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The Impact of Cybersecurity, Digital Spending and Innovation on Economic Growth in 2024

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Abstract

The present study focuses on how cybersecurity, digital spending and innovation are bound to affect economic development of developing nations in Asia and Africa in 2024. The study considers the effects of key dimensions of digital transformation individually and in combination on the GDP growth using a cross-sectional dataset of 200 observations of 58 emerging economies using both simple and multiple regression analyses. The results show that innovation has the most significant positive and statistically significant impact on the economic growth, and cybersecurity has a significant positive impact, as well. Digital spending, on the contrary, does not have a statistically significant independent effect. The integrated regression model describes the variation in economic growth of 60.8 percent, which indicates the structural interdependence of the elements of digital transformation. These findings imply that the innovation capacity is a major driver of economic growth in emerging markets, which is subject to the presence of strong cybersecurity infrastructure as well as digital expenditure is not quite enough without strategic alignment. The paper also adds to the literature on the digital economy by offering a combined analytical framework, as well as policy implication of strategic investment in innovation, strengthening of cybersecurity, and coordinated policies of digital transformation, to attain sustainable economic growth.

Keywords: Cybersecurity, Digital Spending, Economic Growth, Emerging Economies, Innovation.

Introduction

Global economics has changed significantly during the fourth industrial revolution as traditional measures of economic growth are no longer sufficient (1). One major change worldwide is the transition of countries to digital infrastructure. This is having an enormous impact on how production, trade and economic interactions occur. Consequently, the importance of cybersecurity, digital technologies and innovative investment have increased as key components of continued sustainable economic performance and long-term development (2). It is still debated, however, what the overall impact of digital transformation will have on economic growth – especially in developing countries where there are clear differences in the structural/institutional conditions as compared to advanced economies (3, 4).

Digital transformation has become a major force behind structural economic change and impacts productivity, competitiveness and economic resilience. Endogenous Growth theory, for example, identifies that technological innovation, research activity and accumulating knowledge play the major roles in continued long-term economic growth (5, 6). An additional key aspect of digital transformation is the amount of money spent on digital initiatives. Digital spending refers to investments in digital infrastructure, services, technological equipment, and information systems. The investment in these areas will offer greater access to broadband, increase productivity, and facilitate innovation throughout the economy. Additionally, innovation has been identified as a significant driver and enabler of long-term, sustainable economic growth.

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Innovative economies are more productive, competitive, and economically viable (7).

Research on digital transformation is growing; however, most studies focus on individual elements, such as digital infrastructures or ICT investments, as opposed to looking at multiple elements working together. To fill this gap in research, the current research investigates the individual and combined effects of cybersecurity, digital spending, and innovation on economic growth in emerging economies. The analysis uses a panel of 58 developing countries from Asia and Africa, with a focus on 2024. The goal of integrating all three dimensions into a single framework is to provide additional evidence regarding the contribution of digital transformation to economic development in the developing world. Based on the theoretical and empirical discussions presented above, the following hypotheses are proposed:

H1: Cybersecurity has a statistically significant positive effect on economic growth. H2: Digital spending has a statistically significant effect on economic growth. H3: Innovation has a statistically significant positive effect on economic growth. H4: Cybersecurity, digital spending, and innovation jointly have a statistically significant effect on economic growth.

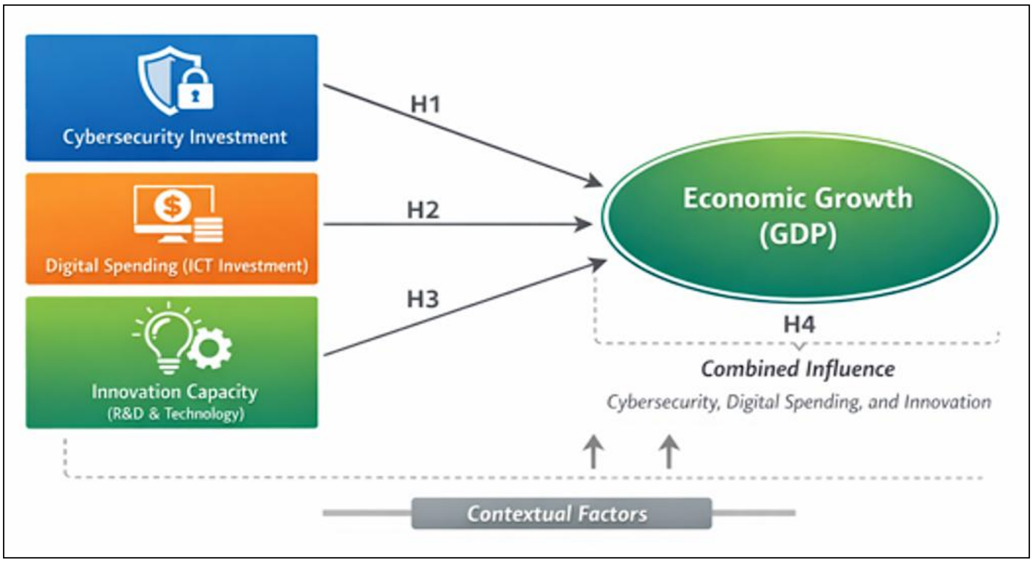

Figure 1: Conceptual Framework of the Impact of Cybersecurity, Digital Spending, and Innovation on Economic Growth

Figure 1 shows the conceptual framework of the study, illustrating the impact of cybersecurity investment, digital spending (ICT investment), and innovation capacity on economic growth measured by GDP. Each variable is assumed to have a direct effect on economic growth, as indicated by hypotheses H1, H2, and H3. The model also highlights a combined influence of these three factors on economic growth, represented by hypothesis H4.

Research Objectives

The main goal of this research is to empirically investigate the linkage between the components of digital transformation and the economic development in the developing economies in Asia and Africa. In particular, the research questions are:

(a) Test the individual impact of cybersecurity investment on economic growth.

(b) Determine the independent effects that digital spending (ICT expenditure) has on GDP growth.

(c) Survey the role of the innovation capacity in performance of economy in terms of R&D expenditure and innovation indices.

(d) Compose an integrated regression to examine the overall explanatory capacity of cybersecurity, digital expenditure, and in-novation to economic growth.

Research Questions

Building on the theoretical foundations and identified research gap, this study addresses the following research questions:

RQ1: To what extent does cybersecurity function as an enabling institutional mechanism influencing economic growth in developing economies?

RQ2: Does digital spending independently generate measurable economic growth, or is its impact contingent upon complementary structural factors?

RQ3: How strongly does innovation capacity contribute to variations in economic growth across emerging markets?

RQ4: Do cybersecurity, digital spending, and innovation operate as complementary and interdependent drivers of economic growth when analyzed within an integrated framework?

Theoretical Framework

a) Endogenous Growth Theory in the Digital Economy Context

This theoretical basis of the research will be the endogenous growth theory; it holds that economic growth in the long run is caused by the internal, that is, in the form of technological advancement, knowledge and development of human capital and not exogenous inputs (8). In the context of digital economy, such a structure means that the digital transformation process, in particular, innovation and technology capability, is a structural multiplier of productivity and sustainable growth. Therefore, the existing model theorizes that innovation capacity is a core growth driver, and this is the theoretical basis of H3.

b) Digital Infrastructure as Institutional Enabler

Contemporary digital economy theory extends endogenous growth models by integrating facilitating factors to productivity growth include, however are not limited to, digital infrastructure and institutional quality (9). According to this perspective, cybersecurity is not seen as a relatively high cost of protection as an aspect of operations but rather as the institutional infrastructure that reduces systemic risk, enhances digital trust and stabilizes economic transactions (10). H1 is anchored on this theoretical premise which argues that there is a positive relationship between cybersecurity and economic growth.

c) Investment-Led Digital Transformation and Conditional Growth Effects

Based on the investment theory and the literature of digital transformation, it is probable that ICT spending would stimulate the economy as well as the digital infrastructure investment because they augment connectivity and technological uptake (11). Therefore, the idea of digital spending is postulated as a potentially growth-enhancing input, the effectiveness of which is predetermined by structural suitability to the systems of innovations and the readiness to cybersecurity. This is a conditional theoretical perspective on which H2 is based.

d) Integrated Digital Transformation Model

Rather than viewing individual determinations in the context of cybersecurity, digital expenditure and innovation, the model organizes them into systemic growth structure interrelations. This joint perception begins to provide the theoretical ground to H4 implying that there is a combined and important influence of the three dimensions on economic growth.

Methodology

Data Gathering and Processing

Data Gathering

The data used in this research consists of 200 observations of 58 countries in the year 2024 and includes such variables in the dataset as macroeconomic, cybersecurity spending, digital spending, and innovation measures. This provides a good basis on the regression analysis of the effects of these variables on economic growth.

Data Sources and Reliability

To achieve reliability and validity of data used in this study, the data were gathered using various authoritative sources on the international level. The economic growth statistics included the data on economic growth in the form of GDP growth rate (Measured in percentage) and were sourced in the World Development Indicators database, which is well known in terms of its extensive and frequent updated macroeconomic statistics of more than 200 countries. The data on cybersecurity were found on the National Cybersecurity Index and ensured with the expenditure data on the International Telecommunication Union (ITU) Global Cybersecurity Index which give standardized measures of cybersecurity preparedness of the countries. The metric of digital spending, namely every one of ICT expenditure per cent of GDP was obtained in the Organization for Economic Co-operation and Development (OECD) database and in the Digital Development indicators of the World Bank. The measurements of innovation were based on the World Intellectual Property Organization (WIPO) Global Innovation Index and the national R&D spending data of the Institute of Statistics of UNESCO. To ensure a high level of statistical rigor consistency was assessed across all sources of data and the missing values (less than 5% of the total observations) were addressed by applying multiple imputation methods based on Expectation-Maximization algorithm. The accuracy of these sources is justified by the fact that they were utilized in many peer-reviewed articles and that they also meet international standards of statistics.

Sampling Strategy and Sample Size Determination

The purposive sampling technique was adopted in this research based on developing nations in Asia and Africa because the two are important areas to explore the economic effects of digital transformation. The sample was randomly chosen and included 58 countries based on the following criteria: a) developing or emerging economies as rated by the International monetary fund- world economic outlook, b) geographical representation by both Asian region and African region to have a diversity in terms of economic structures and level of digital maturity. The size of 200 observations (numerous data points per country at various quarters or at various sub-national regions) was calculated by the priori power analysis with the help of software G*Power 3.1. Given a medium effect size ($f^2 = 0.15$), desired statistical power 0.80 and a significance level of 0.05, the number of observations to be used in multiple regression when using three predictors was determined to be 77. With a sample of 200 observations, our level of statistical power of 0.99 is essentially above this level, which guarantees sufficient sensitivity to the existence of meaningful variables relationships at minimum risk of Type II error. This is also the population size that meets the traditional requirement of 15-20 observations per predictor variable this is another aspect that underlines the strength of our statistical analyses.

Definition of Variables

Table 1 includes a detailed operationalization of each variable used in the current research and indicates its type as either dependent or independent variable, measurement proxies that are used to measure each of the constructs and sources of authoritative data where the measurements were collected. Economic Growth is the dependent variable; it has been operationalized with percentages of GDP growth rate which would represent the change in the economic output that is reported by the world bank on annual basis. The three independent variables are the three dimensions of the digital transformation: Cybersecurity is assessed by national cybersecurity indices and global expenditure on cybersecurity data; Digital Spending is evaluated by the ICT expenditure as the percentage of GDP through OECD databases; and Innovation is measured by the data on R&D expenditure and innovation indexes at the World Intellectual Property Organization (WIPO). This operationalization makes every theoretical construction operationalized on the basis of reliable metrics, which are internationally recognized and can be used to compare across countries and the validity of the latter statistical analyses.

Table 1: Operationalization and Measurement of Variables

Variable	Type	Measurement Proxy	Source
Economic Growth	Dependent	GDP Growth Rate (%)	World Bank
Cybersecurity	Independent	National cybersecurity index / expenditure	Global datasets
Digital Spending	Independent	ICT expenditure (% of GDP)	OECD
Innovation	Independent	R&D expenditure / Innovation Index	WIPO

Table 1 shows that the choice of measurement proxies was informed by their popularity in the literature on the digital economy and their accessibility to all the sample countries. This is because the standardized international databases will be used so that there is uniformity in measurement over various situations in countries and there will be reduced chances of bias which may be brought about by country specific definitions or country specific practice of reporting. The approach to methodology allows us to make strong cross-country contrasts and enhances the ability to generalize the results in the framework of developing economies in Asia and Africa.

Model Development

The primary objective of this study is to see how Cybersecurity, Digital Spending, and Innovation (independent variables) influence Economic Growth (dependent variable). A multiple regression equation will be employed in order to investigate the possible impacts of the independent variables on the dependent variable.

Model Specification

The multiple regression model is represented in Equation [1] as follows:

$$EG = \beta_0 + \beta_1(CS) + \beta_2(DS) + \beta_3(INN) + \varepsilon \qquad [1]$$

Where,

EG = Economic Growth, CS = Cybersecurity, DS = Digital Spending, INN = Innovation, β_0 is the intercept or constant term, β_1, β_2, and β_3 are the coefficients of the independent variables, ε is the error term.

Regression Analysis

This study employs regression analysis using Python to analyze the relationships between the independent variables (Cybersecurity, Digital Spending, and Innovation) and the dependent variable (Economic Growth).

Analytical Methodology and Statistical Procedures

The statistical work was carried out in many strict steps to guarantee the methodological transparency and reproducibility. To analyze the distributions of the variables, first descriptive statistics were calculated of all variables, both central tendencies (mean, median) and dispersions (standard deviation, range). Data screening was done to determine outliers through the method of interquartile range (IQR), and the extremes (more than 1.5 x IQR) were identified which were to be investigated but accepted because of substantive validity. Second, diagnostic tests were conducted to show the assumptions of ordinary least squares (OLS) regression. Variance Inflation Factors (VIF) were used to determine the multicollinearity with all the values falling below the threshold of 10 showing that there was no bad multicollinearity among the predictors. Durbin-Watson statistic was used to test the presence of autocorrelation and Breusch-Pagan test was used to test the heteroscedasticity. The visual check of the normality of the residuals was done using the Shapiro-Wilk test and the Q-Q plots. Third, simple linear regression models (to test H1, H2, and H3 respectively) and a multiple regression model (to test H4) were approximated with the help of Python libraries stats models and scikit-learn. Ordinary least squares method was used to estimate the regression coefficients and standard errors were estimated by the robust estimation (HC3 method) to address the possibility of the heteroscedasticity. Fourth, numerous criteria were measured to evaluate the model fit: explanatory power was measured by the R-squared and adjusted R-squared, the overall significance of the model was measured by the F-statistic, and the model was compared in terms of the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Two-tail t-tests were used to establish the statistical significance of individual predictors at the level of alpha = 0.05. Computational reproducibility was achieved by analyzing all of them with Python 3.9 and using such packages as pandas [1.3.0], NumPy [1.21.0], stats models [0.13.0], and scikit-learn [0.24.2.

The overall methodological framework, including data processing stages, diagnostic procedures, and regression modeling steps, is illustrated in Figure 2.

Figure 2 shows the methodological framework followed in the study. It begins with data collection, followed by data cleaning to ensure accuracy and reliability. Next, diagnostic tests are conducted before applying regression models to analyze the relationships between variables. Finally, the results are evaluated and interpreted to draw meaningful conclusions.

Results

Overview and Categorization of Findings

The results are organized into two distinct categories based on the strength and statistical significance of the observed relationships.

Category A: Variables with Strong Positive Effects (High Explanatory Power)

This category includes variables demonstrating statistically significant positive relationships with economic growth, characterized by meaningful effect sizes and substantial explanatory power. Innovation emerged as the most influential predictor, explaining 44.8% of variance in economic growth (R^2 = 0.448, β = 0.3604, $p <$ 0.001), followed by Cybersecurity, which accounted for 9.3% of variance (R^2 = 0.093, β = 0.2636, $p < 0.05$). These findings provide robust evidence for H1 and H3, indicating that both innovation investments and cybersecurity infrastructure serve as critical drivers of economic development in developing countries. The combined model incorporating all three predictors yielded even stronger results (R^2 = 0.608, F = 101.5, p < 0.001), confirming H4 and demonstrati ng that these digital economy dimensions collectively explain over 60% of economic growth variation.

Figure 2: Methodological Flowchart

Category B: Variables with Weak or Insignificant Effects (Limited Explanatory Power)

Digital Spending, contrary to theoretical expectations, demonstrated no statistically significant relationship with economic growth in the simple regression analysis (β = -0.03, p = 0.429, R^2 = 0.003). This finding led to the rejection of H2, suggesting that mere expenditure on digital infrastructure, without strategic alignment and complementary institutional frameworks, does not translate into measurable economic gains. This result highlights a critical policy implication: developing countries must focus not only on increasing digital investments but also on ensuring these investments are directed toward high-impact areas with strong innovation ecosystems and robust cybersecurity foundations. The weak effect of digital spending underscores the importance of quality over quantity in digital transformation initiatives.

The detailed results for each hypothesis are presented below, organized by individual variable effects (H1-H3) followed by the combined model assessment (H4).

Based on collected and processed data, the author uses Python software to calculate the parameters such as R-square, and Sig of the Cybersecurity, Digital Spending, and Innovation variables.

Table 2: Linear Regression for the Impact of Cybersecurity on Economic Growth

Independent Variable	β	t	Sig	R	R^2	F	Sig
Cybersecurity	0.2636	4.518	0.034	0.305	0.093	20.41	0.034

Note: β = regression coefficient; t = t-statistic; Sig = significance level (p-value); R = correlation coefficient; R^2 = coefficient of determination; F = F-statistic.

As shown in Table 2, cybersecurity has a positive and statistically significant effect on Economic Growth (β = 0.2636; t = 4.518; Sig = 0.034; p < 0.05). The correlation coefficient (R = 0.305) indicates a weak-to-moderate positive relationship between Cybersecurity and Economic Growth. The coefficient of determination (R^2 = 0.093) shows that cybersecurity explains 9.3% of the variance in economic growth. The F-test confirms that the overall regression model is statistically significant (F = 20.41, Sig = 0.034; p < 0.05), indicating that the model provides a valid explanation of the relationship between the variables.

Table 3: Linear Regression for the Impact of Digital Spending on Economic Growth

Independent variable	β	t	Sig	R	R^2	F	Sig
Digital spending	-0.03	-0.793	0.429	0.056	0.003	0.628	0.429

Note: β = regression coefficient; t = t-statistic; Sig = significance level (p-value); R = correlation coefficient; R^2 = coefficient of determination; F = F-statistic.

The results of the regression analyses in Table 3 indicate that there is not a statistically significant relationship between digital expenditures and economic growth. The regression coefficient is negative and negligible (β = -0.03), and the t-value confirms the absence of statistical significance (t = -0.793, Sig = 0.429; $p > 0.05$). The correlation coefficient indicates a very weak relationship between Digital Spending and Economic Growth (R = 0.056), and the coefficient of determination shows that digital spending explains only 0.3% of the variance in economic growth (R^2 = 0.003). Furthermore, the F-test confirms that the overall regression model is not statistically significant (F = 0.628, Sig = 0.429), indicating no valid linear relationship between Digital Spending and Economic Growth. This finding provides support for the theoretical arguments that having only capital allocated to digital infrastructure will not create increased productivity unless there is also innovation capacity and institutional alignment.

Table 4: Linear Regression for the Impact of Innovation on Economic Growth

Independent variable	β	t	Sig	R	R^2	F	Sig
Innovation	0.3604	12.681	0.000	0.669	0.448	160.8	0.000

Note: β = regression coefficient; t = t-statistic; Sig = significance level (p-value); R = correlation coefficient; R^2 = coefficient of determination; F = F-statistic.

From Table 4, it can be observed that Innovation has a positive and statistically significant effect on Economic Growth. The regression coefficient is positive (β = 0.3604), and the t-value confirms the statistical significance of this effect (t = 12.681, Sig = 0.000; $p < 0.001$). The correlation coefficient indicates a moderately strong positive relationship between Innovation and Economic Growth (R = 0.669). Moreover, the coefficient of determination shows that Innovation explains 44.8% of the variance in Economic Growth (R^2 = 0.448), which reflects a substantial and meaningful explanatory power. Additionally, the F-test demonstrates that the overall regression model is statistically significant (F = 160.8, Sig = 0.000; $p < 0.001$), confirming the existence of a significant linear relationship between Innovation and Economic Growth.

Table 5: Multiple Linear Regression for the Impact of Cybersecurity, Digital Spending and Innovation on Economic Growth

Independent variable	Unstandardized B	Coefficients (Beta)	B	t	Sig	R	R^2	F	Sig	VIF
Cybersecurity	0.347	0.039	0.3498	8.955	0.000					1.024
Digital Spending	-0.001	0.024	-0.001	-0.032	0.975	0.779	0.608	101.5	0.000	1.022
Innovation	0.432	0.027	0.3892	16.023	0.000					1.032

Note: β = regression coefficient; t = t-statistic; Sig = significance level (p-value); R = correlation coefficient; R^2 = coefficient of determination; F = F-statistic; VIF = variance inflation factor.

According to the multiple regression results shown in Table 5, there exists a significant structural connection between the elements of digital transformation and economic development (R = 0.779, R^2 = 0.608, F = 101.5, Sig = 0.000). The variable that best predicts economic growth is innovation (β = 0.3892, $p < 0.001$) and the second-best predictor is cybersecurity (β = 0.3498, $p < 0.001$). Digital spending has not exhibited statistically significant predictive power with respect to economic development (β = -0.001, Sig = 0.975). Furthermore, the VIF values were low (Cybersecurity = 1.024, Digital Spending = 1.022, Innovation = 1.032), indicating a lack of multicollinearity. Thus, these results suggest that economic growth because of digital transformation occurs chiefly via innovation systems and cybersecurity structures, rather than because of volume of digital spending alone.

Discussion

The findings confirm the fundamental framework of the endogenous growth theory in a digital world. Innovation will increase productivities as well as knowledge spillovers and reduce systemic uncertainty on the one hand and reduce transaction risk on the other hand. Yet it seems that the amount of spending on the digital level is inadequate to drive growth without a strategy that would coordinate such spending. The significance of these results is that a supplementary approach is needed among the multiple pillars of digital transformation and not an autonomous investment approach.

In 2024 the study was about the roles of digital capital, expenditures, and economic growth, its impacts, as well as cross sectional regression with other expenditures like expenditure on innovation and expenditure on cyber security. As 0.05, we may assume that there are economically positive and statistically significant growth impact of innovation, cyber growth and security as hypothesized in H1 and H3. The results however gained in relation to hypothesis (H2) with respect to the impacts of digital expenditure on the other hand, recorded slightly lower. Regarding hypothesis (H4), the positive effect was statistically significant and was 60.8 in the measures that were ascribed to economic growth. Economic productivity of innovations and cyber security was also found to be economically productive, whereas the impact of digital spending did not show statistically significant contribution to economic growth. The following section seeks to propose a theory to practice with regards to these findings and above.

Cybersecurity has been identified as a significant determinant of economic development (12). It is probable that the strength of the association is a product of three logical processes: first, the strengthening of cyber security results in the reduction of probable economic losses incurred due to cyber security attacks (13). Second, cyber security can be used to boost trust in the smooth conduct of digital transactions, which is very essential in the development of e-commerce and digital financial services (14). Third, cybersecurity protects economically important and productivity improving digital resources. It has been suggested that AI-based cybersecurity technologies contribute to economic stabilization (15). These findings indicate that in the coming years, due to the trend in the upward direction of cyber security spending and economic expansion, cyber security should not be thought of as a cost center, but as an investment in economic resilience (16).

The relationship between innovation and economic growth has been grounded in endogenous growth theory (17). It is claimed that innovation relates to an economic advantage and with the economic productivity and sustainable economic development (18). It is established that innovation remains to be a core driver of economic growth, be it digital products, a digital breakthrough in various intermediation systems of digital nature (19). The research explains the incremental and the disruptive innovation that occurs in economic growth and innovation (20). The innovations introduced through digital technology are very substantial not only about the economic turnover, but also inter-industry innovation networks in China have proved that collaboration in innovation also brings external economies to economic growth (21). Moreover, green innovative processes in the digital economy could be made a determinant to achieve a more desirable and quality economic growth (22).

Regarding impact on economic growth, H4 hypothesis investigates the joint impact on Cybersecurity, Digital Spending, and Innovation on economic growth. The multivariate regression model confirmed a statistically significant joint effect (H4, $p < 0.001$), explaining 60.8% of the variance in economic growth. Therefore, the regression model indicated a highly strong relationship ($R=0.779$) such that the variates in the model significantly positively correlated with the underlying economic results ($R^2=0.608$) and that association was also proved to be significant by the F test ($F=101.5$, Sig=0.000).

The fact that the individual variables forecast economic growth brings out the significance of individual effects on economic growth. The cybersecurity was found to be a positive and significant factor to economic growth ($\beta = 0.3498$, $t = 8.955$, $p < 0.001$), and it confirms that a well-developed digital security infrastructure can have an enabling effect on economic development. The combined model showed innovation to be the best predictor of economic growth and the strongest and the most significant ($\beta = 0.3892$, $t = 16.023$, $p < 0.001$). This positive and, also, very significant coefficient shows that an increase in the innovation activity leads to an economic growth that goes up significantly, even when the effects of Cybersecurity and Digital Spending are removed. The scale of the coefficient of Innovation highlights its focal position as the key driver of economic growth out of the three dimensions of digital transformation scrutinized. The correlation encountered between Digital Spending and Economic Growth (β = -0.001, t = -0.032, p = 0.975) was not significant, and digital expenditure volume cannot be proposed to be reflected in real economic improvements in the environment of the joint model.

The values of VIF also suggest that there is no multi-collinearity (Cybersecurity = 1.024, Digital Spending = 1.022, Innovation = 1.032), so the values of regression coefficients are credible.

The findings show that in the consolidated model, Digital Spending does not have an independent effect, and the effects of Cybersecurity and Innovation are the only ones that cause Economic Growth, which shows the interdependent and complementary effect of the predictors. This implies that the protective attribute of Cybersecurity and the innovative attribute of Innovation are arguably the attributes that counter the marginal direct impact of Digital Spending (23). This helps in the idea of a digital economy (24), a relationship of Digital Spending, Cybersecurity, and Innovation, which spearheads the complexities of the economic system ontologically. The interactions among variables and concentrations of the variables emphasize the need to use a multifaceted model in the context of comprehending the several roles of the digital economy (25, 26). The current digital transformation needs an operative framework in which numerous, heterogeneous, but interrelation criteria are intertwined to enable continuous development of an economy. Therefore, the fact that the Digital Spending, as such, may not be a measure of Economic Growth, may yet have a less direct effect in a more complicated system that is defined by the balance in the relation to Cybersecurity and Innovation. The findings show that in digital investments, the economic implication and not the scale of expenditure ascertains the suitability of the digital investment. Therefore, the possibilities of the digital investments to the economy returns, along with the strategic applicability of the investments to the economic environment is of the key role.

Conclusion

The provided research article provides the empirical data about the structural association between cybersecurity, digital spending, innovation, and economic growth in 58 developing economies of Asia and Africa in 2024. The findings confirm that digital transformation is a multidimensional system, through which the constituents are differentiated but complementary in their effects to macroeconomic performance.

The results demonstrate that innovation is the strongest and most consistent determinant of the growth of the economy. The high explanatory power of this fact justifies the theoretically proposed hypotheses of the endogenous growth theory that places great significance on the growth of knowledge, technological advancement, and research intensity in the development of the economy in the long-term. It appears that more economies with stronger innovation ecosystems are better placed to generate productivity benefits and competitive advantage during the digital era.

The statistical significance and the positive correlation between cybersecurity and the economic growth are also statistically significant. It has modest explanatory power that is not as high as that of innovation, but it is evident that it is an enabling institutional infrastructure. Cybersecurit y enhances structural pillars which digital economic activities need to flourish, through reduction of systemic risk, enhancing digital trust as well as stabilizing economic transactions. The findings demonstrate that cybersecurity must be perceived as an economic decision of a strategic investment rather than a technical protection.

Quite on the contrary, the effect of digital spending on economic development is not statistically significant. This observation indicates that the financial outlay in the digital infrastructure is not one that can lead to visible economic performance unless it is supported by the added institutional quality and capacity to innovate. The effectiveness of the digital spending appears to need the strategic alignment and integration of larger systems of innovation and security.

The integrated regression model proves the fact that the digital transformation is a systemic phenomenon, as it explains 60.8% variation in economic growth. Within this composite model, innovation and cybersecurity remain highly articulate predictors though there is no direct influence on digital expenditure. These findings suggest the enhancing side of relationships between the elements that make up digital transformation.

Altogether, the paper contributes to the literature on the topic of the digital economy-growth nexus by demonstrating that single-digital investments are not the most crucial factors that can trigger sustainable economic growth in the emerging markets, the coordination of the innovation ecosystem, the secure digital infrastructure, and strategic aligned financial allocation is a combination that can do it.

Research Limitations and Future Directions

Although this paper provides valuable information on the digital economy-growth nexus of developing nations, some limitations are worth noting, First, the current study deals with the developing economies in Asia and Africa. Although this is essential in bridging a vital research gap, we should take care in our methodology approach in case we intend to extrapolate our findings and lessons to other regions due to a strong disparity across geographies in institutional, culture, and digital infrastructure settings. Second, the speed of the digital technology development poses time risks to our results, and the information gathered with the help of a 2024 date will soon become outdated when faced with disruptive technologies and constant regulatory shifts and will have to be re-analyzed again, with the incorporation of newly developed technologies, such as artificial intelligence (AI), blockchain, and quantum computing. These limitations in future research need to be overcome by incorporating longitudinal data, broader geography, and indicators of newer technology.

Policy Implications

Based on the findings of the empirical evidence, the policy implications are as follows:

a) Establishing additional innovation networks: Governments should target its spending on research and development, support technology-based start-ups and innovation clusters to enhance productivity and long run development.
b) Considering cybersecurity as economic infrastructure: Investment into national cybersecurity frameworks, regulatory frameworks and digital protection frameworks should be viewed as components toward economic resilience and digital trust.
c) Enhancing the strategic allocation of the digital spending: The policymakers need to put to an end the quantity mode of investment to quality digital projects according to the innovation and institutional readiness.
d) Development of digital human capital: The education and professional training programs based on the emerging technologies, innovation management, and cybersecurity competencies must be created to transform the digital investment into effective efficiency gains.
e) Ensuring an integration of digital policies: The national growth plans should support the alignment of innovations and cybersecurity programs with the investments in the digital infrastructure as the component of one growth-oriented policy.

The implications of these implications are that the digital age requires the systemic alignment of economic development and not the individualized investment in technology.

Abbreviations

AI: Artificial Intelligence, CS: Cybersecurity, DS: Digital Spending, EG: Economic Growth, GDP: Gross Domestic Product, ICT: Information and Communication Technology, INN: Innovation, R&D: Research and Development, OECD: Organization for Economic Co-operation and Development, VIF: Variance Inflation Factor.

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Author Contributions

Jumana Yousef Abubaker: conceptualization, methodology, data curation, formal analysis, writing – original draft preparation, project administration, Basel Al-Shaer: conceptualization, writing – original draft preparation, writing – review and editing, supervision, Fairouz Ahmad Bahlaq: formal analysis, writing – original draft preparation, writing – review and editing, Ashraf Al-Adwan: investigation, writing – original draft preparation, writing – review and editing, Mohammed Ibrahim Alqaoud: methodology, software and data analysis, Anas Abdelrahman Ababneh: software and data analysis, visualization, Alia Emad Alsabbagh: data curation. All authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper. The authors have no financial or personal relationships that could inappropriately influence or bias the content of this work.

Data Availability

The data used in this study were obtained from publicly available international databases and official statistical sources. The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

The authors declare that generative artificial intelligence (AI) and AI-assisted technologies were not used to generate scientific content, analyze data, or draw conclusions in this manuscript. Any language editing, if applicable, was limited to improving clarity and grammar, and all intellectual responsibility for the content remains with the authors.

Ethics Approval

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