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FINANCIAL DEVELOPMENT AND SUSTAINABLE DEVELOPMENT: ROLE OF TECHNOLOGY INNOVATION IN SAHARAN AFRICAN ECONOMIES

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ABSTRACT

Purpose: This study investigates the relationship between financial development and sustainable development, emphasizing the moderating role of technological innovation in sub-Saharan region.

Design/Methodology: The analysis is based on a sample of 33 sub-Saharan countries over the period 2003–2022, utilizing composite indicators for financial development and technological innovation constructed through a novel approach. Principal component analysis was employed to extract information from these indicators. To ensure robust and consistent regression coefficients, the study applied Driscoll–Kraay standard errors (D-K) and generalized least squares (GLS), addressing issues of temporal dependency and heteroscedasticity.

Findings: The results revealed that financial development and technological innovation individually have positive impact on sustainable development. But combined have negative impact on sustainable development in sub-Saharan region.

Originality: This research provides new insights into the dynamic relationship between financial development, technological innovation, and sustainable development in sub-Saharan countries. By proposing strategies to strengthen these linkages, it offers valuable guidance for stakeholders and policymakers working toward sustainability goals

Keywords: *Financial development, sustainable development, technological innovation, sub-Saharan countries.*

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INTRODUCTION

The World is facing critical challenges like poverty, climate change, economic inequality and environmental degradation. To solve these issues, it requires a lot of money and financial limitations are making it more difficult for countries to invest in these solutions. Strong financial systems lead to sustainable development. Therefore, the pursuit of both financial and sustainable development have become a vital objective for nations worldwide, especially for sub-Saharan African countries, where economic and environmental challenges are prominent. In addition to the challenges posed by sustainability, the COVID-19 pandemic has exacerbated economic conditions globally by creating further financial limitations. While the substantial lack of long-term financial strategies remains a major obstacle, lockdowns and isolation measures have raised uncertainty about production and economic outputs (Giannetti et al., 2023). Therefore, it is essential to assess how financial development (FD) and many socioeconomic elements contribute to sustainable economic development (SED).

Financial development contributes in better resource allocation, economic growth and stability, by providing loans and investing in sustainable projects (Puatwoe & Piabuo, 2017). Strong financial systems lead to sustainable economies. Sustainable development plays a significant role in balancing social inclusion, economic progress and environmental stability. In order to mobilize and allocate resources effectively, financial development is essential (Nor, 2015). By optimizing resource distribution, encouraging equitable growth and enabling technical innovation, financial development makes a considerable contribution to sustainable development (Ahmad et al., 2024). Robust financial frameworks provide resources to profitable ventures, growth of green financing supports low-carbon economies and makes environmental activities easier (Omar & Inaba, 2020).

The primary causes of this damage to the environment are waste from industrial processes, vehicle emissions, and an over reliance on fossil fuels for energy. Global warming is still mostly caused by greenhouse gas emissions, especially CO2 (Xu et al., 2022). Technological innovation has the ability to decrease the use of natural resources and improves efficiency. With smart technology and solutions, technological innovation addresses these problems. A driver for economic transformation, technological innovation increases productivity, creates new industries, and develops more environmentally friendly, efficient processes (Januar Mahardhani, 2023). Fintech and other technological advancements in the financial services sector have the potential to greatly influence sustainable development and expand financial inclusion (Falaiye et al., 2024). While financial development may provide the money and resources needed for sustainable development, technological innovation has the ability to boost productivity, reduce waste, and open up new opportunities for sustainable growth. Omri (2020) states that Innovation in technology is a major force behind sustainable development, facilitating efficiency

improvements in resource utilization and energy production. It enables the development of cleaner production methods and pollution control technologies, aiding environmental conservation efforts. According to Ortega-Navas (2017), innovative technologies promote social inclusion and equity by improving access to basic services like healthcare and education. Innovation boosts the economy by generating jobs and creating new markets for products and services that are environmentally friendly (Ntsondé & Aggeri, 2021). By addressing environmental challenges and eventually boosting sustainable economic growth, innovation in technology is essential to achieving sustainable development (Xiao & Su, 2022).

Endogenous Growth Theory links technical innovation to sustainable development and offers insightful information, taking into account the important role of technological innovation in promoting the long-term economic growth. This theory holds that research and development (R&D) in sustainable practices and green technology enhances environmental sustainability. Innovation in technology has the potential to be very important in promoting sustainable development through the allocation of resources towards human capital, new technologies through research and development, and identification of positive consequences (Bircan & Gençler, 2015).

This study aims to investigate the complex relationship among financial development (FD) and sustainable development (SD), especially with the moderating role of technological innovation. Previous studies have looked at how financial development affects sustainable development in various places, but the sub-Saharan region has produced very little literature. Also, the role of technological innovation had not been discussed in past studies. Therefore, this research aims to add empirical evidence to the conversation on sustainable development in academia and policy, particularly in sub-Saharan countries. It emphasizes how technical innovation and financial development interact, and what are the outcomes after using technology in financial activities. It is anticipated that the results would provide insightful information to scholars, practitioners, and policymakers. And will assist in the development of inclusive and environmentally sustainable growth policies.

This study involves using a larger dataset and a more thorough model than earlier studies, which may offer novel views on the connection between these traits and economic expansion also influence future research and policy decisions. To address problems like endogeneity, cross sectional dependence, heteroscedasticity and data reliance, we employ a variety of statistical techniques. To guarantee reliable findings, these techniques include the Generalized Least Squares (GLS), Driscoll–Kraay standard errors, and regression techniques. This gives us a thorough grasp of how financial development, technical innovation, and sustainable growth are related

LITERATURE REVIEW

Financial Development and Sustainable Economic Development

The relationship between technical innovation, financial progress and sustainable economic development is explained best in the light of by Resource-Based View (RBV). According to the theory, businesses and economies can gain a sustained competitive edge through efficient management of rare, unique, and non-replaceable resources. Financial resources are vital components in achieving sustainable economic growth (Barney, 1991).

With the help of this theory, synergies between financial resources and technological innovation can be generated in areas like sub-Saharan countries. By investigating how technology helps in sustainable development and examining the outcomes, this study expands RBV and increases the value of financial resources. There has been a lot of discussion on the connection between sustainable development and financial development. Theoretically, this present literature study examines many viewpoints and actual data to clarify the ways in which financial development fosters sustainable development.

Hunjra et al. (2022) investigated how financial development (FD) affects low- and middle-income nations' sustainable economic development (SED). Using panel data that is uneven, study examines 50 low- and middle-income nations (FDI) between 1991 and 2020. Study discovers that trade openness (TO), foreign direct investment (FDI), international tourism IT), financial development (FD) and the advancement of natural resources (ANS), positively impact sustainable economic development (SED). Moreover, richness of natural resources provides a favorable moderating effect for financial development (FD).

Abbas et al. (2022) by utilizing information from 44 nations, including 42 middle-income countries, investigated the relationship between financial development (FD), income inequality, and economic growth. The results demonstrate that, over time, financial development (FD) contributes to the sustainable development of both sets of countries' economies (SD). However, the role of financial development (FD) in driving economic growth is more pronounced in upper middle-class countries.

Amjad et al. (2021) carried out research to investigate the potential applications of financial development (FD) between 1980 and 2020 in mitigating environmental degradation and advancing sustainable economic growth. Based on the results, financial development (FD) increases economic expansion and lowers pollution levels in the environment.

Matei (2020) using data from 11 Emerging European Countries (EEU), investigated the connection between financial development (FD) and sustainable economic growth from 1995 to 2016. According to the findings, financial development (FD) has a big influence on economic expansion.

Khan and Arshad (2020) between 1980 and 2017, looked into the nonlinear relationship between Pakistan's financial development and economic growth. According to the study's findings, when economic growth above the 0.151 threshold, financial development (FD) has a favorable impact on it. The findings additionally indicated that there is a U-shaped association between the financial development and economic growth in Pakistan and that the two variables have distinct effects on

growth. Quantile regression results provide more evidence of Pakistan's non-linear relationship between financial stability and economic growth.

Hypothesis 1: *Financial development has a positive impact on sustainable economic development.*

Technological Innovation and Sustainable Economic Development

Innovation in technology is essential for stimulating economic growth and encouraging eco-friendly behavior and improving the living standards and wellbeing. It raises global competitiveness, increases productivity and it develops new markets and employment opportunities.

Wang et al. (2023) looks into how technological advancement affects China's sustainable development from 1990 to 2022. To examine how cutting-edge technology and resource-rich regions can work together to promote long-term, sustainable economic growth. To determine the effect of contributing parameters that affect GDPG, the method employed was support vector regression with radial basis function (SVR-RBF). The findings indicated that technology has contributed significantly to the goal of sustainability. Through strategic use of technology and investment in new ideas, governments and corporations can lessen their environmental impact while advancing sustainable economic growth.

Ahmad et al. (2023) examined the impact of technological innovation (TI) on sustainable development (SD) using data spanning 40 years, and determined the avenues through which it facilitates the latter. The empirical results demonstrate that, by promoting economic growth without adversely harming the environment, technological innovation plays a critical role in fostering sustainable development. The findings also show that economic growth (EG) moreover starts the sustainability process by lowering the CO2 emissions so that financial development greatly contributes to a country's sustainable development through the decrease of the carbon dioxide (CO2) emissions.

Shabir et al. (2023) discovered that between 2004 and 2018, the long-term effects of trade openness, quality of governance, energy consumption, and economic growth on CO2 emissions in APEC member countries. Results of the study showed that, energy consumption, trade openness, and economic expansion all have a beneficial effect on CO2 emissions. In order to meet sustainable development goals, APEC nations should increase their investments in technical innovation connected to the environment and enhance the standard of the institutional environment.

Khan et al. (2021) examined, the short- and long-term impacts of finance, foreign direct investment, and advancements in technology, on the use of non-renewable energy, and CO2 emissions, in 69 countries participating in the "Belt and Road Initiative (BRI)" between 2000 and 2014. The study demonstrated that foreign direct investment (FDI), technological advancement, and economic expansion all had a detrimental effect on renewable energy. On the other hand, it has been demonstrated that financial advancements significantly boost the renewable energy sector in the

studied area. The BRI countries appear to be influenced in terms of CO2 emissions and energy consumption by favorable perceptions of FDI, economic expansion, and technological innovation.

Muhammad Fakhrul Yusuf (2018) conducted a study to analyze companies who have integrated environmental technology innovation (ET innovation) into their operations to tackle Malaysia's competitiveness within the framework of worldwide environmental transformation. This study shows the connections between ET innovation and sustainable economic development and discusses how it may be applied at the corporate level. The firms selected for this research focused on the whole spectrum of ET innovation while putting their environmental technology into practice. Businesses marketed their green technologies and eco products to foreign markets as well. But we also found that in order to meet market demands, they must become more focused on the market while developing new technologies and goods. For businesses to be successful in ET innovation, they must make large investments in R&D and resource management.

Hypothesis 2: *Technological innovation moderates the relationship between Financial Development and Sustainable Economic Development.*

Theoretical Underpinning and Framework

According to Resource-Based View (RBV) theory, strong financial systems promote long term economic growth, but when it is combined with technological innovation, it enhances financial stability and efficiency. This study expands on RBV theory by presenting technology as a moderating element. It suggests that the combination of technology and financial resources enhances the benefits of financial development on long-term results, especially in areas like sub-Saharan Africa.

To sum up, prior studies confirmed the significant impacts of the financial development (FD) and technological innovations on sustainable economic growth (SEG). But there is a lesser understanding on this topic available. This study aims to bridge that gap by examining the combined effects of financial development and technical innovation on sustainable economic growth in emerging countries.

METHODS

Data and variables

The aim of this research is to develop a composite financial development index for global evidence by taking into account a wide range of factors based on existing research. To ascertain which indicators, have the greatest influence on the index for international evidence overall as well as for each nation included in the study sample, principal component analysis, or PCA, is employed. Our countries sample consists of 33 sub-Saharan countries from 2003-2022. The data is freely accessible on World Development Indicators (WDI). List of the countries is presented in Table 1 below. This study examines the connections between 33 different nations' financial development (FD), technological innovation (TI) and sustainable development (SD).

One of the components used to create composite financial indicators is financial development. The World Bank's Global Financial Development Database classification and the availability of data in our sample over a considerable period of time were the main factors considered when choosing the variables for the single composite financial indicator. Table 3 displays the variable's statistical descriptions.

The dependent variable is Sustainable Economic Development (SED) which is measured through Adjusted Net Savings (ANS), variable of interest is Financial Development (FD). We have taken Technological Innovation as a moderator (Techindex). Control variables include, GDP, International Tourism (IT), Trade Openness (TR), FDI, Age Dependency Ratio (ADR), Total Natural Resources (TNR).

Table 3 illustrates the great variability of some parameters and the low variability of others. PCA favors big variances because its goal is to maximize variance. It is necessary to convert the chosen indicators into normalized variables. Prior to aggregating the indication into a composite index, this adjustment is required. The normalization strategy used in this study includes the z-score. Indicators are scaled according to their departure from the mean using the z-transformation, which standardizes them. Two crucial considerations to keep in mind when ensuring reliable results are (1) sample size and (2) need for recalibration with newly gathered data points.

The following is the construction of standardization using z-score normalization.

$$zee = \frac{Xi - \bar{X}}{\sigma}$$

Where, X = group average

σ = standard deviation

$SED=\beta_o+\beta_1 FDindex+\beta_2 GDP+\beta_3 FDI+\beta_4 ADR+\beta_5 IT+\beta_6 TR+\beta_7 TNR+\beta_8 Techindex+\beta_9 (FDindex*Techindex)+\varepsilon_0$

Table 1: List of Countries

	33 sub-Saharan countries
	Cape Verde, Ethiopia, Madagascar, Botswana, Zambia, Burkina Faso, Sierra Leone, Mauritius, Mauritania, Guinea-Bissau, Namibia, Equatorial Guinea, Gabon, Cameroon, São Tomé and Príncipe, Benin, Nigeria, Mali, Niger, Ghana, Congo. Republic, Guinea, Togo, Uganda, Burundi, Zimbabwe, Central African Republic, Senegal, Tanzania, Chad, Côte d'Ivoire, Malawi, Congo, Dem. Republic.

Note: Data source: World Bank's Global Financial Development Database 2024

Table 2: Variables Description

Variable name	Symbol	Description of Variable	Source
Financial development (FD)	F1D	i) Broad money (% of GDP)	WDI
	F2D	ii) domestic credit to private sector (% of GDP)	WDI
Sustainable Economic Development (SED)	ANS	Adjusted net savings, excluding particular emission damage (% GNI)	WDI
Economic Growth	GDP	GDP per capita (constant 2010 US$)	WDI
International Tourism	IT	International tourism, receipts (% of total exports)	WDI
Foreign Direct Investment	FDI	Foreign direct investment, net inflows (BoP, current US$)	WDI
Aging population Dependency	ADR	The Age dependency ratio (% of working-age population)	WDI
Natural resource abundance	TNR	Total natural resources rents (% of GDP)	WDI
Internet	IU	Individuals using the Internet (% of population)	WDI
Patent	PR	Patent applications, residents	WDI
Technology exports	TE	High-technology exports (% of manufactured exports)	WDI
Mobile subscriptions	MS	Mobile cellular subscriptions (per 100 people)	WDI

Note: Data Source: WDI: World Development Indicators; Note that the data for Financial Inclusion (financial access indicators) from WDI only starts from 2003 to 2022.

DATA ANALYSIS

Table 3: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
SED	660	3.169	12.549	-52.263	35.955
F1D	660	29.809	20.887	.035	159.949

F2D	660	18.253	16.705	.003	104.894
GDP	660	1958.47	2450.743	255.1	14222.549
IT	660	13.789	12.874	.001	73.194
TT	660	67.758	23.887	22.24	156.862
FDI	660	66.160	10.910	-19.830	88.410
ADR	660	84.602	13.874	40.421	110.723
TNR	660	12.382	10.267	.002	56.289
MS	660	58.105	40.785	.07	174.025
IU	660	12.997	15.61	.106	73.5
TE	660	5.443	7.096	0	95.618
PR	660	20.52	27.515	0	439

The mean value of dependent variable SED is 3.169 and its standard deviation is 12.549. F1D, first proxy of independent variable has mean of 29.809 and its standard deviation is 20.887. Second proxy F2D has mean value 18.253 and standard deviation of 16.705.

Table 4: Matrix of Correlations

	SED	FD	TI	GDP	IT	TR	FDI	ADR	TNR
SED	1.00								
FD	0.25***	1.00							
TI	0.24***	0.51***	1.00						
GDP	0.18***	0.44***	0.41***	1.00					
IT	0.26***	0.48***	0.04	0.10**	1.00				
TR	0.07	0.35***	0.26***	0.60***	0.06	1.00			
FDI	0.15***	-0.11**	0.13***	0.04	-0.14***	0.04	1.00		
ADR	-0.18***	-0.72***	-0.59***	-0.70***	-0.29***	-0.57***	-0.01	1.00	
TNR	-0.31***	-0.27***	-0.22***	0.14***	-0.09*	0.33***	0.09*	0.10*	1.00

Sustainable Economic Development (SED), Financial Development (FD), Technological Innovation (TI), Economic Growth (GDP), International Tourism (IT), Foreign Direct Investment (FDI), Aging Population Dependency (ADR), Natural Resource Abundance (TNR).

The Correlation Matrix explanations for the Financial Development and Technological Innovation index components are displayed in Table 4. There is a positive connection of 0.25 between sustainable development and the financial development index. It suggests that the relationship between financial development and sustainable development is only slightly positive. A moderately positive adjustment is shown by the correlation coefficient of 0.24 between the Technology Innovation Index and the sustainable development (SD). It implies that, in contrast to financial development, there is a larger positive correlation between technological innovation and sustainable development. Furthermore, there is a significant

association (r = 0.25, p < 0.001) between financial development and sustainable

Table 5: Result of Bartlett of sphericity and Kaiser-Mayer Olkin Measure of Sampling Adequacy

	Bartlett test of sphericity			Kaiser-Mayer Olkin Measure of Sampling Adequacy
	Chi-square	Degrees of freedom	p-value	
Financial Development				
Z-score normalization	1071.845	1	0.0000	0.5
Technological Innovation				
Z-score normalization	520.443	6	0.0000	0.506

Source: Authors' calculations. Note Bartlett test of sphericity: H0: variables are not intercorrelated. ***indicates statistical significance at 1% level.

development, indicating that higher savings rates may be a result of increased financial development.

Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) test, were conducted to confirm that our data is appropriate for Principal Component Analysis (PCA) before beginning any analysis. By determining if the correlation matrix is the identity matrix, Bartlett's test determines whether the variables in our data are adequately connected. A significant result ($p < 0.05$) suggests that there is sufficient correlation between the variables for PCA. The KMO test indicates how much variance in the data may be shared by the variables, which helps us determine how suitable our sample is for factor analysis. If the KMO value is more than 0.5, PCA may be acceptable.

According to the findings, all of the p-values for Bartlett's test were less than 0.01; this indicates that the variables are connected and supports the suitability of PCA. A sufficient sample size for factor analysis was indicated by the majority of the KMO test values being more than 0.5. We carried out PCA in two steps after the appropriateness was established. Starting with the first factor, which explains the greatest percentage of the total variation, we first determined which factors account for the most variance in our data. With no relationship to previously found factors, each succeeding factor explains the greatest amount of residual variance. Until the number of factors equals the number of initial variables, this process is repeated. The important components, or those that explain a sizable percentage of the variation and usually have eigenvalues larger than one, were extracted in the second stage. These procedures assist us in decomposing the data into its most important components.

The technological innovation (0.506) and financial development (0.5) KMO values show moderate to acceptable sample adequacy, suggesting that the variables within each construct are suitably related for the analysis of components. The results validate the constructs in the research study by showing that the variables of technological innovation and financial development are related and worthy of more research. The outcome of both tests thus validates the application of PCA in this investigation.

Table 6 explains total variance for the financial development index (FDI) and the technological innovation index. The first component, which accounts for 94.84 % of the variance, emerges as the most significant one when examining the financial development index. The other components explain progressively less of the variation; the second component explains 5.16% of the variance. Comparably, in the technological innovation index, the first component explains 44.30% of the variation, with the remaining components accounting for 24.96%, 24.11% and 6.64% of the overall variation. These findings emphasize how crucial the components that have been found are to properly characterizing the underlying entities. The total explanatory power of the components is represented by the cumulative variance percentages.

Using Driscoll-Kraay standard errors, Table 7 presents estimate findings with a focus on the Financial Development (FDindex), Technology index (Techindex), and (tech_in) as moderating variables. In the combined OLS regression using GLS regression, the regression coefficients for the Techindex and FDindex are statistically significant. The Techindex's regression coefficient is 1.331, indicating that a change of one unit in Techindex corresponds to a change of 1.331 units in sustainable development, while the FDindex's regression coefficient is 1.170, indicating a change of one unit in FDindex corresponds to a change of 1.170 units in sustainable development. The statistical significance level (***) for the coefficient for tech_in, in the Pooled OLS and GLS regression models is -0.693, indicating a robust correlation. This negative coefficient means that although the dependent variable falls by 0.693 units and other variables stay constant, the relation between financial development and technological innovation increases by one unit. With an R-squared of 0.275, the independent variables (IVs) of the model account for roughly 27.5% of the variability in the dependent variable (DV).

Table 6: Total Variance explained

	Component	Eigenvalues	% of Variance	Cumulative variance %
Financial Development Index				
Normalized variables	1	1.89672	0.9484	0.9484
using standardized Z-score	2	0.10328	0.0516	1
Technological Innovation index				
Normalized variables	1	1.77181	0.4430	0.4430
using standardized Z-score	2	0.998338	0.2496	0.6925
	3	0.964448	0.2411	0.9336
	4	0.265407	0.0664	1.0000

Table 7: Estimation result: Driscoll-Kraay standard errors

	GLS	DK
FD	1.170*	1.170***
	(0.615)	(0.393)
Techindex	1.331***	1.331**
	(0.422)	(0.588)
TI	-0.693***	-0.693***
	(0.201)	(0.119)
GDP	0.00149***	0.00149***
	(0.000267)	(0.000403)
IT	0.266***	0.266***
	(0.0395)	(0.0549)
TT	0.0627**	0.0627***
	(0.0253)	(0.0205)

FDI	2.15e-09***	2.15e-09***
	(3.96e-10)	(3.94e-10)
ADR	0.276***	0.276***
	(0.0603)	(0.0553)
TNR	-0.453***	-0.453***
	(0.0494)	(0.0977)
Constant	-26.20***	-26.20***
	(5.995)	(6.321)
Observations	660	660
R-squared		0.275
Wald Test	250.44	115.08
P value	0.0000	0.0000
Number of id	33	33
Number of groups	33	33

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

Financial Development (FD), Technological Index (Techindex) Technological Innovation (TI), Economic Growth (GDP), International Tourism (IT), Foreign Direct Investment (FDI), Aging Population Dependency (ADR), Natural Resource Abundance (TNR).

CONCLUSION

In a sample of 33 Sub-Saharan nations, this study intends to evaluate the relationship between financial development (FD), technological innovation, and economic sustainability (ES) from 2003 to 2022. Through comprehensive data analysis and regression modeling, we have discovered significant findings that contribute to our understanding of the region's economic dynamics. Our results indicate that both financial development (FD), as calculated by the Financial Development Index (FDindex), and technological innovation, represented by the Technological Innovation Index (Techindex), play crucial roles in fostering sustainable development.

Based on our empirical data, it is conceivable to achieve a balance between financial progress and stability because of their mutually reinforcing relationship. While technical innovation and financial development individually support sustainable development, their combined effect can be harmful if improperly handled, according to the negative interaction term. In order to guarantee that the pursuit of financial and technological progress does not compromise sustainability goals, effective policy design must take these relationships into account.

Conversely, our results imply that policies aimed at promoting financial development may inadvertently lead to a decline in financial efficiency. Table 7 shows the results

of a generalized least squares (GLS) estimation. Financial development the degree to which involvement in the financial markets increases the social costs associated with specific institutional flaws. As a result, moral and social standards will probably rise. Moreover, substantial transaction and information costs may result from low-income clients' increased involvement in the financial system and expanding financial inclusion.

The resultng negative moderating influence of technological innovation (TI) forming the link between financial development (FD) and sustainable development (SD) should be further investigated in future studies to better understand the underlying mechanisms. Examining how particular facets of technological innovation and financial growth may have varying effects on sustainable development is crucial in order to perhaps uncover traits or environments that either exacerbate or lessen this influence.

Such focused findings have the potential to help firms and policymakers create more successful policies. Larger, more useful policy frameworks might also be developed with the aid of longitudinal research that looks at the long-term effects of different financial and technology initiatives on sustainable development outcomes. Future sustainable development projects may benefit from an examination of the ways in which governance and regulatory frameworks affect the relationship between the finance and technological sectors.

However, there are certain restrictions in this study. The research is limited by its dependence on cross-sectional data, which might not adequately represent the dynamic interplay among technical innovation, financial development, and sustainable development as they change over time. A more thorough understanding of how these interactions evolve and interact over time may be possible with longitudinal data. Furthermore, the granularity of the results may be limited by the use of secondary data and a generic research technique, which may cause particular sectoral or geographical patterns to be missed. It is also difficult to establish causation with certainty because the results reached depend on the quality and availability of the data, which may miss certain subtle or unnoticed elements. This study does have some limitations, though. The study's reliance on cross-sectional data, which may not accurately capture the dynamic interactions between financial development, sustainable development, and technical innovation as they evolve over time, is one of its limitations. Longitudinal data may provide a more complete picture of how these relationships change and interact over time. Additionally, the use of secondary data and a broad research methodology may limit the granularity of the results by missing specific sectoral or geographic patterns. Also, it is challenging to definitively show causation because the conclusions drawn rely on the availability and quality of the data, which may overlook few minor factors.

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