantile, all the effects are significant at the 0.001 level). The correlation of the population with the unemployment is positive indicating that the higher the population, the higher the unemployment. This might be due to the fact that increasing population level boosts the supply of labor, and this may exceed the formation of new employment. The coefficients are higher at the lower quantiles, which suggests that the role of population growth in rising unemployment is larger in the areas or times with lower unemployment. This might be due to an initial oversupply of labor that cannot be absorbed quickly enough by the job market, leading to higher unemployment rates.

The method of moments quantile regression results indicate that Foreign Direct Investment (logFDI) has a generally positive relationship with unemployment in Africa. This relationship is particularly significant at the 80th quantile (0.012*), suggesting that higher levels of FDI are associated with higher unemployment in regions or periods with higher unemployment rates. This positive relationship may be due to the capital-intensive nature of many foreign investments, which do not immediately generate a large number of jobs, or due to skill mismatches where the local workforce does not possess the skills required by foreign enterprises, leading to higher unemployment despite increased investment. The graphical outcome is shown in Figure 2 where GVC, EDU and GDPgr sloping downward while POPgr and FDI exhibit a positive slope.

Table 6: Method of moment quantile regression

			Lower Quantile			Middle Quantile			Upper Quantile		
Variables	Location	Scale	10	20	30	40	50	60	70	80	90
logGVC	-0.037	-0.029	-0.009	-0.007	-0.019	-0.028	-0.039**	-0.050***	-0.059***	-0.073***	-0.083***
	(0.021)	(0.015)	(0.769)	(0.768)	(0.364)	(0.135)	(0.013)	(0.000)	(0.000)	(0.000)	(0.000)
logGDPgr	-0.176	0.152	-0.421	-0.334	-0.272	-0.226*	-0.166	-0.105	-0.074	-0.142**	0.067**
	(0.748)	(0.705)	(0.689)	(0.694)	(0.705)	(0.072)	(0.756)	(0.825)	(0.897)	(0.032)	(0.033)
logEDU	-0.302	-0.051	-0.384***	-0.355***	-0.334***	-0.319***	-0.299***	-0.278***	-0.263***	-0.244***	-0.221***
	(0.000)	(0.163)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
logPOPgr	0.285	0.072	-0.401***	-0.360***	-0.330***	0.309***	0.280***	0.251***	0.230***	0.202***	0.170***
	(0.000)	(0.017)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
logFDI	0.203	0.166	0.472	0.376	0.308	0.258	0.193	0.126	0.077	0.012*	0.062
	(0.230)	(0.181)	(0.147)	(0.152)	(0.165)	(0.185)	(0.244)	(0.390)	(0.590)	(0.072)	(0.727)

Note: ***,**, and * denotes significance at 1%, 5% and 10% respectively

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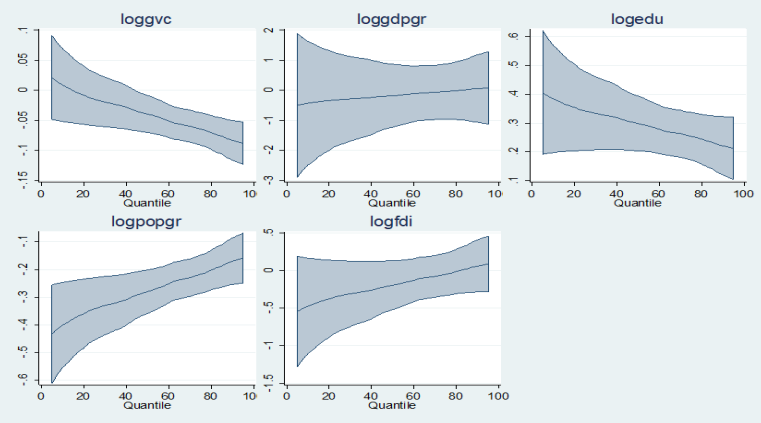

Figure 2: Graphical representation of the effect of global value chain on labour market along with the control variables (LogGDPgr, logEDU, logPOPgr and logFDI)

Panel Quantile Autoregressive Distributed Lag (PQARDL) Results

In order to test for more robustness, this paper uses the Panel Quantile Autoregressive Distributed Lag (PQARDL) model to investigate the short and long-run impacts of global value chain (GVC) integration on the labour market dynamics in the 25th, 50th and 75th quantile. The findings indicate that GVC integration always decreases unemployment in all quantiles in both the short and long term, but the effects are stronger in the long term. Precisely, the effect of a 1 percentage point increase in GVC participation on unemployment is -1.558, -1.616 and -1.675 percentage points in the long run, as opposed to -0.634, -0.942 and -0.732 percentage points in the short run. The greater effect of the upper quantile implies that there is more benefit of the GVC integration with time in countries characterized by higher unemployment rates. This is attributable to long term structural benefits which include infrastructure development, acquisition of skills, expansion of value chain and diversification of an economy which in totality contribute to sustainable employment development.

In terms of the control variables, GDP growth has much stronger impacts on unemployment over the two quantiles in both periods with stronger long-run impacts, especially at the lower quantile. Education (proxied by school enrollment) also displays such a negative impact on unemployment, and the short-run effect is stronger at the median quantile. Conversely, population growth raises both short and long-term unemployment, but in the long-run, at the upper quantile, the magnitude of the effect is the highest. The results are mixed when it comes to foreign direct investment (FDI): in both the short-term, it lowers unemployment rates across all quantiles indicating immediate employment impacts, but in the long-term, it is positively correlated to unemployment at the median and upper quantiles, indicating that short-term benefits may disappear unless inflows and supportive policies are maintained.

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Table 7: Panel Quantile ARDL Result

	Short Run			Long Run		
	0.25	0.50	0.75	0.25	0.50	0.75
logGVC	-0.634*	-0.942	-0.743**	-1.558**	-1.616**	-1.675***
	(0.082)	(0.016)	(0.032)	(0.023)	(0.035)	(0.006)
logGDPgr	-0.732***	-0.559	-0.421**	-1.248***	-0.359***	-0.387**
	(0.000)	(0.000)	(0.036)	(0.000)	(0.000)	(0.014)
logEDU	-1.067	-2.000*	-1.561**	-0.651	-0.313**	-0.424***
	(0.479)	(0.081)	(0.012)	(0.129)	(0.038)	(0.001)
logPOPgr	0.667**	0.176**	0.062**	0.705**	0.844***	0.914***
	(0.043)	(0.017)	(0.023)	(0.045)	(0.002)	(0.000)
logFDI	-1.161*	-1.213*	-1.007***	-0.349	-0.224**	-0.806**
	(0.090)	(0.058)	(0.000)	(0.951)	(0.047)	(0.038)

Note: ***,**, and * denotes significant at 1%, 5% and 10% respectively

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Causality Test

The direction of causality among the variables was determined by using the DumitrescuHurlin panel causality test. The findings are that there is a unidirectional causality between unemployment and GVC participation (W-Stat = 4.423,ρ< 0.05; W-Stat = 2.013, ρ> 0.05) meaning that unemployment is the cause of GVC integration in Africa, and there is no feedback at the aggregate level. Similarly, unemployment is found to Granger-cause GDP growth (W-Stat = 2.818, ρ< 0.05; W-Stat = 2.322, ρ> 0.05) and foreign direct investment (W-Stat = 2.829, ρ< 0.05; W-Stat = 2.311, ρ> 0.05).Bidirectional causality, however, is found between education (secondary school enrollment) and unemployment (W-Stat = 4.664, ρ< 0.05; W-Stat = 3.891, ρ< 0.05). There is also a close two-way relationship between the population growth and unemployment (W-Stat = 2.996, ρ< 0.05; W-Stat = 5.238, ρ< 0.05), indicating that there is a feedback effect between labour market conditions and population dynamics.

Table 8: Causality Test

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
LOGGVC ⟹LOGUEM	2.013	1.906	0.245
LOGUEM ⟹ LOGGVC	4.423***	3.908	0.001
LOGGDPGR ⟹LOGUEM	2.322	0.417	0.677
LOGUEM ⟹ LOGGDPGR	2.818**	1.750	0.040
LOGEDU ⟹ LOGUEM	4.664***	6.706	0.000
LOGUEM ⟹ LOGEDU	3.891***	4.631	0.000
LOGPOPGR ⟹LOGUEM	2.996***	2.227	0.026
LOGUEM ⟹ LOGPOPGR	5.238***	8.248	0.000
LOGFDI ⟹ LOGUEM	2.829*	1.777	0.076
LOGUEM⟹ LOGFDI	2.331	0.442	0.659

Note: *** ,** and * denotes significance at 1%, 5% and 10% respectively

VII. CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS

The paper examines how Africa is being integrated into the global value chains and its effects on labour market over the next 1990-2024 using Method of Moments Quantile Regression (MMQR) and PQARDL, in addition to the Westerlund cointegration test. The results affirm the existence of cross-sectional dependence and long-run equilibrium relationship between participation in GVCs and unemployment. Empirically, GVC integration has a significant effect on unemployment. Its influence is more serious at the higher quantiles of unemployment and negligible at lower quantiles, and the long-run effects predominate over the short-run effects. Moreover, the other macroeconomic variables, including GDP growth, education, and FDI are significant in alleviating unemployment with dynamic interrelationships among them observed.

On the basis of such findings, the following policy recommendations are made. First, to increase GVC participation and sustainable foreign investment, African governments should also focus on improving infrastructure, the quality of governance and institutional structures. Critical is also the need to match the educational systems with the needs of the labour market in order to enhance the skills and employability of the workforce. Also, long-term economic growth, entrepreneurship, and innovation policies should be reinforced. Specific interventions are especially needed in those countries that are negatively impacted by GVC integration. After all, to ensure that the benefits of global economic integration are maximized, long-term initiatives towards trade policy reforms, human capital development, and technological improvement are necessary.

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