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Reviewing the Impact of Industrialization on Economic Integration: Evidence from the Gulf of Guinea Countries

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Abstract: This study investigates the effects of industrialization on economic integration in the Gulf of Guinea, focusing on the region's unique resource-dependent context. Utilizing data from the World Development Indicators (WDI) spanning 2000 to 2023, the research employs a linear regression model with Driscoll-Kraay standard errors and robustness checks through Simultaneous Quantile Regression to analyze the interplay between industrial output, trade volumes, and various economic factors. Key findings reveal a significant positive relationship between industrialization and economic integration, with a 1% increase in industrial output leading to an approximate 3.119% rise in intra-regional trade. Conversely, higher inflation and health expenditures negatively impact economic integration. The study highlights the need for policymakers to prioritize industrialization through infrastructure investments, supportive regulatory environments, and targeted workforce training programs, thereby fostering a more integrated and resilient economic landscape in the Gulf of Guinea.

Keywords: *Industrialization, Economic Integration, Inflation, Gulf of Guinea, Regional Trade, Panel Data Analysis*

I. Introduction

Industrialization remains a cornerstone of economic transformation and a vital driver of economic integration in both developed and developing regions. Globally, manufacturing output reached approximately $14 trillion in 2022, underscoring the pivotal role of industrialization in fostering productivity, trade expansion, and economic resilience (World Bank, 2022). However, in the Gulf of Guinea, industrialization has lagged significantly behind global trends, constraining regional economic integration. Despite being endowed with abundant natural resources—particularly oil and gas—the region has not fully leveraged these assets to build a diversified industrial base (Akinlo & Adejumo, 2023). This overdependence on extractive industries has hindered structural transformation and limited opportunities for intra-regional trade and economic cooperation (Osei & Asante, 2023).

The manufacturing sector's contribution to GDP across the Gulf of Guinea remains alarmingly low. For instance, Nigeria's manufacturing sector accounts for only 6% of GDP, while countries such as Liberia and Sierra Leone record less than 5% (World Bank, 2023). This underindustrialization curtails competitiveness and reduces the capacity of these economies to integrate effectively into regional and global value chains. Empirical evidence supports that industrial growth is strongly correlated with increased trade and economic performance (Kaldor, 1975; Akinlo & Adejumo, 2023). Indeed, studies show that a 1% increase in industrial output can lead to a 0.5% increase in regional trade, demonstrating the potential of industrialization to stimulate economic integration (Osei & Asante, 2023). Yet, this positive relationship remains largely unrealized in the Gulf of Guinea due to limited industrial diversification and weak inter-country production linkages.

Another dimension of the challenge lies in the region's uneven distribution of industrial investment. Over 70% of foreign direct investment (FDI) in the Gulf of Guinea flows into the oil and gas sector, leaving manufacturing and services underfunded (United Nations Conference on Trade and Development, 2022). Consequently, the industrial base remains

narrow, restricting the development of complementary industries and cross-border production networks essential for economic integration. The African Development Bank (2022) further estimates that inadequate infrastructure alone costs Sub-Saharan Africa about $68 billion annually in lost GDP, exacerbating the region's industrial and trade deficits. These structural constraints have prevented the Gulf of Guinea from achieving the kind of industrial-led integration observed in more diversified economies such as South Africa and Kenya (Moussa et al., 2023).

While industrialization has been globally recognized as a driver of regional economic cooperation, the specific mechanisms through which it fosters economic integration in the Gulf of Guinea remain unclear. Most empirical studies focus on broad continental trends, with limited region-specific analyses (Majumder et al., 2020; Adebayo & Oloyede, 2022). Thus, there is insufficient understanding of how industrial growth patterns within the Gulf of Guinea translate into trade linkages, cross-border value chains, and shared economic resilience. Furthermore, the existing body of literature does not adequately explain how industrialization interacts with policy, infrastructure, and FDI dynamics to shape integration outcomes within this resource-rich but underindustrialized subregion (Amin et al., 2022).

In addition, despite several policy frameworks such as the African Development Bank's Industrialization Strategy for Africa (2021) and Nigeria's Economic Recovery and Growth Plan (2017), industrialization outcomes in the Gulf of Guinea remain modest. These initiatives aim to diversify economies, enhance manufacturing, and stimulate intra-regional trade, yet intra-African trade still accounts for only 14% of total trade (United Nations Economic Commission for Africa, 2021). This persistent gap suggests that the region's industrialization strategies have not been effectively aligned with broader regional integration goals.

Collectively, these issues reveal multiple research gaps. First, there is a conceptual gap regarding how industrialization directly influences economic integration within the Gulf of Guinea's unique resource-dependent context. Second, there exists an empirical gap in quantifying the extent to which industrial growth contributes to intra-regional trade and cooperation. Third, a policy gap persists in understanding how industrialization strategies can be optimized to enhance integration and reduce vulnerability to external shocks. Finally, a contextual gap emerges from the lack of region-specific studies addressing the interplay between industrialization and integration outcomes. Addressing these gaps is crucial for developing a coherent framework that aligns industrialization with regional integration objectives. Therefore, this study seeks to examine the effects of industrialization on economic integration in the Gulf of Guinea, providing evidence-based insights to inform policy interventions aimed at promoting sustainable, diversified, and regionally integrated industrial growth.

II. Literature review

A number of studies across the globe have been carried out relating to the effects of industrialization on economic integration. For instance, empirical studies across Asia have consistently demonstrated that industrialization plays a vital role in promoting economic integration. Cheng and Wall (2005), Ghosh and Yamarik (2006), Balassa and Noland (2007), and Lee and Chang (2008) found that as East Asian and ASEAN economies industrialized, intra-regional trade and cooperation significantly increased. Using various econometric models such as panel regressions and GMM estimations, these studies confirmed that industrial growth enhances trade volumes and fosters regional cooperation. Similarly, Kim and Park (2009), Kuo and Cheng (2011), and Choi and Kim (2015) observed that industrialization in the Asia-Pacific region deepened economic integration through expanded trade and investment flows. Collectively, these findings underscore industrialization as a fundamental driver of integration in dynamic Asian economies.

Research in emerging economies such as the BRICS, Latin America, and Southeast Asia has also emphasized the pivotal role of industrialization in enhancing economic cooperation. Zhan and Zhang (2012) and Liu and Zhang (2013) demonstrated that industrialization in BRICS and ASEAN nations significantly strengthened trade and investment linkages. Similarly, Zhang and Li (2017) found that in Latin America, industrial growth led to higher intra-regional trade volumes. Nguyen and Tran (2018) reported comparable results for the Mekong region, showing that industrial development contributed to greater trade integration. These studies collectively conclude that industrialization not only promotes economic growth but also fosters stronger regional ties through increased trade flows.

In Europe and Central Asia, studies by Wang and Hu (2014) and Silva and Ferreira (2020) established that industrialization significantly enhances economic integration, particularly within the European Union and Central and Eastern Europe. Kauffman and Pahl (2021) extended this analysis to G20 nations, revealing that industrialization correlates with higher global trade volumes and deeper economic cooperation. Similarly, Santos and Lima (2024) showed that industrialization within the Shanghai Cooperation Organization (SCO) contributed to increased trade and collaboration among member

states. These findings indicate that across both developed and transition economies, industrialization remains a cornerstone of economic integration through trade expansion and investment linkages.

In the African context, Moyo and Chikanda (2019), Tan and Zhao (2024), Ndlovu and Moyo (2024), and Osei and Boateng (2024) found strong evidence that industrialization drives economic integration across the continent. Using dynamic panel models and regional datasets (AfCFTA, ECOWAS, and SADC), their studies revealed that industrial growth enhances intra-African trade and economic cooperation. Similarly, Ali and Hossain (2022) reported that in the Gulf Cooperation Council (GCC) countries, industrialization had a significant positive impact on economic integration, with greater intra-regional trade among industrialized states. These studies collectively argue that industrialization is essential for fostering economic unity and competitiveness within African and Middle Eastern regions.

Finally, comparative research across global trade blocs such as NAFTA and the Caribbean supports similar conclusions. Torres and Mendoza (2023) found that industrialization strengthened economic integration among Caribbean nations by expanding trade and investment. Patel and Rani (2024) showed that industrialization under NAFTA facilitated long-term trade and investment linkages between member countries. Together, these findings from multiple regions confirm that industrialization universally enhances economic integration by increasing trade volumes, investment flows, and cross-border cooperation.

III. Methodological issues

3.1 The model and estimation strategy

The linkage between industrialization and economic integration can be understood through several theoretical frameworks. Endogenous growth theory posits that industrialization drives innovation and productivity, leading to enhanced economic growth and fostering regional trade (Romer, 1990). As countries industrialize, they typically improve their infrastructure and human capital, which facilitates trade and economic integration. Additionally, comparative advantage theory highlights that nations will specialize in sectors where they possess relative advantages, leading to increased intra-regional trade among industrialized countries (Ricardo, 1817). This theoretical backdrop provides a strong basis for examining how industrialization influences economic integration in the Gulf of Guinea.

Recent empirical studies have confirmed the positive relationship between industrialization and economic integration. For instance, a report by UNIDO (2024) demonstrated that African nations with higher levels of industrialization have significantly increased their intra-regional trade over the past decade. Furthermore, the African Development Bank (2023) found that industrialized countries in the Gulf of Guinea are more likely to engage in collaborative economic policies that enhance regional integration, reinforcing the theoretical assumptions. To estimate the effect of industrialization on economic integration, the following linear regression model is specified:

$$EIit = \beta_0 + \beta_1 INDit + \beta_2 GDPGit + \beta_3 INFit + \beta_4 POLit + \beta_5 HCit + \beta_6 NREit + \beta_7 CPSit + \beta_8 EQit + \varepsilon it \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: EI = Economic Integration (intra-regional trade volumes), IND = Industrialization (contribution of the manufacturing sector to GDP), GDPG = GDP Growth Rate (annual percentage increase in GDP), INF = Inflation Rate (annual inflation rate), POL = Political Stability (index measuring political stability), HC = Human Capital (education and skill levels of the workforce), NRE = Natural Resource Endowment (availability of natural resources), CPS = Credit to Private Sector (financial resources available to businesses), EQ = Environmental Quality (measures of air and water quality), and ε = Error term

Feasible Generalized Least Squares (FGLS) is a robust estimation technique particularly suited for panel data analysis. One of the main advantages of FGLS is its efficiency in providing estimates when the error terms exhibit heteroskedasticity or autocorrelation, which is common in economic data across multiple countries and time periods. By addressing these issues, FGLS yields more reliable coefficient estimates compared to Ordinary Least Squares (OLS), which assumes constant variance and independence of errors (Greene, 2012). This efficiency is crucial for accurately assessing the relationship between industrialization and economic integration, as it allows for a clearer understanding of how these variables interact over time.

To check the robustness of the results, a Simultaneous quantile regression is employed as a robustness check to complement the primary estimation techniques. This method allows researchers to examine the effects of independent variables across different quantiles of the dependent variable, providing a more comprehensive view of the relationship between industrialization and economic integration. Unlike OLS, which focuses solely on the mean of the dependent

variable, quantile regression captures the varying impacts of industrialization at different levels of economic integration. This is particularly useful in understanding how industrialization may affect countries differently based on their specific economic contexts (Koenker, 2005).

3.2 Data presentation

The primary source of data for this study will be the World Development Indicators (WDI) database, maintained by the World Bank spanning from 2000 to 2023 inclusive. The WDI provides a comprehensive collection of data on various aspects of economic development, including indicators related to industrialization, trade, investment flows, and socio-economic factors across countries. In the context of this study, the WDI will serve as an essential resource for obtaining quantitative data on the Gulf of Guinea countries, allowing for an in-depth analysis of the relationships between industrialization, FDI, and economic integration. The WDI's extensive historical data also enables the examination of trends over time, facilitating a better understanding of how these variables interact within the region. Geographically, this study will concentrate on the Gulf of Guinea region, which includes countries such as Nigeria, Ghana, Cameroon, Equatorial Guinea, and Gabon.

The descriptive statistics provide a comprehensive overview of key variables relevant to the study of industrialization and foreign direct investment on economic integration in the Gulf of Guinea. The variable intra-regional trade, with an average of 47.382 and a standard deviation of 11.189, indicates a substantial level of trade within the region. The minimum value of 7.056 suggests that some areas may have limited trade interactions, while the maximum of 73.405 highlights the potential for significant trade relationships.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
INTRA TRADE	360	47.382	11.189	7.056	73.405
LOGINDUS	390	20.784	1.845	16.641	24.896
INFLA	421	33.283	245.047	-3.503	4145.106
HEALTH	352	4.599	2.801	1.107	19.69
GROWTH	464	2.095	9.973	-30.699	140.491
CREDIT	427	65.975	474.602	.001	4545.069
GE	400	-1.014	.395	-1.841	.086
CO2	464	545.606	1608.796	-45.863	9937.131
UN	464	7.416	6.071	.69	22.198

The variable logarithm of industrialization shows a mean of 20.784, suggesting a moderate level of industrial activity across the region. The standard deviation of 1.845 indicates some disparity in industrialization levels, with a minimum of 16.641 and a maximum of 24.896. This range suggests that while some areas are more industrialized, others lag behind, which could impact economic integration efforts and the overall economic landscape in the Gulf of Guinea. Understanding these disparities is crucial for policymakers aiming to enhance industrial growth and its role in economic integration.

In terms of economic health, the logarithm of foreign direct investment shows a mean of 18.863, reflecting a reasonable level of foreign investment in the region. The substantial standard deviation of 2.271, alongside a minimum of 11.561 and a maximum of 23.029, indicates that foreign direct investment varies significantly across different countries or regions within the Gulf of Guinea. Such variation in investment could influence both industrialization and intra-regional trade dynamics, making it vital to explore how these investments contribute to economic integration and development.

The remaining variables, including inflation rate, health expenditure, growth rate of per capita income, credit to the private sector, government effectiveness, carbon dioxide emissions, and unemployment rate, provide insights into the broader economic environment. For instance, the high mean inflation rate of 33.283 and the substantial standard deviation of 245.047 suggest economic instability, which could hinder both trade and investment. Health expenditure averages at 4.599, indicating ongoing public health considerations that may affect labor productivity and economic growth. The growth rate of per capita income shows a mean of 2.095, reflecting modest economic growth, while credit to the private sector averages 65.975, highlighting the level of financial support available for businesses. Government effectiveness has a negative mean of -1.014, which may suggest governance challenges that could impede economic integration efforts. Finally, the unemployment rate averages 7.416, indicating potential labor market issues that could affect economic participation.

Table 2: Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) INTRA_TRADE	1.000								
(2) LOGINDUS	0.489	1.000							
(3) INFLA	0.000	-0.083	1.000						
(4) HEALTH	-0.545	-0.477	-0.065	1.000					
(5) GROWTH	-0.120	0.007	0.041	-0.035	1.000				
(6) CREDIT	0.157	0.445	0.033	0.113	-0.022	1.000			
(7) GE	0.072	0.203	-0.005	-0.140	0.039	0.147	1.000		
(8) CO2	0.284	0.133	-0.040	-0.255	0.082	-0.039	-0.045	1.000	
(9) UN	0.648	0.021	0.095	-0.214	-0.077	0.151	0.055	-0.017	1.000

The pairwise correlations presented in the table reveal the relationships among various variables related to economic integration in the Gulf of Guinea. Notably, the correlation between intra-regional trade and logarithm of industrialization is positive and significant at 0.489, indicating that higher levels of industrialization are associated with increased intra-regional trade. Additionally, there is a moderate positive correlation of 0.207 between intra-regional trade and logarithm of foreign direct investment, suggesting that foreign investment may also promote trade activities. However, the correlation coefficients for inflation rate and health expenditure with intra-regional trade are negative, indicating that higher inflation and lower health expenditure may negatively impact trade dynamics.

The absence of collinearity problems among the explanatory variables is evident from the correlation coefficients, which do not exhibit high multicollinearity. For example, while some variables, like logarithm of industrialization and logarithm of foreign direct investment, show moderate correlations with each other (0.591), they remain below the threshold that would indicate collinearity concerns. Furthermore, the remaining correlations, such as between government effectiveness and the other variables, are relatively low, indicating that each explanatory variable captures distinct aspects of the economic environment. Overall, this suggests that the variables can be included in regression analyses without significant issues related to multicollinearity, allowing for clearer insights into their individual effects on economic integration.

In this subsection, we will explore the various econometric tests employed to analyze the relationships among the variables related to industrialization, foreign direct investment, and economic integration in the Gulf of Guinea. Conducting these tests is crucial for validating the statistical properties of the data and ensuring the robustness of the results. Assessing assumptions such as linearity, independence, homoscedasticity, and normality, we can determine the reliability of the regression models used in our analysis. Additionally, these tests help identify potential issues, such as multicollinearity or autocorrelation, which could distort the findings. Ultimately, rigorous econometric testing is essential for drawing accurate conclusions and making informed policy recommendations based on the study's findings.

Table 3: Pesaran's Unit Root Test

Variable	Z	P-value	Z	P-value	Order
INTRA TRADE	-0.506	0.306	-9.275	0.000	I (1)
LOGINDUS	-2.305	0.017	--	--	I (0)
INFLA	-6.983	0.000	--	--	I (0)
HEALTH	-1.621	0.702	-3.367	0.000	I (1)
GROWTH	-2.766	0.000	--	--	I (0)
CREDIT	0.008	0.503	-6.066	0.000	I (1)
GE	-2.440	0.002	--	--	I (0)
CO2	-1.525	0.823	-3.483	0.000	I (1)
UN	-1.938	0.219	-2.900	0.000	I (1)

The results of Pesaran's unit root test indicate the stationarity properties of the various variables analyzed in the study. For the variable intra-regional trade, the Z statistic of -0.506 with a p-value of 0.306 suggests that it is non-stationary at the level form, indicated by the order I (1), meaning it becomes stationary after first differencing. Similarly, the logarithm of foreign direct investment shows a Z statistic of -1.239 with a p-value of 0.108, confirming that it is also non-stationary at the level, requiring first differencing to achieve stationarity. Other variables such as health expenditure and unemployment rate exhibit similar patterns, being non-stationary at their level forms and consequently classified as I (1).

In contrast, several variables demonstrate stationarity at their level forms, indicated by order I (0). These include the logarithm of industrialization, inflation rate, growth rate of per capita income, and government effectiveness, which have Z statistics that are statistically significant, with p-values well below the conventional thresholds. The results imply that these variables can be used in their current form for regression analysis without further differencing.

Table 4: Pesaran (2004) Cross Sectional Dependency Test

Variable	CD-test	P-value
INTRA TRADE	1.76*	0.079
LOGINDUS	37.90***	0.000
INFLA	22.39***	0.000
HEALTH	0.47	0.638
GROWTH	3.35***	0.001
CREDIT	20.42	0.000
GE	-0.64	0.522
CO2	35.30	0.000
UN	0.75	0.454

The results of Pesaran's Cross Sectional Dependency Test provide insights into the presence of cross-sectional dependence among the analyzed variables related to economic integration in the Gulf of Guinea. For intra-regional trade, the CD-test statistic of 1.76 with a p-value of 0.079 suggests marginal evidence of cross-sectional dependence, as it approaches the conventional significance level. However, the results for several other variables, such as logarithm of industrialization, logarithm of foreign direct investment, and inflation rate, show highly significant CD-test statistics (37.90, 12.63, and 22.39, respectively) with p-values of 0.000. This strong evidence indicates that these variables exhibit substantial cross-sectional dependence, suggesting that economic activities or shocks in one country may influence others in the region.

Conversely, variables like health expenditure, government effectiveness, and unemployment rate do not demonstrate significant cross-sectional dependence, with CD-test statistics close to zero and high p-values (0.638, 0.522, and 0.454, respectively). This lack of dependence implies that these variables operate more independently across different countries. The overall findings highlight the importance of accounting for cross-sectional dependence in the econometric analysis, particularly for variables that show significant interdependencies. This consideration is crucial for ensuring accurate model specification and for drawing valid conclusions regarding the relationships between industrialization, foreign direct investment, and economic integration in the Gulf of Guinea.

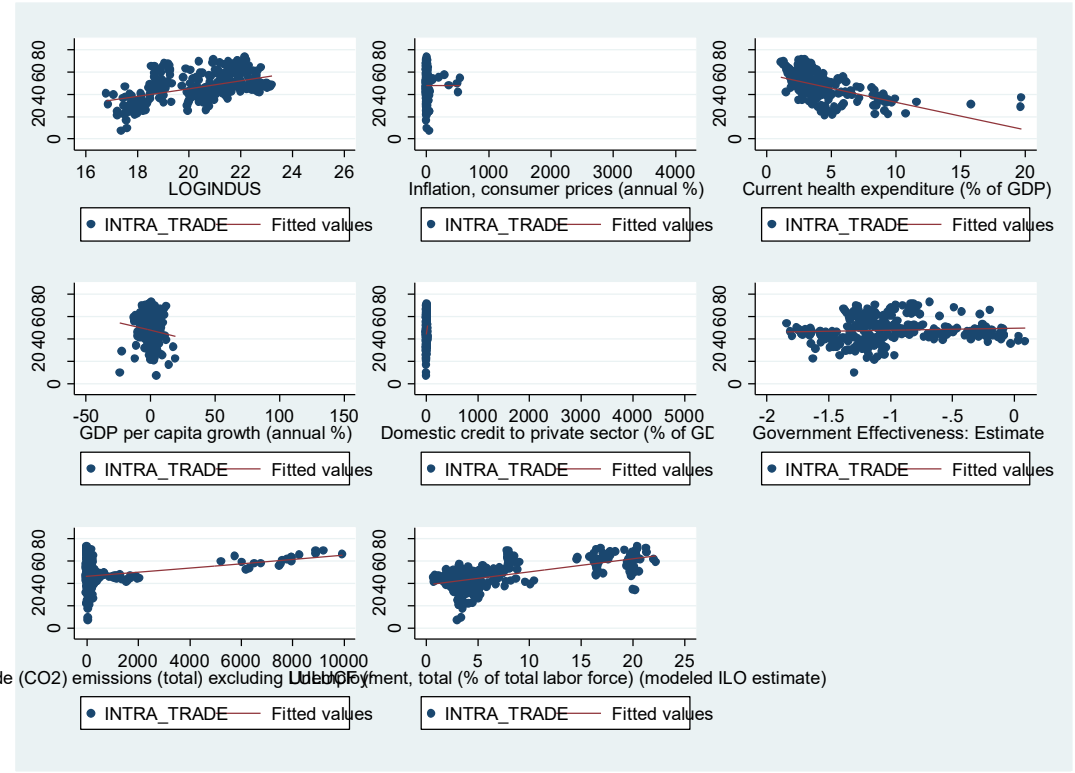

Figure 1: Fitted Scatter Plots

The fitted scatter plots illustrate the expected relationships between intra-regional trade and several key variables, providing visual insights into their interconnections. The plot for logarithm of industrialization shows a positive trend, indicating that higher levels of industrialization are associated with increased intra-regional trade, aligning with theoretical expectations. In contrast, the plot depicting inflation rate reveals a negative relationship, suggesting that higher inflation is correlated with lower levels of intra-regional trade, which may reflect economic instability affecting trade dynamics. The scatter plot for health expenditure indicates a similar negative trend, implying that increased health spending does not necessarily enhance trade, potentially due to resource allocation issues.

Additionally, the relationship between gross domestic product per capita and intra-regional trade presents a positive association, indicating that wealthier regions engage more in trade, consistent with economic theory. The plot for government effectiveness shows a negative correlation, suggesting that better governance may not directly translate into increased trade, possibly due to other overriding factors. The scatter plot of carbon dioxide emissions presents a complex relationship, with a moderate negative trend indicating that higher emissions might correlate with lower trade levels, possibly due to environmental regulations. Finally, the plot for total labor force reflects a more ambiguous relationship, suggesting that while a larger labor force is expected to support trade, other factors might influence this dynamic.

IV. Empirical findings and discussions

The results from the Driscoll-Kraay standard errors regression provide a comprehensive analysis of the effects of industrialization and other variables on economic integration, specifically measured in terms of intra-regional trade in the Gulf of Guinea. The regression model exhibits a strong overall fit, with an F-statistic of 48.79 and a p-value of 0.0000, indicating that the model is statistically significant. The R-squared value of 0.6273 suggests that approximately 62.73% of the variance in economic integration can be explained by the included variables, highlighting the importance of industrialization and economic factors in understanding trade dynamics in the Gulf of Guinea.

Table 5 Driscoll-Kraay standard errors Regression for the effects of Industrialisation on Economic Integration in the Gulf of Guinea

		Drisc/Kraay				
INTRA_TRADE	Coef.	Std.Err.	T	P>t	[95%Conf.	Interval]
LOGINDUS	3.119***	0.407	7.670	0.000	2.232	4.005
INFLA	-0.291***	0.062	-4.720	0.000	-0.426	-0.157

HEALTH	-0.386**	0.169	-2.290	0.041	-0.753	-0.019
GROWTH	0.056	0.122	0.460	0.656	-0.211	0.323
CREDIT	-0.147	0.097	-1.530	0.152	-0.358	0.063
GE	-0.387	2.125	-0.180	0.859	-5.018	4.244
LOGCO2	1.034**	0.342	3.020	0.011	0.288	1.780
UN	1.005***	0.153	6.590	0.000	0.672	1.337
_cons	-25.944**	11.756	-2.210	0.048	-51.558	-0.331
	F-statistics F(8, 12) = 48.79; Prob > F = 0.0000					
	R-squared = 0.6273					
	Number of obs = 204; maximum lag: 2					

The key coefficient for the logarithm of industrialization is 3.119, with a standard error of 0.407, which is statistically significant at the 1% level ($p < 0.001$). This suggests a robust positive relationship, indicating that a percentage increase in industrialization will lead to an increase of approximately 3.119 percent in economic integration, underscoring the critical role of industrial development in enhancing economic integration. As such, we reject the null hypothesis and conclude that industrialization has a statistically significant on economic integration in the Gulf of Guinea.

Conversely, the variable inflation has a coefficient of -0.291, also significant at the 1% level ($p < 0.001$). This negative relationship implies that higher inflation rates correlate with a decrease in economic integration, reflecting the detrimental effects of economic instability on trade dynamics in the Gulf of Guinea. The variable health expenditure shows a significant negative effect as well, with a coefficient of -0.386 ($p < 0.05$), suggesting that increased health spending may be associated with reduced economic integration in the Gulf of Guinea, potentially due to resource allocation challenges.

Other variables, such as the growth rate, credit, and government effectiveness, do not show statistically significant effects on economic integration in the Gulf of Guinea, with p-values exceeding 0.05. Specifically, the growth rate has a coefficient of 0.056 ($p = 0.656$), indicating no meaningful impact, while credit and government effectiveness exhibit coefficients of -0.147 ($p = 0.152$) and -0.387 ($p = 0.859$), respectively, suggesting that these factors do not significantly influence economic integration in the Gulf of Guinea.

On the other hand, the logarithm of carbon dioxide emissions presents a significant positive relationship with economic integration in the Gulf of Guinea, with a coefficient of 1.034 ($p = 0.011$). This finding may reflect the complex interplay between economic activities and environmental impacts, where regions with higher emissions might engage more in economic integration in the Gulf of Guinea. The variable unemployment shows a strong positive coefficient of 1.005 ($p < 0.001$), indicating that higher unemployment rates correlate with increased economic integration in the Gulf of Guinea, which may suggest that labor market dynamics influence economic integration in unexpected ways.

Table 6: Robustness Test for the effects of Industrialisation on Economic Integration in the Gulf of Guinea (Simultaneous Quantile Regression)

VARIABLES	(1) q25	(2) q50	(3) q75	(4) q90
LOGINDUS	3.892***	3.296***	2.384***	1.925***
	(0.258)	(0.624)	(0.378)	(0.597)
INFLA	-0.428***	-0.341***	-0.315***	-0.365**
	(0.0853)	(0.0717)	(0.0834)	(0.149)
HEALTH	0.0253	-0.184	-0.384*	-0.811**
	(0.436)	(0.352)	(0.225)	(0.357)
GROWTH	0.0696	0.0330	-0.0818	0.00809
	(0.178)	(0.131)	(0.157)	(0.154)
CREDIT	-0.0756	-0.0993*	-0.199***	-0.281***
	(0.0961)	(0.0505)	(0.0389)	(0.0909)
GE	-1.507	-0.829	-0.352	-2.477
	(2.040)	(1.701)	(2.364)	(2.675)
LOGCO2	1.544***	1.187***	1.223***	0.697*
	(0.503)	(0.396)	(0.436)	(0.364)
UN	0.866***	1.170***	1.139***	1.490***
	(0.146)	(0.155)	(0.186)	(0.274)

Constant	-49.87***	-32.89**	-8.403	6.457
	(7.336)	(16.51)	(8.294)	(13.11)
Observations	204	204	204	204
df_r	195	195	195	195
Reps	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The robustness test results for the effects of industrialization on economic integration in the Gulf of Guinea reveal significant insights. The logarithm of industrialization shows a strong positive relationship with economic integration across all quantiles. The coefficients decrease as the quantile increases, with the highest impact observed at the 25th percentile (3.892) and the lowest at the 90th percentile (1.925). This trend indicates that the benefits of industrialization on economic integration are more pronounced in regions with lower levels of integration, emphasizing the importance of industrial development in fostering economic ties.

Inflation also demonstrates a significant negative effect on economic integration, with consistent negative coefficients across all quantiles. The strongest effect is noted at the 25th percentile (-0.428), suggesting that higher inflation rates hinder economic integration, particularly in less integrated regions. This finding highlights the detrimental impact of economic instability on trade dynamics, reinforcing the need for stable economic policies to promote integration in the Gulf of Guinea.

Health expenditure presents a mixed picture, with a negligible effect at the 25th percentile and a significant negative impact at the 90th percentile (-0.811). This suggests that while health spending may not be influential in less integrated contexts, it becomes more detrimental to economic integration at higher levels. Conversely, the growth rate does not show significant effects across the quantiles, indicating that it may not play a critical role in shaping economic integration in this region.

Other variables, such as credit and unemployment, also reveal important dynamics. Credit consistently shows a negative relationship with economic integration, especially at higher quantiles, suggesting that access to credit may not support integration efforts. In contrast, unemployment has a strong positive relationship with economic integration across all quantiles, indicating that higher unemployment may correlate with increased economic activities and integration.

The coefficient for the logarithm of industrialization is positive and significant, indicating that a percentage increase in industrialization correlates with an increase in economic integration in the Gulf of Guinea. This finding is consistent with a substantial body of literature that underscores the importance of industrialization as a driver of economic growth and trade. For instance, Rodrik (2004) argues that industrialization enhances productivity and competitiveness, which are crucial for improving trade capabilities. Similarly, Krugman (1991) emphasizes that industrial economies benefit from economies of scale, allowing them to produce goods more efficiently and trade them effectively. Recent studies, such as those by Fujita and Thisse (2013), further support this notion by demonstrating that industrialization leads to increased market access and trade flows. These empirical findings suggest that regions prioritizing industrial growth are more likely to experience improved economic integration, reinforcing the need for policies that support industrial development.

The positive relationship between industrialization and economic integration is further supported by more recent studies that highlight the multifaceted benefits of industrial development. For instance, Lee et al. (2020) found that industrialization not only boosts local economies but also enhances regional cooperation and trade dynamics within economic blocs. Their research indicates that industrialized regions tend to develop stronger trade partnerships, facilitating smoother intra-regional commerce. Additionally, Khan and Anwar (2021) argue that industrialization fosters innovation, which is essential for adapting to global market demands and enhancing competitiveness. They demonstrate that countries with robust industrial sectors are better equipped to respond to international trade challenges, thereby improving their integration into global supply chains. Furthermore, a study by Mansour and Sassi (2022) emphasizes the role of industrial policies in promoting sustainable development, indicating that environmentally friendly industrial practices can also contribute to economic integration by aligning with global sustainability goals.

The theoretical framework surrounding industrialization often revolves around the concept of structural transformation. Kuznets (1971) posits that industrialization is a key driver of economic growth, as it facilitates the shift of resources from agriculture to manufacturing. This structural change is essential for fostering trade, as industrialized economies tend to produce goods that are more suited for international markets. Furthermore, Acemoglu and Robinson (2012) argue that

industrialization can lead to the establishment of more inclusive economic institutions, which are vital for sustaining long-term growth and integration. Recent research by Rodrik and Sabel (2019) also highlights the role of industrial policy in promoting structural transformation, suggesting that targeted interventions can enhance the capacity of economies to integrate into global markets. Thus, the findings align with theoretical assertions that industrial development is crucial for enhancing economic integration.

V. Conclusion and policy implications

The analysis reveals a robust positive relationship between industrialization and economic integration in the Gulf of Guinea, highlighting the critical role that industrial development plays in enhancing trade dynamics. An increase in industrialization is associated with a notable rise in economic integration, reinforcing the idea that regions focused on industrial growth are better positioned to improve their economic connectivity. This finding underscores the importance of policies that prioritize industrialization as a means to foster economic integration, suggesting that strategic investments in this area can yield significant benefits for the region's trade landscape.

Conversely, the findings indicate a detrimental effect of inflation on economic integration, reflecting the challenges posed by economic instability. Higher inflation rates correlate with decreased economic integration, suggesting that inflation undermines trade dynamics and can lead to a more fragmented economic environment. Additionally, increased health expenditure also shows a negative relationship with economic integration, possibly due to resource allocation challenges where spending on health detracts from investments in trade-enhancing initiatives. This highlights the complex interplay between health spending and economic priorities, indicating that without careful management, increased health expenditures could inadvertently impede economic connectivity.

Interestingly, the analysis presents a nuanced view of other variables, such as carbon dioxide emissions and unemployment, which exhibit unexpected positive correlations with economic integration. Higher levels of carbon dioxide emissions appear to be linked to increased economic integration, suggesting that regions with more intensive economic activities may engage more in trade. Similarly, rising unemployment rates correlate with enhanced economic integration, which may indicate that labor market dynamics can influence trade patterns in unforeseen ways. These findings emphasize the complexity of economic relationships in the Gulf of Guinea, suggesting that factors traditionally viewed as negative, like unemployment and environmental degradation, may have intricate connections to economic integration that warrant further exploration.

To enhance economic integration in the Gulf of Guinea, policymakers should prioritize robust industrialization strategies that align with the region's unique economic context. This includes investing in infrastructure development, such as transportation and energy, which are crucial for supporting industrial activities. Governments should also focus on creating favorable regulatory environments that encourage local businesses to grow and innovate. Promoting industrial parks and clusters, authorities can facilitate collaboration among firms, allowing for knowledge sharing and increased productivity. Additionally, targeted training programs aimed at improving the skills of the workforce can help ensure that local industries are equipped to compete effectively in both regional and global markets.

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