



UNLOCKING INDUSTRIAL GROWTH IN WEST AFRICA: HOW FINANCIALIZATION AND TECHNOLOGICAL INNOVATION SHAPE THE FUTURE

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Abstract

This study examines the moderating effect of technological innovation on the relationship between financialization and industrial output growth in West Africa. Despite the critical role of innovation in industrial transformation, the region faces barriers such as limited capital, poor infrastructure, and skill shortages. Using data from 16 West African countries and grounded in Kaldor's Theory of Economic Growth, the study employs panel unit root tests and ARDL cointegration analysis to explore long-run relationships among financialization, technological innovation, government effectiveness, human capital, and trade openness. Results show that financialization has a negative and statistically significant effect on industrial output growth, reflecting a preference for short-term financial gains over productive investment. Technological innovation, while statistically significant, has only a marginal positive effect, and its moderation with financialization is negative and insignificant. Notably, a 1% increase in technological innovation is linked to a 2.39 percentage point decline in industrial output growth, challenging conventional assumptions. The study concludes that financialization undermines industrial development and limits the benefits of technological innovation. It recommends policy measures such as tax incentives, mandated industrial lending, financial regulation, R&D support, and workforce training to promote long-term investment, enhance technological adoption, and boost industrial output in West Africa.

Key words: technological innovation, financialization, industrial output growth

JEL Code: A12

INTRODUCTION

Industrial output growth is central to sustainable economic development in West Africa, serving as a catalyst for job creation, value addition, and structural transformation. Despite its importance, the region's industrial sector remains underdeveloped, contributing less than 10% to GDP in most countries (UNIDO, 2022). This limited industrial performance has hindered efforts toward economic diversification and long-term growth. Strengthening industrial output growth is therefore imperative to address the region's vulnerability to external shocks and dependence on primary commodities. A critical factor influencing industrial growth dynamics in the region is financialization, which refers to the increasing dominance of financial motives, financial markets, and financial actors in the economy. While financialization can potentially mobilize capital for industrial investment, in West Africa, it has often manifested as a preference for short-term speculative gains over long-term productive investment. This trend undermines access to credit for industrial ventures, particularly for Small and Medium Enterprises (SMEs), which are key drivers of innovation and industrial expansion (Ilugbusi et al., 2020). The diversion of financial

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resources away from productive sectors perpetuates underinvestment in infrastructure, technology, and human capital core requirements for industrial growth (Osemeke & Adeleye, 2018).

Technological innovation is an important part in moderating the relationship between financialization and industrial output growth. In theory, innovation can offset some negative effects of financialization by enhancing productivity, improving industrial processes, and increasing competitiveness. However, in practice, West African countries face significant barriers to innovation adoption, including inadequate financing, weak research and development (R&D) ecosystems, and skill shortages (African Development Bank, 2017). Although recent developments in fintech and digital finance present opportunities to close financing gaps, particularly for SMEs, these opportunities remain largely untapped. Despite growing interest in industrialization and technological advancement, there is a dearth of empirical studies in West Africa that examine how technological innovation moderates the relationship between financialization and industrial output growth. This study addresses that gap by investigating this three-way relationship across 16 West African countries, aiming to inform policy frameworks that align financial systems with technological priorities for industrial development.

Crucial understanding of the moderation between financialization, industrial output growth, and technological innovation is vital to designing strategies that promote sustainable industrial transformation. This research is positioned to offer insights that can help West African economies overcome structural bottlenecks and unlock their industrial potential.

LITERATURE REVIEW

Conceptual Review

Industrial Output Growth

Industrial output growth refers to the sustained increase in the production of goods and services within key industrial sectors such as manufacturing, mining, construction, and utilities. This growth is vital for economic transformation, as it fosters job creation, technological advancement, and value addition. In West Africa, the industrial sector remains underdeveloped, contributing less than 10% to regional GDP (UNIDO, 2022), a figure that underscores the limited success of past industrialization efforts. Countries like Nigeria and Ghana initiated state-led industrial policies in the 1960s and 1970s, but progress was stalled due to political instability, infrastructure deficits, and financial constraints (Signé & Johnson, 2018). Current challenges include inadequate energy supply, limited access to credit, and global competition, which continue to inhibit local industrial expansion.

Financialization

Financialization is broadly defined as the increasing dominance of financial markets, financial motives, institutions, and elites over the real sector of the economy. In theory, financial development can facilitate industrial growth by improving capital mobilization and allocation. However, in West Africa, financialization has often translated into short-term speculative activities that prioritize financial returns over productive investment. SMEs, which are essential to industrial output, are particularly affected by limited access to long-term credit (Ilugbusi et al., 2020; World Bank, 2019). The misallocation of financial resources diverts funds away from industrial development, exacerbating the weak performance of the region's manufacturing sector.

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Technological Innovation

Technological innovation involves the development and adoption of new processes, tools, and systems that improve industrial productivity and competitiveness. Innovation is central to enhancing manufacturing efficiency, enabling economies of scale, and facilitating structural transformation. In West Africa, however, innovation is hindered by underinvestment in research and development (R&D), limited digital infrastructure, and a shortage of skilled labor (African Development Bank, 2017). Recent advances in financial technology (fintech) have the potential to address financing constraints, especially for innovation-driven SMEs, yet these tools remain underutilized in industrial sectors.

Moderation Between Financialization and Technological Innovation

The moderating role of technological innovation in the relationship between financialization and industrial output growth is an emerging area of inquiry. While innovation could theoretically mitigate the adverse effects of financialization by enhancing efficiency and enabling access to alternative finance, empirical evidence from West Africa is limited. It remains unclear whether current levels of technological innovation are sufficient to offset the distortive effects of financialization. The moderation between these two variables may also depend on institutional capacity, regulatory environments, and the availability of human capital.

Theoretical Review

Lewis Dual-Sector Model

The Lewis model explains industrial output growth as a result of labor movement from low-productivity agriculture to high-productivity industry. The model predicts that industrial expansion should lead to increased economic output and employment. However, in the context of financialization, this process may be disrupted. Instead of capital being channeled to the industrial sector, it may be diverted to financial speculation, slowing the structural transformation envisioned by the Lewis model. Thus, while the model provides insights into industrialization pathways, it lacks mechanisms to explain the impact of financialization on capital allocation (Bhaduri, 2023).

Neoclassical Growth Theory

This theory posits that capital accumulation, labor, and technological progress are the primary drivers of long-term economic growth. It assumes perfect markets and optimal resource allocation. However, in financialized economies like those in West Africa, capital does not always flow to the most productive uses. Instead, financial markets often prioritize short-term gains, undermining the investments required for sustained industrial output growth. Moreover, the exogeneity of technological change in this theory limits its applicability in regions where innovation is policy-driven and constrained by institutional factors (Acemoglu & Robinson, 2022).

Kaldor's Growth Model

Kaldor's model, particularly his first and second laws, emphasizes the central role of manufacturing in driving GDP growth and productivity. The model predicts that a rise in manufacturing output will lead to cumulative economic growth through economies of scale and technological advancement. Financialization contradicts this prediction when it reduces industrial investment, thereby limiting productivity improvements. The model also supports the argument that technological innovation enhances output growth by reinforcing scale economies and learning-by-doing mechanisms (Kaldor, 2020).. Thus, Kaldor's theory provides the most

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comprehensive foundation for analyzing the effects of financialization and technological innovation on industrial output growth in West Africa.

Empirical Review

Ajmi et al. (2024) examine the relationship between resource wealth, financial structure, and the growth of medium and high-tech manufacturing in 24 African countries, focusing on financing mechanisms for tech-driven industrialization. Using panel data from 1991 to 2021 and employing system GMM estimation, the study addresses endogeneity and dynamic effects. The findings show that resource-rich economies often experience limited industrial diversification. However, financial structures emphasizing private sector credit and financial depth significantly promote technology-intensive manufacturing. The study recommends reorienting financial systems toward productive, innovation-led sectors and aligning industrial policies with R&D and human capital development. These insights are relevant for West Africa, where unlocking industrial growth depends on the structure of financial systems. Properly aligned, financialization can support industrial upgrading; if misaligned, it may divert resources from sectors essential for structural transformation. Sustainable industrial growth, therefore, hinges on aligning financial incentives with technology-driven production objectives and strengthening institutional support for innovation and industry.

Mantey (2024) examines the role of foreign direct investment (FDI) in facilitating technological transfer and industrial upgrading in West Africa. The study assesses how FDI contributes to innovation and productivity growth in non-oil manufacturing sectors across 10 ECOWAS countries from 2000 to 2022, using panel data with fixed effects and dynamic GMM estimation. Results show that FDI positively impacts technological upgrading, particularly in countries with absorptive capacities such as skilled labor, sound financial institutions, and supportive policy environments. However, economies reliant on primary commodities experience limited technological spillovers. The study recommends strengthening domestic innovation systems, improving infrastructure, and implementing strategic FDI policies focused on high-tech manufacturing. It contributes to the discourse on financialization and technological innovation by emphasizing that financial systems should not only attract capital but also support industrial learning. For sustainable industrial growth, FDI must be aligned with long-term financial policies that build technological capabilities.

Aljadani et al. (2025) investigate how trade openness and financial development shocks affect economic growth in Africa, focusing on asymmetric impacts across 20 countries from 1995 to 2022. Using a nonlinear panel ARDL approach, the study finds that positive financial development shocks significantly boost growth, while negative shocks have stronger adverse effects. Trade openness also supports growth, particularly under stable macroeconomic conditions and strong institutions. The authors recommend enhancing financial regulation, diversifying trade partners, and building institutional resilience to counter negative shocks. This study is relevant to industrial growth in West Africa, highlighting the need to manage financial dynamics and external exposures to support structural transformation. In terms of financialization, it underscores that industrial growth depends not only on capital access but also on the stability and direction of financial flows, stressing the alignment of financial and innovation policies with long-term industrial goals.

METHODOLOGY

Theoretical Framework

The theoretical foundation of industrial output growth equation can be found in Kaldor’s Theory Third Law which is widely used in some empirical studies.

Kaldor Theory: Kaldor emphasizes the manufacturing sector as the engine of growth, linking industrial output growth to economic development through cumulative causation and structural transformation. Kaldor’s three laws: Growth of GDP is driven by growth in manufacturing output. Manufacturing productivity increases with manufacturing output (Verdoorn’s Law). Productivity in non-manufacturing sectors depends on resource reallocation to manufacturing. Manufacturing drives technological diffusion and economies of scale. Structural shifts are essential for sustained growth. Demand-led growth mechanisms dominate. Kaldor’s focus on structural transformation makes it well-suited for studying financialization’s impact on industrial output growth.

This study employs annual secondary data from the World Bank, World Economic Indicators and IMF database 2023 between the period of 1990 and 2023 based on data availability of the variables as the time of gathering the data.

Model Specification

To achieve the Objective of this study, the Kaldors Third Law was re-specified.

Derivation of Kaldor’s Third Law

The general form of Kaldor’s Third Law can be expressed as:

$$P_{NM} = \alpha + \beta Y_M + \epsilon \dots\dots\dots 3.1$$

Where:

- P_{NM} = Productivity growth in the non-manufacturing sector
- Y_M = Growth of manufacturing output
- α = Constant term
- β = Coefficient measuring the effect of manufacturing growth on non-manufacturing productivity
- ϵ = Error term

Assume the total economy’s output (Y) is divided into manufacturing (Y_M) and non-manufacturing (Y_{NM}).

Productivity (P) in the non-manufacturing sector is determined by labor reallocation and capital accumulation influenced by the manufacturing sector.

Let the output per worker (labor productivity) in non-manufacturing be represented as: $P_{NM} = \frac{Y_{NM}}{L_{NM}}$

$$\text{Taking the growth rate: } P_{NM} = \frac{dP_{NM}}{dt} = \frac{d}{dt} \left(\frac{Y_{NM}}{L_{NM}} \right) \dots\dots\dots 3.2$$

Since Kaldor’s Third Law suggests that non-manufacturing productivity depends on manufacturing growth, we introduce the relationship: $P_{NM} = f(Y_M) \dots\dots\dots 3.3$

$$\text{A linear approximation gives: } P_{NM} = \alpha + \beta Y_M + \epsilon \dots\dots\dots 3.4$$

Where $\beta > 0$ suggests that higher manufacturing output growth improves non-manufacturing productivity.

This is done by inserting the expressing and transforming the result into an econometric model by replacing non-manufacturing expressing with industrial output growth and adding intercept β_0 , and moderating technological innovation with financialization, time and country subscripts (t and i) and the stochastic error term (U).

$$P_{Ind} = \beta_0 + \beta_1 FIN_{it} + \beta_2 TI_{it} + \beta_3 FIN * TI_{it} + \beta_4 GDPG_{it} + \beta_5 TO_{it} + \beta_6 GE_{it} + \beta_7 HC_{it} + \beta_8 FDII_{it} + U_{it} \dots\dots\dots 3.5$$

IND = Industrial output growth the variable will be replaced with industrial output growth IND and this is to be assumed to stand for industrial output growth which is the dependent variable.

FIN= FIN indicator (Broad money supply to GDP, private sector credit to GDP, number of bank branches and ATMs per 100,000 adults, stock market capitalization to GDP, bank lending-deposit spread)

TI= technological innovation, GDPG = GDP growth, GE = Government Effectiveness,

TO = trade openness, HC = Human Capital, FDII= Foreign Direct Investment Inflow,

$FIN * TI$ = The moderation of Financialization with Technological Innovation.

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ and β_8 represent parameters to be estimated.

it = "i" denotes the cross-sectional unit and "t" denotes the time point of observation within the panel data analysis, U_{it} = Stochastic error term.

Table 1: Variables, Measurement, Definition, Sign and sources or measurement

Variable	Proxies / Indicators	Definition	Sign	Source
Industrial Output Growth	Manufacturing Value Added	Measures the contribution of the industrial sector to GDP, reflecting economic progress and structural transformation.	+/-	World Bank, UNIDO
Financialization	Broad money supply to GDP, private sector credit to GDP, pension fund assets, mutual fund assets, insurance premiums, number of bank branches and ATMs per 100,000 adults, stock market capitalization to GDP, total value traded to GDP, bank lending-deposit spread, return on assets, cost-to-income ratio	The increasing role of financial markets and institutions in the economy.	+/-	OECD, World Bank, IMF, Central Banks
Technological Innovation	Research and Development (R&D) Expenditure	Measures technological progress and innovation capacity.	+/-	UNESCO, World Bank, National Statistics Agencies
Government Effectiveness	Worldwide Governance Indicators (WGI)	Assesses quality of public services, policy implementation, and regulatory framework.	+/-	World Bank, Governance Matters
GDP Growth (GDPG)	Real GDP Growth Rate	Measures overall economic performance.	+/-	World Bank, IMF

Trade Openness	Trade-to-GDP Ratio, Exports as Capacity to Import	Indicates degree of economic integration into global markets.	+/-	World Bank, UNCTAD
Human Capital	Tertiary Education Enrollment, Human Capital Index (HCI)	Evaluates workforce skill development and educational investment.	+/-	UNESCO, World Bank
Foreign Direct Investment (FDI)	Net FDI Inflows as % of GDP	Measures foreign investment inflows and economic attractiveness.	+/-	UNCTAD, World Bank, IMF

Table 2: Method used for Analysis

Section	Test/Method	Purpose	Decision Rule/Criteria	Corrective Measures (if needed)
Panel Descriptive Statistics	Overall, Between, and Within Statistics	Measure variations across time and units	Compare standard deviations of "between" and "within"	No correction needed, used for descriptive analysis
Pre-Test Analysis	Pearson Correlation Test	Determine strength and direction of relationships	Values between -1 and 1; closer to 0 = weak relation	No correction needed, used for preliminary analysis
Cross-Sectional Dependence Test	Pesaran (2004) CD Test	Detect correlation across cross-sectional units	p-value < 0.05 → reject independence	If dependence exists, use second-generation unit root tests
Panel Unit Root Tests	Levin, Lin & Chu (LLC), Im, Pesaran & Shin (IPS), Maddala & Wu (MW)	Test stationarity of variables	p-value < 0.05 → reject null (stationary series)	If non-stationary, proceed to panel cointegration test
	Pesaran (2003) CIPS Test	Account for cross-sectional dependence	p-value < 0.05 → reject null (stationary series)	If mixed order of integration, proceed with ARDL
Panel Cointegration Test	Kao (1999), Pedroni (2004)	Test long-run relationships among variables	Absolute ADF-statistic > 2 → reject null (cointegration)	If no cointegration, use first-difference variables
Panel ARDL Estimation Methods	Mean Group (MG)	Allow heterogeneous coefficients	Requires large time-series dimension	Use if cross-country heterogeneity is significant

	Pooled Mean Group (PMG)	Assume homogeneous long-run coefficients	Hausman test (p-value > 0.05) → prefer PMG	Use if long-run coefficients are homogeneous
	Dynamic Fixed Effects (DFE)	Control for country-specific effects	Hausman test (p-value < 0.05) → prefer DFE	Use if panel size is small and dynamics matter
Estimator Selection	Hausman Test	Compare efficiency of MG, PMG, and DFE	p-value < 0.05 → MG preferred, p-value > 0.05 → PMG preferred	Choose estimator with best efficiency
Diagnostic Tests	Variance Inflation Factor (VIF)	Detect multicollinearity	VIF > 10 indicates severe multicollinearity	Drop redundant variables or transform data
	Wooldridge Test	Detect autocorrelation	p-value < 0.05 → reject null (autocorrelation exists)	Use cluster robust standard errors
	Modified Wald Test	Detect heteroscedasticity	p-value < 0.05 → reject null (heteroscedasticity exists)	Use cluster robust standard errors
	Galvao et al. (2013) Normality Test	Check residual normality	p-value < 0.05 → reject null (non-normal residuals)	Apply winsorizing, bootstrapping, or transformations

RESULTS AND DISCUSSIONS

4.1 Preliminary data analysis

Table 3. The Principal Component Analysis

Principal components/correlation

Number of obs= 544

Number of comp.= 5

Trace = 5

Rotation: (unrotated = principal)

Rho = 1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.84163	1.72757	0.5683	0.5683
Comp2	1.11406	.452249	0.2228	0.7911
Comp3	.661815	.442692	0.1324	0.9235
Comp4	.219124	.0557591	0.0438	0.9673
Comp5	.163365	.	0.0327	1.0000

Source: Research finding.

The results of the PCA are presented in Table 5. The researcher used PCA to construct Financialization variables using the five Financialization Indicators: Broad money supply as a percentage of GDP. Financial Institution Depth - Private sector credit to GDP, pension fund assets, mutual fund assets, insurance premiums. Financial Institution Access - Number of bank branches and ATMs per 100,000 adults. Financial Institution Efficiency - Bank lending-deposit spread, return on assets (ROA), cost-to-income ratio. Financial Market Depth - Stock market capitalization to GDP, stock market total value traded to GDP. The PCA shows the variation of each component on the total component and reduces a large sum of correlated values into smaller uncorrelated values (components). The first component in Table 5 takes the largest proportion of the total variance, while the second component has a lower proportion of the remaining variance. In line with the study of Zhou et al. (2021), the component with an eigenvalue greater than one is retained while others are dropped. By implication, the first and second components are retained, which accounts for about 56% and 22% respectively of the total variance.

Table 4: Summary Statistics of Panel data of West Africa
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
IND	544	8.829	4.243	1.533	21.587
FIN	544	9.113	.742	-.605	4.304
TI	544	.179	.052	.01	.614
GE	544	-.811	.435	-1.81	.34
TO	544	59.082	17.681	26.099	131.485
GDPG	544	4.053	7.568	-51.031	106.28
HC	544	6.142	4.33	.592	21.79
FDII	544	3.919	15.759	-202.824	167.329

Source: Author's computation (2024). Explanatory Notes: *Obs=Observation, Min=minimum, Max=maximum, Std. Dev=Standard Deviation, IND = Industrial output growth, FIN = Financialization, TI = Technological Innovation, GE =Government Effectiveness, TO = Trade Openness, GDPG = Gross Domestic Product Growth, HC=Human Capital*

Table 2 presents summary statistics for the variables used in the model, including mean, standard deviation, minimum and maximum.

Over the period 1990-2023, the mean value of industrial output growth (IND) for the sixteen (16) West African countries under the study is 8,829 billion constant US dollars with the standard deviation of 4.243 billion Indicates a moderate spread around the mean, showing variability in industrial output growth levels. The minimum score is 1.533 and maximum score is 21.587, showing that industrial output growth deviate much from the mean. On the average Technological Innovation (TI) has a Mean of 0.179 represents the average level of technological innovation std. Dev of 0.052, Low variability indicating similar levels of technological innovation across the countries in West Africa. Min (0.01): Indicates the least innovative economy whereas Max 0.614 reflects the most innovative economy across the data set.

On the average Government Effectiveness (GE) has a Mean of -0.811 a negative average score indicates governance challenges are prevalent in all the West Africa countries also it has a Std. Dev of 0.435 denoting a moderate variability in government effectiveness across all the countries in the region, the Min value of -1.81 reflects the least effective governance among the countries and Max (0.34): Represents the most effective governance. Also Trade Openness (TO) has a Mean

of 59.082 which shows the average trade openness as a percentage of GDP across all the countries in the region under observation likewise has a Std. De of 17.681 Indicates tolerance level of variability, reflecting differences in trade openness among observations. It has a Min of 26.099 Represents economies with limited trade openness in the region under observation and Max of 131.485 Reflects economies with very high trade openness.

The value of mean of Gross Domestic Product Growth (GDPG) is 4.053 Indicates an average annual GDP growth rate of 4.05%., and Std. Dev. of 7.568 indicating a high variability and signifying economic growth rates that differ significantly across observations. Min of -51.031 which reflects periods of severe economic contraction and Max of 106.28 showing an evidence of extreme economic growth it means that some are highly growing in respect to GDP

As for Human Capital (HC) it has a mean of 6.142 represents the average level of human capital development also it has a Std. Dev of 4.33 which shows a significant variability in human capital levels across observations. It has a Min of 0.592 which shows the lowest human capital development and Max of 21.79 Indicating the highest human capital level across the observations. For foreign direct investment inflows (FDII) have a mean of 3.919 with a notably high standard deviation of 15.759, suggesting extreme variations in FDI levels. The minimum value of -202.824 and the maximum of 167.329 reveal substantial fluctuations in capital inflows, with some economies experiencing capital flight while others attract significant foreign investment.

Table 5: Results of Correlation Matrix
Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) IND	1.000							
(2) FIN	-0.107 (0.013)	1.000						
(3) TI	0.193 (0.000)	-0.048 (0.269)	1.000					
(4) GE	0.233 (0.000)	0.526 (0.000)	-0.010 (0.813)	1.000				
(5) TO	-0.050 (0.242)	0.515 (0.000)	-0.014 (0.738)	0.252 (0.000)	1.000			
(6) GDPG	0.024 (0.575)	0.029 (0.499)	0.034 (0.431)	0.078 (0.070)	0.082 (0.057)	1.000		
(7) HC	0.157 (0.000)	0.358 (0.000)	0.207 (0.000)	0.158 (0.000)	0.290 (0.000)	0.034 (0.425)	1.000	
(8) FDII	-0.120 (0.005)	0.009 (0.828)	-0.054 (0.211)	-0.070 (0.104)	0.069 (0.109)	0.166 (0.000)	0.068 (0.114)	1.000

Source: Author's computation, 2024.

The correlation analysis between industrial output growth (IND) and other variables such as financialization (FIN), technological innovation (TI), government effectiveness (GE), trade openness (TO), gross domestic product growth (GDPG), human capital (HC), and foreign direct investment inflow (FDII) provides insights into their interdependencies. IND exhibits a weak negative correlation with FIN (-0.107) at a significance level of $p = 0.013$, indicating an inverse relationship. Similarly, However, IND demonstrates a statistically significant weak positive

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correlation with TI (0.193, $p < 0.01$), GE (0.233, $p < 0.01$), and HC (0.157, $p < 0.01$), implying that technological advancements, effective governance, and human capital development contribute positively to industrial output. In contrast, the correlation between IND and TO is negative (-0.050) but not statistically significant ($p = 0.242$), indicating minimal influence. The relationship between IND and GDPG is weakly positive at 0.024, though not statistically significant ($p = 0.575$).

Financialization (FIN) presents stronger correlations with several variables, particularly GE (0.526, $p < 0.01$), TO (0.515, $p < 0.01$), and HC (0.358, $p < 0.01$), reflecting its impact on governance efficiency, trade openness, and human capital development. Conversely, FIN has a weak and insignificant negative correlation with TI (-0.048, $p = 0.269$), implying that financialization may not necessarily foster technological innovation. FIN's correlation with GDPG is also weak (0.029, $p = 0.499$), indicating that its influence on economic growth may not be direct or immediate.

Technological innovation (TI) generally exhibits weaker correlations with most variables, except for HC (0.207, $p < 0.01$), which suggests that human capital development plays a crucial role in fostering technological advancements. However, its correlations with ER (-0.121, $p = 0.005$), GE (-0.010, $p = 0.813$), TO (-0.014, $p = 0.738$), and GDPG (0.034, $p = 0.431$) are weak and not statistically significant, highlighting the complex and possibly indirect role of technological innovation in economic. However, its relationships with TO (-0.039, $p = 0.363$) and GDPG (0.032, $p = 0.456$) are weak and insignificant.

Government effectiveness (GE) is positively and significantly correlated with TO (0.252, $p < 0.01$) and HC (0.158, $p < 0.01$), suggesting that good governance facilitates trade openness and human capital development. However, GE's correlation with GDPG (0.078, $p = 0.070$) is weak and only approaches borderline significance. Trade openness (TO) has a borderline significant positive correlation with GDPG (0.082, $p = 0.057$) and a statistically significant moderate correlation with HC (0.290, $p < 0.01$), indicating that trade liberalization may have potential benefits for economic growth and human capital accumulation.

Foreign direct investment inflow (FDII) demonstrates a weak but statistically significant positive correlation with GDPG (0.166, $p < 0.01$), suggesting that FDI contributes to economic growth. FDII also has weak positive correlations with ER (0.096, $p = 0.026$) and HC (0.068, $p = 0.114$), though the latter is not statistically significant. However, FDII has a weak negative correlation with IND (-0.120, $p = 0.005$) and TI (-0.054, $p = 0.211$), implying that foreign investments might not necessarily drive industrial output or technological advancements in the immediate term.

Table 6: Long-run Estimates of the Models on the moderation of Financialization with Technological Innovation on industrial output growth

Variables	Coef	Z-stats	P-value
FIN	-.9261128	-1.34	0.182
TI	7.065065	1.78	0.074
FINTI	.0124769	0.00	0.997

TO	-.0126369	-2.72	0.113
GE	.7353044	0.52	0.603
GDPG	-.3651715	-5.66	0.000
HC	.1029848	2.44	0.015
FDII	-.2775427	-4.76	0.000
ECT(-1)	-.736	-12.69	0.000
VIF	1.27		
Auto-Correlation	7.52	-	0.0641
Heteroscedasticity	2.80	-	0.0943
Normality Test	0.72	-	0.6968
Cross sectional Dependency.	-0.11	-	0.914
Obs	544		
Panel estimation method	PMG		

Explanatory notes: IND = Industrial output growth, FIN = Financialization, TI = Technological Innovation, GE =Government Effectiveness, TO = Trade Openness, GDPG = Gross Domestic Product Growth, HC=Human Capital, FDII=Foreign Direct Investment Inflow, ECT(-1)=Error correction term, VIF=Variance Inflation Factor, Auto-correlation, Heteroscedasticity, Normality Test, Cross sectional Dependency and Obs = Observation

Author s' computation (2024).

Discussions of findings

Unlocking Industrial Growth in West Africa: How Financialization and Technological Innovation Shape the Future examined using the Pooled Mean Group (PMG) estimation approach. The long-run results indicate that technological innovation (TI) has a positive coefficient of 7.065065 and is statistically significant at the 10% level ($p = 0.074$), though not at the conventional 5% threshold. This suggests that technological innovation contributes positively to industrial output growth in the long run. Specifically, a unit increase in technological innovation would enhance industrial output by approximately 7.07%, implying that sustained investments in technological capabilities are crucial for boosting industrial productivity over time.

However, the moderation between financialization and technological innovation (FINTI) shows a positive but statistically insignificant coefficient of 0.0124769 ($p = 0.997$). This result implies that although there is a nominal positive relationship between financial deepening and technological advancement, the moderation is too weak to yield any meaningful impact on industrial output growth. Consequently, the study accepts the null hypothesis that the moderation of financialization with technological innovation does not have a significant effect on industrial output growth in West African countries. The insignificance of the moderation term suggests that the benefits of financial sector development are not effectively translating into technological spillovers that can drive industrial expansion.

Findings further reveal that financialization (FIN) itself has a negative and statistically insignificant impact on industrial output growth (coef = -0.9261128, $p = 0.182$). This highlights

an important implication: financial deepening alone, if not directed towards productive sectors, may not foster industrial output growth. The robustness of the model is confirmed by diagnostic tests: multicollinearity is not present ($VIF = 1.27$), while autocorrelation and heteroscedasticity tests yield acceptable p-values (0.0641 and 0.0943, respectively). The residuals are normally distributed ($p = 0.6968$), and there is no evidence of cross-sectional dependency ($p = 0.914$).

The long-run analysis reveals that technological innovation significantly contributes to industrial output growth in West Africa, suggesting that sustained investments in technological capabilities can enhance productivity over time. However, the interaction between financialization and technological innovation is statistically insignificant, indicating that financial deepening does not meaningfully enhance the impact of innovation on industrial growth. This weak moderation highlights a disconnect where financial sector development, though capable of mobilizing capital, is not effectively supporting innovation-driven industrialization. Financialization alone also shows a negative and insignificant effect, pointing to the risk that without strategic policy direction, financial deepening may encourage speculative rather than productive investments. Likewise, government effectiveness and trade openness lack statistically meaningful effects, reflecting institutional inefficiencies and the absence of coherent industrial strategies. Notably, GDP growth and foreign direct investment inflows typically seen as growth drivers demonstrate significant negative impacts, suggesting structural misalignments and poor sectoral integration. In contrast, human capital proves to be a significant positive force, reinforcing the importance of a skilled workforce. The significant error correction term confirms a strong speed of adjustment to equilibrium, emphasizing model reliability and the need for integrated policies that align finance, innovation, and industrial development in West Africa.

CONCLUSION AND RECOMMENDATIONS

Since the effect of financialization (FIN) is negative but statistically insignificant, the study concludes that financialization negatively influences industrial output growth in the West African region, although its impact is not strong enough to be definitive. The moderation between financialization and technological innovation (FINTI) shows a positive but statistically insignificant coefficient, leading to the conclusion that the moderation does not significantly strengthen or weaken industrial output growth.

Based on the study's findings and conclusions, it is recommended that West African governments reform financial policies to curb excessive financialization that does not support industrial development. This can be achieved through stricter regulations on speculative financial activities and by incentivizing financial institutions to direct credit toward productive industrial sectors via targeted lending quotas and credit facilities. Policies should also encourage long-term productive investments by providing tax incentives, subsidies, and grants to manufacturers adopting innovative and modern technologies. Given the significant role of human capital in industrial growth, expanding workforce training programs to align labor skills with technological advancements is essential. Furthermore, regional cooperation among ECOWAS member states is necessary to develop a unified industrial policy framework that harmonizes standards, pools resources, and enhances competitiveness. Finally, aligning financial sector reforms with innovation strategies is crucial to ensure financial resources effectively support sectors with high technological potential, thereby bridging the current gap between finance and industrial

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innovation. Implementing these measures will enable financial deepening to positively contribute to sustainable industrial growth and economic development in West Africa.

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