Journal of Social & Organizational Matters
Vol 4 No 2 (2025): 159-181

Impact of Financial Factors on Digital Economy: Assessing the Role of Government Intervention and Literacy Rate

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Keywords: *Digital Economy; Financial Inclusion; Technology Innovation; Financial Globalization; Literacy Rate and Government Intervention*

JEL Codes: F65, G21, H10, I25, O33, O31

DOI No: https://doi.org/10.56976/jsom.v4i2.208

Paper Received: 21-01- 2025
Paper Accepted: 17-04- 2025
Publication Date:18-04-2025

This study explores the interplay between financial development, technological innovation, financial inclusion, financial globalization, government intervention, and literacy levels, and their collective impact on the digital economy in 44 Asian countries from 2003 to 2020. The findings reveal that financial development significantly enhances the digital economy by providing necessary infrastructure, increasing access to capital for tech firms, and fostering consumer confidence. Technological innovation is identified as a primary driver, with substantial investments in R&D and support for tech startups leading to robust digital economic growth. Financial inclusion profoundly impacts the digital economy by broadening access to financial services for underserved populations, thus enabling greater participation through digital banking and mobile money services. Financial globalization also positively affects the digital economy by integrating financial markets and facilitating cross-border transactions, enabling the transfer of capital, technology, and best practices. Government intervention serves as a critical mediator, with effective regulatory frameworks, supportive policies, and investments in digital infrastructure significantly enhancing the digital economy. However, excessive intervention may stifle innovation, emphasizing the need for balanced government involvement. Literacy levels moderate these impacts, with higher literacy rates enhancing individuals' capacity to utilize digital technologies effectively. Policy recommendations include strengthening financial systems, promoting technological R&D, enhancing financial inclusion, facilitating financial globalization, and achieving balanced government intervention. These strategies are crucial for fostering a conducive environment for digital economic growth and maximizing the benefits of financial development, technological innovation, financial inclusion, and globalization in the Asian region.

1. Introduction

An economic system known as the "digital economy" is one in which the majority of economic activity, transactions, and interactions are powered by digital technology and

information. Recognized for its platforming and permeability, the digital economy minimizes information asymmetry, decreases production costs, and optimizes resource distribution, all of which contribute to the global acceleration of renewable energy growth (Nambisan). In addition to providing a fresh stimulus for industry development innovation, the digital economy is now a crucial engine of global economic growth. Its growth rate exceeds that of the world economy as a whole, making up over 15% of the global economy. Its predicted value in 2020 is $32.6 trillion (Zhang et al., 2022). Low resource consumption, low marginal cost, low pollution, and emissions are traits of green growth that the digital economy inherits, and which alters economic output as well as energy structures. According to (Abadie et al., 2022), the digital economy is a powerful economic tool used for industrial upgrading with the goal of achieving the SDGs. China's technology and digital economy have advanced quickly in recent years, leading the world in certain fields (Couture et al., 2021). The fundamental tenet of the digital economy is to facilitate innovation, lifelong learning, product and service production, and transmission and processing of contemporary technologies under the historical context of sustainable development and global market integration (Loiseau et al., 2016).

Furthermore, the focus of the Internet is increasingly changing from information to value, and the idea of the "digital economy" is gaining traction. On the one hand, Internet technology expands the reach and efficiency of marketplaces and offers new models for socioeconomic firms (Che et al., 2020). This kind of innovation involves developing new goods, services, or ways to enhance current procedures using either new or current technology. A major force behind transformation in several industries is frequently technological innovation. Digital technology innovation has advanced significantly, especially with the creation of innovative smartphone-based financial apps, advanced e-payment systems, and inclusive digital banking services (Salamah et al., 2023). People's interactions with the financial system now follow a completely different paradigm because of this development. People now have the incredible capacity to obtain financial services through these solutions without being restricted to physically visiting a location, like a traditional bank branch. Thanks to these advancements in digital technology, creating a bank account has become more convenient and available to a larger group of individuals. People may execute financial transactions with amazing simplicity by only using a smartphone device.

A payment method, risk management via insurance and derivatives, economic stability, and intermediation (the linking of savers and borrowers) are only a few of the purposes of financial growth. Business expansion facilitated by financial development can result in more waste, land use, and energy consumption (EC). In addition, financial development enhances the purchasing power of the public, hence boosting resource consumption by helping to fulfill the financial demands of more people. Through clean, environmentally friendly manufacturing and advanced technology, FD helps society benefit and enhances environmental sustainability on a regional and global scale (Acheampong et al., 2019). Financial inclusion act as provision of financial services that are appropriate, sufficient, and affordable to a variety of populations (Anu et al., 2023). The rate and extent of financial inclusion development varies widely between nations, even if some may have experienced an increase in access to it. Fostering financial inclusion enables small businesses to get funding which was in early times unattainable through traditional financial channels, hence increasing efficiency and expediting

advancement (Yao et al., 2023). Different number of estimations and studies say that, the world is now decarbonizing very slowly, mostly because there aren't enough effective technologies.

Financial globalization in recent decades has emerged and its economic effects have been the subject of several research. These studies show that increased economic growth, an increase in the productivity of public debt, enhanced export expansion, and increased bank profit efficiency are all related to financial globalization. Additionally, financial globalization has been shown to have certain detrimental consequences on economies, including a rise in bank risk, financial instability, and economic inequality. (Jaumotte et al., 2013). Financial globalization in terms of foreign money entering the local financial market puts financial institutions under intense competition, which forces them to lower the needed interest rate. This lowers the importance of research and development (R&D) operations and encourages innovation, which is one way that financial globalization has a spillover impact on domestic businesses. The speed at which technology is developing, there is a lack of knowledge on how technological innovation affects the digital economy index. More research is necessary since it is still unclear how financial development has impacted the increase of digital economy index. Detailed research is required to determine how financial inclusion boost digital economic growth to guide practice and policy.

A closer examination of how financial globalization has affected the digital economy index is necessary, particularly given how linked the globe is becoming. Furthermore, there appears to be a dearth of studies examining the mediating role that financial literacy adopts in the connections between different financial variables and the digital economy. Government intervention's moderating effect in the link between important financial indicators and the digital economy is not well understood and necessitates focused research. This study is essential because it addresses the gaps in already available literature by providing a comprehensive analysis of relation between key independent variables (technology innovation, financial development, financial inclusion, financial globalization), a mediator variable (financial literacy), a moderator variable (government intervention), and the dependent variable (digital economy). This research study is the first of its kind to calculate the index for digital economy covering different angles through PCA technique. Looking closely into these dynamics is useful for policymakers, businesses, and academics to make much needed decisions and design strategies that foster sustainable digital economic growth.

2. Literature Review

All sectors of the global economy have been affected by digitalization, which has transformed non-digital economies into digital economies (Tapscott et al., 1996) with internet-based functionality. According to (Beck et al. 2014), there is recognition that the digital transition has the potential to promote inclusivity and hasten the advancement of global economic growth. It has shown itself to be a potent tool for expanding into new markets and enhancing the provision of services in important industries. According to (Singh et al., 2017), the financial industry has acknowledged has tried to improve financial inclusion by using technology interventions as a crucial component, considering the broad effects of digitalization. From a macroeconomic perspective, the digital economy drives economic growth by improving the efficiency of production inputs and outputs. This is demonstrated by the

advancement of technology and its spillover effects, which raise factor inputs, improve factor allocation efficiency, and boost overall factor productivity (Guo.et al., 2019). In emerging economies, digitization is the main force driving economic growth. According to (Dahlman et al., 2016), it promotes national integration into the global market system, reduces transaction costs, and increases labor and capital productivity.

The digital economy is influencing quality in two major ways: by encouraging sustainable development and by increasing organizational agility of economic development in industrialized nations. Between 2004 and 2012, the US economy grew mostly due to the digital economy (Byrne et al., 2013). The separate investment in R&D total factor productivity (TFP) increase was significantly positively impacted by the technical advancements made in its manufacturing sector (Chou et al., 2014). Twelve of the OECD's largest nations have seen substantial increases in TFP because of digitization. Data from 2009 to 2018 in the fifteen well equipped economies of the European Union demonstrate the substantial impact that digital policies at the national and industrial levels may have on fostering economic growth (Skare et al., 2021). Furthermore, there has been a notable decline in the rate of employment within large-scale production making due to the larger productivity of digital assets (Bertani, F. et al., 2021). It has moreover had a long-term stabilizing influence on the advancement of technical innovation. According to (Wallis et al., 2018), digital manufacturing technology enhances an organization's competitiveness and performance from a micro perspective. It also assists businesses in using a business model for the circular economy and successfully advancing the advancement of electronic government. (Anta et al., 2021). Even though digital and information technology have developed quickly, the digital economy represented by information data and cloud computing has not had the greatest influence on economic growth.

Technological innovation has the potential to significantly boost core competitiveness while lowering corporate expenses and facilitating the modernization and transformation of the industrial sector (Zhao et al., 2022). Sort the elements affecting technical innovation in the high-end equipment manufacturing sector into three groups. Putting money and people into innovation, as well as in enterprise R&D, technology, and innovation resource input and enterprise learning capability and enterprise knowledge management are some of the elements that influence internal control. Though some academics argue that technological innovation has negative effects on the environment, it is still unclear how technological innovation will ultimately affect sustainability. Examples of technological innovation in big data, computers, mobile phones, healthcare, and other fields have opened doors to improve economic circumstances and spur economic growth (R. Sharma et al). To illustrate why technological innovation fails, (Omri et al., 2020), for instance, claims that technological innovation is a hot issue among academics and researchers. Author by looking at how technology innovation affects 75 nations' sustainable development in lower-income nations to support sustainable development.

High-quality economic growth, which is the inescapable outcome of social and economic progress, steadily emphasizes the significance of technical innovation. We can only actually achieve the sustainable growth of the economic cycle, particularly in the modern day, by depending only on technical innovation and advancement. Romer developed the

endogenous growth model of technological development among previously conducted studies, emphasizing that knowledge cost derived from scientific and technological innovation is the primary source of economic progress's internal power (Romer et al., 1986). Theoretical and empirical discussions of financial development in international commerce have been extensively covered in recent literature on international economics. International organizations like the World Trade Organization (WTO), the International Monetary Fund (IMF), and the World Bank have highlighted in their different roles the role that financial development plays as a source of trade in accelerating growth in developing nations, particularly in many Sub-Saharan African economies. The study of Khan et al. (2023) evaluates various models using the business risk metric Value at Risk (VaR) to identify the most suitable framework for the KMI-30 stock market. The results indicate that although past banking experiences may not directly influence customers, several mediating factors play a significant role in shaping their willingness to adopt RAAST (Ullah et al., 2023). This study explores key themes including investment behavior, the efficient market hypothesis, and stock price prediction in the context of the anticipated second wave of COVID-19 (Khalil & Ullah).

The development of the financial sector marketplaces would finance domestic businesses, as the World Trade Organization (WTO) highlights the potential for foreign involvement and competition to reduce the cost of international commerce. However, in contrast to comparable regions like the Middle East, Latin Americas, and Asia, the sub-region has struggled to make significant progress in its financial sectors due to several factors, including high levels of corruption, poverty, political instability, and regulatory issues (Beck et al., 2012). Digital financial inclusion is the "deployment of cost-saving digital means at a cost affordable to customers and sustainable for providers," according to the World Bank and is aimed at offering a range of formal financial services that are tailored to the needs of the underserved and financially excluded populations. Digital financial inclusion (DFI) consists of the following four primary components: Consumers can use digital transactional platforms to send and receive transaction data and link to a bank or non-bank that is authorized to hold electronic value. They let users transmit and receive payments as well as store values electronically. Two types of gadgets that the clients may use are either physical (credit cards) or digital Smartphones and other information-transmitting gadgets linked to POS terminals have been identified. (3) Store employees who allow customers to exchange cash for electronically stored value (also known as "cash-in") and then convert stored value back into cash (also known as "cash-out") using a digital device linked to a communications network. Additional financial services via an online transactional platform: banks and non-banks can offer credit, savings, insurance, and even securities to the poor and excluded from the financial system; they also commonly utilize digital data to target clients and manage risk. Technology for information and communication enhances corporate governance and assists underprivileged groups obtain financial access. It also yields much higher returns than company outputs from loans that do not use credit cards (Anakpo et al., 2023), reaches the sustainable development target, boosts economic growth, and lowers the amount of corruption in society in addition to improving credit card returns and the banking industry's overall performance (Shaikh, I. et al., 2022).

Experts have been attempting to do research on the implications, extensions, facilitators, and consequences of digital finance, which is still very much in its early phases of development. Furthermore, the widest and most comprehensive indexes in this field of study are thought to be those that evaluate the advancement of digital money and explore its effects. During the last several years, no region on the countries is investigated by Nasreen et al. (2020), with an emphasis on financial globalization (FIG), economic increment, and the growth of the financial industry. Economic growth and financial development have a positive correlation, according to empirical studies based on panel data gathered for EU economies from 1989 to 2016. The impact of FIG on exchange rate fluctuations on the economic growth of emerging economies is investigated by (Gaies et al., 2020). Data were estimated using the Generalized Method of Moments (GMM) framework. The next thing is empirical findings which demonstrate that investment globalization, which includes foreign direct investment (FDI) and portfolio investment, promotes growth by mitigating the adverse effects of exchange rate volatility and the conventional path of capital accumulation. Also, the government's choice to restrict foreign capital policies in rising nations is justified by the fact that foreign debt does not guarantee these results (Kihombo et al., 2021). These studies have examined the trade-offs between economic growth, environmental sustainability, and FIG, which is measured by the KOF index. Their study examines how the economic, political, and social aspects of globalization as a whole impact ecological footprints using the economies of West Asia and the Middle East as a model. The financial transparency, liberalization, and digital financial inclusion that are influenced by financial globalization make R&D more appealing. To foster technical advancements inside businesses and further societal development, the government, acting as a market regulator, establishes regulations that provide subsidies for technological investments made by these businesses (Wu and Hu, 2020).

The strategy of government lowering the value technology raises society's scientific and technical standards in an efficient manner. According to the fundamental ideas of Marxism, the superstructure influences the economic basis in an inverted manner, and the economic base is determined by the superstructure (Wang & Guo, 2022). In comparison to culture and philosophy, politics and its manifestations have the strongest and most immediate reaction to the economic basis across the whole superstructure. Political circumstances have a significant impact on and can ultimately dictate the course of economic growth. The term "digital economy" refers to the utilization of advanced technology and digital tools in daily business, including e-commerce, mobile applications, and social media. Generally speaking, government help refers to targeted policy support from the government for a newly started industry or national strategic industrial investment. The expansion of the digital economy depends on government support because it is a new state and paradigm. Both scientific research and anecdotal evidence highlight the significance of government policy in dictating the course and rate of technological progress (Winthrop et al., 2002). Consequently, examining the relationship between (R&D) as well as investments in science and technology. Government assistance helps to reorganize the sector in addition to relieving financial strain and lowering manufacturing costs. Recent studies have looked at how government policies affect the growth of digital economy from a theoretical perspective.

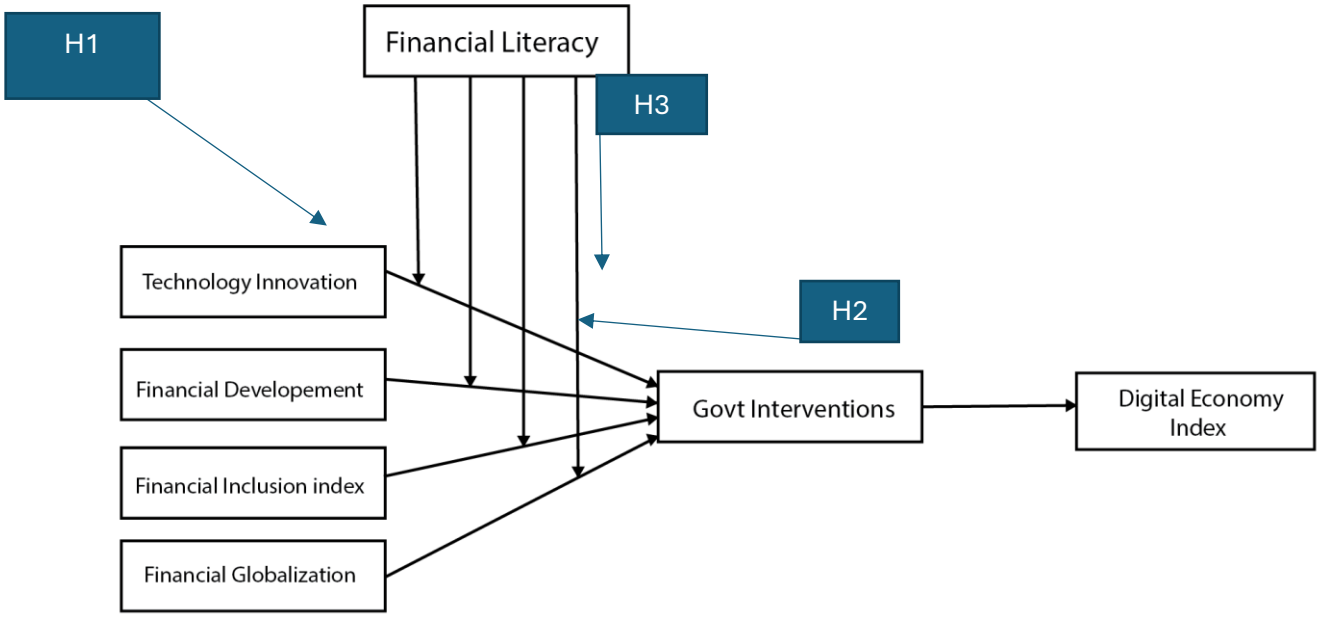
3. Research Methodology

The research aims to investigate the relationship between digital economy and financial factors like technology innovation, financial development, financial globalization and financial inclusion in presence of literacy level and government intervention. The primary objective is to understand how these variables interact and influence the digital economy's performance. In this study we would be using different variables. Digital economy is the dependent variable, technology innovation, financial development, financial inclusion and financial globalization is serving as independent variables. Government intervention is working as mediator variable while financial literacy will work as moderator variable. Digital economy is measured from two aspects which are fix broadband subscription, medium and high-tech value added. The digital economy index previously used by (Huang et al., 2023). Technology Innovation which is measured by high-technology exports (% of manufactured exports). This was previously measured by (Guo et al., 2022). Financial Development which is indicated by Domestic credit to private sector (% of GDP). This indicator is previously used by (Luo et al. 2019). Financial Inclusion and is measured by Automated teller machines (ATMs) (per 100,000 adults) and Commercial bank branches (per 100,000 adults). This method is previously used by (Adedokun et al. (2023).

Financial Globalization is measured through Koff index and is previously used by (Ahmad et al., 2023). Government Intervention is mediator variable and is measured by final general government expenditure %GDP. This was previously used by (Barro et al., 1990). Moderator variable is literacy level of young people from age 18-25years. All the data is collected from website of world bank except financial globalization from Koff Index. This secondary data includes historical data on the dependent and independent variables for the specified time period of 2003 to 2020 of 44 Asian Countries and ensuring a diverse sample of 837 responses. Data is collected in a systematic and consistent manner to ensure reliability. The theoretical framework incorporates concepts from digital economy theory, government intervention theory, financial development theory, financial inclusion theory, financial globalization theory, technology innovation theory, and financial literacy theory. These theories provide a foundation for understanding the relationships between the variables.

3.1 Theoretical Framework

Figure No 1: Hypothesized Research Model



The research hypotheses are formulated based on the theoretical framework and existing literature.

H1: *Technology innovation, financial development, financial inclusion and financial globalization significantly affect digital economy.*

H2: *Government intervention significantly mediate the relationship between Technology innovation, financial development, financial inclusion, financial globalization and digital economy.*

H3: *Literacy rate significantly moderates the relationship between Technology innovation, financial development, financial inclusion and financial globalization and Government Intervention.*

3.2 Econometric Models

This model examines the direct relationship between the independent variables (FG, TI, FI, FD) and the dependent variable digital economy (DE), without considering any moderator or mediator effects.

$DE=\beta 0+\beta 1FG+\beta 2TI+\beta 3FI+\beta 4FD+\epsilon DE=\beta 0+\beta 1FG+\beta 2TI+\beta 3FI+\beta 4FD+\epsilon$

$DEDE$ = Dependent variable which is Digital economy

$FG, TI, FI, FD, FG,TI,FI ,FD$ = Independent variable which are FG is financial globalization, TI is technological innovation, FI is financial inclusion and FD is financial development

$\beta 0, \beta 1,2,\beta 3,\beta 4\beta 0,\beta 1,\beta 2,\beta 3,\beta 4$ = Coefficients of the independent variables

$\epsilon\epsilon$ = Error term

The following model incorporates a moderator variable (LR) that may influence the strength or direction of the relationships between the independent variables and the dependent variable.

$DE=\beta 0+\beta 1FG+\beta 2TI+\beta 3FI+\beta 4FD+\beta 5LR+\beta 6(FG\times LR)+\beta 7(TI\times LR)+\beta 8(FI\times LR)+\beta 9(FD\times LR)+\epsilon DE=\beta 0+\beta 1FG+\beta 2TI+\beta 3FI+\beta 4FD+\beta 5LR+\beta 6(FG\times LR)+\beta 7(TI\times LR)+\beta 8(FI\times LR)+\beta 9(FD\times LR)+\epsilon$

$LRLR$ = Moderator variable which is literacy rate

$(FG\times LR),(TI\times LR),(FI\times LR),(FD\times LR)(FG\times LR),(TI\times LR),(FI\times LR),(FD\times LR)$ = Interaction terms between the independent variables and the moderator

The following model incorporates a mediator variable (GI) government intervention that explains the relationship between the independent variables and the dependent variable.

$GI=\gamma 0+\gamma 1FG+\gamma 2TI+\gamma 3FI+\gamma 4FD+\zeta GI=\gamma 0+\gamma 1FG+\gamma 2TI+\gamma 3FI+\gamma 4FD+\zeta$
$DE=\beta 0+\beta 1GI+\beta 2LR+\beta 3(FG\times LR)+\beta 4(TI\times LR)+\beta 5(FI\times LR)+\beta 6(FD\times LR)+\epsilon DE=\beta 0+\beta 1GI+\beta 2LR+\beta 3(FG\times LR)+\beta 4(TI\times LR)+\beta 5(FI\times LR)+\beta 6(FD\times LR)+\epsilon$

$GIGI$ = Mediator variable which is government intervention

$\gamma 0,1,\gamma 2,\gamma 3,\gamma 4\gamma 0,\gamma 1,\gamma 2,\gamma 3,\gamma 4$ = Coefficients of the mediator model

$\beta 0,\beta 1,\beta 2,\beta 3,\beta 4,\beta 5,\beta 6\beta 0,\beta 1,\beta 2,\beta 3,\beta 4,\beta 5,\beta 6$ = Coefficients of the mediation model

$\zeta\zeta$ = Error term for the mediator model

These models provide a framework for understanding how various factors influence the dependent variable, both directly and indirectly through moderation and mediation effects. Statistical software Stata 15 is used for data analysis. These tools will facilitate detailed statistics, correlation analysis, regression analysis, and testing of hypothesis.

4. Data Analysis

The script about conditional summary statistics contribute essential diagnostic inquiry to the components of study associated with the digital economy and its determinants, including the financial development, technological innovation, financial inclusion, and financial globalization, and the modifying and causality ones. The observed mean for the independent variable (Decon) is rather close to zero (-0.001) and minimally varied in each entity (SD = 1). This suggests that the average digital economy is near to mean values with a relatively low variability. This '4.112-1.901 range' indicates a wide spectrum of digital economy level within the sample. The independent variables, especially FD (Financial development) has a mean of 55.481 and a shockingly high standard deviation of 56.301. Therefore, it can be interpreted that there is significant variability among observations in financial development. The TI (Technological innovation) mean is 10.409, and the standard deviation of 12.288, which is indicative that there are different implementations of technology.

FI (Financial inclusion) is widely distributed, with a mean value of 402.571 and standard deviation is 1979.057, mean us is generally low, implying that the level of financial

inclusion among this sample is significantly different. As an explanatory variable (FG), there is 43.31 mean and 27.971 moderate standard deviation which indicate moderate changes in the financial globalization levels. On the other hand, government intervention (GI or also known as the mediator variable) is a mean variant of 34.327 and a standard deviation of 33.456, which suggests differences among areas with respect to the level of GIs and means that there are different levels of GIs among areas, which possibly may affect the relationship among the variables. This link (LR – literacy rate) is the moderator factor with a mean of 56.511 and standard deviation of 48.367, which shows variability in the values of literacy rate across the sample, may moderate the relationships between the independent and dependent variables. Therefore, this study investigates the aspects of electronic economy through their different determinants, and it is essential to note that there is a huge disparity across the most of these variables. The appearance of and mediator is variation further illustrates of the causal relations being studied.

4.1. Descriptive Statistics

Table No 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Decon	835	-.001	1	-4.112	1.901
FD	835	55.481	56.301	-102.532	314.722
TI	835	10.409	12.288	-7.918	66.296
FI	834	402.571	1979.057	.171	17269.877
LR	835	56.511	48.367	-347.138	193.639
GI	835	34.327	33.456	-75.075	255.31
FG	835	43.31	27.971	.25	91

4.2 Matrix of correlation

The following matrix shows every cell where a value represents a correlation coefficient between every pair of variables in a range from -1 to 1; positive and negative numbers show the strength and direction of the relation between the variables pairs. Going to the dependent variable we see that there is a moderately strong and positive correlation between Decon (Digital Economy) and FG (Financial Globalization) (0.575) meaning that the magnitude of the digital economy increases with the financial globalization. On the other hand, a moderately strong and positive sign (0.612) is KPD and FG, which shows that as the financial globalization decreases, the digital economy decreases as well. Financial development index (FD), however, shows the weak (positive) correlation with both Decon (0.284) and FG (0.247), which means that higher levels of financial development are connected with higher levels of both digital economy and financial globalization reported. Computing innovation (Computerization) and financial inclusion (FI) are positively correlated with digital economy with a low value of correlation (+0.197 and +0.171, correspondingly), showing significant possibility that the higher technological innovation level and financial inclusion contributes to more developed digital economy. Investigating the GI, which is (mediator variable), we note a weak+ive correlation with the FD (0.247), meaning that the higher government intervention levels are likely to be linked to the higher levels of financial development. Finally, the moderating variable (LR for Literacy rate) presented with weak, negative correlations with (Decon of -0.033) and (FG of 0.033), which means that there is some negative association between the

digital economy and the possible side effects of globalization, and on the other hand, some positive association between financial globalization and the economically developed countries. In a nutshell, the correlation matrix allow you to see the link between the variables in your data set and to understand which of these variables have a correlation with each other, this serves as a guide to identify variables that would be useful in further analysis and interpreting your research findings.

Table No 2: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(3) Decon	0.575	0.030	1.000						
(4) FD	0.284	0.030	0.268	1.000					
(5) TI	0.197	0.016	0.077	0.160	1.000				
(6) FI	0.171	0.044	0.258	0.095	0.099	1.000			
(7) LR	-0.033	-0.057	-0.042	-0.005	0.211	0.016	1.000		
(8) GI	0.247	0.028	0.163	0.466	0.007	0.038	0.018	1.000	
(9) FG	0.612	0.043	0.361	0.068	0.174	0.033	0.141	0.314	1.000

4.3 Variance Inflation Factor

The Variance inflation factor (VIF) examines essential elements of interaction among the independent variables in regression analysis. This study depicts the about VIF that reveals the levels of multicollinearity are acceptable and not much over the reference level, so that estimation of the coefficients is not affected widely when applied to the predictors. The particular vignettes which include GI, FD, FG, and TI for the remaining variables show up a multicollinearity level from 1.147 to 1.43, meaning that there is a medium to high degree of similarity among them. The observation that the low levels of multicollinearity make the VIF values 1.092 for literacy rate and 1.023 for financial inclusion strong, thus brings the correlation between VIF with those exogenous variables lower. The 1/VIF which is the reciprocal of VIF has the redundant meaning that in explaining the rest of the variance by other predictor the proportion is not significant, hence multicollinearity is not a serious concern issue in the regression. The multicollinearity problem is considered as one of the major problems arising in regression analysis. Nevertheless, with a mean VIF of 1.206, which is lower compared to commonly accepted thresholds, the independent variables do not prove to raise a substantial issue related with multicollinearity. Therefore, the regression model does not employ multicollinearity.

Table No 3: Variance inflation factor

	VIF	1/VIF
GI	1.43	.699
FD	1.34	.747
FG	1.202	.832
TI	1.147	.872
LR	1.092	.916
FI	1.023	.977
Mean VIF	1.206	.

4.4 Regression results with fixed effect

Regression analysis with fixed effects brings to light the associations between independent variables (Decon, FD, TI, FI, LR, and GI) and the dependent variable (FG), as well as forecasting their impact on the economic development while holding constant other potential causes. Deconomy (Decon) reflected a positive and significant correlation with FD, at .001 (p = .025), which means that a rise in the level of financial development leads to an almost materially higher digital economy. On the other hand, Technological Innovation (TI), and that is digitalization, is characterized by the highly significant, positive relationship with Decon (Computerization), whose coefficient is .01 (p <.001). This implies that greater amount of technological innovations results in the robustness of the digital economy. In the model under discussion, Financial Inclusion does not indicate any liner relationship with Decon encrypted symbol for the digital economy, as shown by the coefficient sign of 0 with a 0.132 p-value, which means that it has no statistical meaningful impact on the digital economy growth in the model.

LR is capably defined as having a negative and a highly significant correlation with Decon; this has the coefficient of -.002 (p < .001) which means higher literacy rates corresponds to a fuquier degree of digital economy. Sizeable evidence has been given by GI being the dominant variable in Decon with coefficients equal to .003 (p = .015), implying that more government involvement is associated with a stronger digital economy.The link between the FG and Decon is not that vivid in terms of the -.001 coefficient and a 585 p value appears to be non-significant. The constant part represents the intercept of the regression equation, reflecting the extend value of Decon when the all independent variables are zero. Temporary is -.0098, although it is not confident (p =. 22). As a whole, it is noteworthy that a small portion of the variance in digital economy is explained within the model (R-squared=0.067). For overall significance of the F-test is statistical significance (p value <0.001), which, in turn, suggests that the model as a whole is useful in the explanation of the variability of 'Decon'. The AIC and BIC metrics that stand for Akaike Information Criterion and Bayesian Information Criterion – are used as measures of model fit, simplicity and appropriate level of model complexity. The lower values of these metrics in turn imply that the measure of model fit is better.

Table 4.4: Regression results with fixed effect

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.001	.001	2.24	.025	0	.002	**
TI	.01	.002	5.15	0	.006	.014	***
FI	0	0	-1.51	.132	0	0	
LR	-.002	.001	-4.00	0	-.003	-.001	***
GI	.003	.001	2.44	.015	.001	.005	**
FG	-.001	.001	-0.55	.585	-.004	.002	
Constant	-.098	.08	-1.23	.22	-.255	.059	
Mean dependent var		0.000	SD dependent var		0.999		
R-squared		0.067	Number of obs		834		
F-test		9.335	Prob > F		0.000		
Akaike crit. (AIC)		731.090	Bayesian crit. (BIC)		764.174		

*** p<.01, ** p<.05, * p<.1

4.5 Regression results with random effect

The regression model with random effects provides explanation to the effects of the independent variables (FD, TI, FI, LR, GI, and FG) on the dependent variable (Decon), taking possible hidden effects from unobserved heterogeneity of the observed entities into consideration. The financial development (FD) assures positive significant relation with decon, where the respective p-value become .010, showing that rise in financial development leads to the little upsurge in the digital economy. Almost like TI, the Decon is also found to be positively and highly significant about TI. The coefficient is estimated to be around .01 and ($p < .001$), implying that a higher occurrence of technological innovation is considerably linked with a stronger digital economy. An encounter between FI and Decon yields a statistically significant negative association, with an estimate of the coefficient of -0 and a p-value of .031 that presents FI to be in alignment with the decline of digital economy in this model.

However, the model also finds Decon to display negative and highly significant relationship with LR, meaning that the higher literacy rate corresponds with the week digital economy (β=-0.002, $p < .001$). Here, the results state the positive and significant connection between GI and promotion of Digital Economy (Decon), where with the coefficient 0.003 ($p = 0.015$), government intervention encourages a rise in digital economy. FG shows positive sign of regression slope line and this relation becomes theoretically plausible (p= .159) but not statistically significant. The most germane term is a coefficient which specifies the value of Decon when all independent variables equal to zero, or have value of 0 The -.049 is the constant denominator, down to .084 at the .05 level of significance ($p = .733$). The model provides a rather moderate prediction of the digital economy variations (within group R-squared = 0.066 and between groups R-squared = 0.183), also unobserved characteristics of via entities (R-squared between groups) play a significant role in making the general R-squared value to high (R-squared Overall = 0.15 Finally, an informative of the model which indicates how these independent variables are effectual in the variation of Decon, is that the chi squared test for overall significance being statistically significant ($p < .001$).

Table No 5: Regression results with random effect

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.001	.001	2.58	.01	0	.002	***
TI	.01	.002	5.24	0	.006	.014	***
FI	0	0	-2.16	.031	0	0	**
LR	-.002	.001	-4.10	0	-.003	-.001	***
GI	.003	.001	2.44	.015	.001	.005	**
FG	.002	.001	1.41	.159	.005	.001	
Constant	-.049	.145	-0.34	.733	-.333	.235	

Mean dependent var	0.000	SD dependent var	0.999
Overall r-squared	0.155	Number of obs	834
Chi-square	62.759	Prob > chi2	0.000
R-squared within	0.066	R-squared between	0.183

*** p<.01, ** p<.05, * p<.1

4.6 Hausman Test

The test examines whether, based on the Hausman (1978) specification, it is a fixed effects model or a random effects model that is the more suitable for the regression analysis. The statistical feature is specified by the chi-square value, and a small p-value means that the other test is better. Precisely, we find that the chi-square test's value is 14.975 with a p-value equal to .02. Since the p-value is lower than 0.05 we make a decision to reject the null hypothesis statement that the random effects model is present and conclude that the fixed effects model is appropriate. Hence, while a fixed effects model passes the Hausman specification test, the random effects model seems inappropriate for running the regression analysis that follows. Hence, any ethesis-specific factor that is not visible in the regressions can be attached to the fixed effects model but not the random effects model.

Table No 6: Hausman (1978) specification test

	Coef.
Chi-square test value	14.975
P-value	.02

4.7 Regression results without mediation and moderation

In results is the regression equation without the inclusion of any mediating or moderated effects, only the directional relationships between the dependent variable (Decon) and the independent variables (FD, TI, FI, and FG) is affecting. The Financial Development (FD) variable has a positive and highly significant connection with Decon and its coefficient of .002 can be interpreted in a natural and meaningful form which says an increase in financial development would cause a larger increase in the digital economy. Moreover, Technical Innovation (TI) showed a steady and very significant (+) relationship with Decon with a coefficient of .008 ($p < .001$), thus indicating that higher levels of technical innovations would be beneficial for a strongly digitized economy. Financial inclusion (FI) transmits a highly negative relationship with Decon at a significance 0 and than .011 and so it should be noticed that the presence of financial inclusion has a great effect to the decrease of digital economy in this model. Financial Globalization (FG) doesn't show any significant bond with Decon regardless of coefficient estimate (-4.6e-04) and inappropriate p-value (0.401).

Intercept denoted by the constant term is the point where the regression line crosses the Y axis, showing the predicted value of Decon for when all independent variables are zero. As a result, the constant is -.103, but the t-statistics test shows it is relatively insignificant ($p = .455$). Model has a modest impact on the change in the weight of the digital economy (Overall R-squared = 0.154), the within-group R-squared (.039) which is the amount of the variance explained by the observed independent variables and the between-group R-squared (.193) of heterogeneity, which are not observed across the entities. The model helps to show the importance of factors like air pollution (Decon), emission level, climate finances, and climate policy in forecasting this variable since the p-value is very significant ($p < .001$).

Table No 7: Regression results without mediation and moderation

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.002	0	3.45	.001	.001	.003	***
TI	.008	.002	4.25	0	.004	.012	***
FI	0	0	-2.53	.011	0	0	**
FG	-.001	.001	-0.84	.401	-.004	.002	
Constant	-.103	.138	-0.75	.455	-.372	.167	

Mean dependent var	0.000	SD dependent var	0.999
Overall r-squared	0.154	Number of obs	834
Chi-square	38.580	Prob > chi2	0.000
R-squared within	0.039	R-squared between	0.193

*** p<.01, ** p<.05, * p<.1

4.8 Regression results with mediation

With respect to the mediation results, the model using a mediation analyzes including the mediator variable (GI) to explore its potential role in changing the relationship between the independent variables (FD, TI, FI, and FG) and the dependent variable (FDI). We exploit Financial Development (FD) as our IV, and we estimate its impact on Decon to be .001 (p = .025), showing a minor increase in the digital economy in response to an increase in financial development. The Dependent Variating (DV) of Technological Innovation (TI) has a positive and highly significant correlation with a Digital Economy (Decon), with a coefficient of .008 (p < .001), meaning that a stronger relationship exists between a higher grade of technological innovation and a stronger digital economy. The presence of Financial Inclusion (FI) shows negative relationship with Decon term in this model, with the coefficient term of 0 and p-value of .011. Financili Inclusion is significantly associated with the drop of Digital Economy in this model. However, it is impossible to ascertain if Financial Globalization (FG) shows any association with Decon given the insignificant coefficient estimate that is .001 and a minimal p-value of .497. Also, there is a positive and significant impact of GI (Government Intervention) on Decon (Digital Economy), with a model coefficient value of A0.003, (p = .011), denoting an association of higher government interventions with a stronger digital economy.

The omnipresent term corresponds to the intercept of the regression equation and illustrates the average Decon value while all independent variables are equal to zero. And the constant is actually -.182, but it is not statistically significant (p - values is .197). The model appears to capture a moderate portion of uncertainty variation (Total R-squared = 0.137) with the R-squared within-group (0.047) that represents the proportion of explained variance due to observed independent variables, and the R-squared between-group (0.165) which may be attributed it to unobserved heterogeneity between the entities. Overall, the model suggests that financial development, technological innovation, financial inclusion, and government intervention play important roles in shaping the digital economy, with government intervention acting as a significant mediator in this relationship. The chi-square test for overall significance is statistically significant (p < .001), indicating that the model as a whole is useful in explaining the variation in Decon.

Table No 8: Regression results with mediation

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.001	.001	2.23	.025	0	.002	**
TI	.008	.002	4.36	0	.005	.012	***
FI	0	0	-2.54	.011	0	0	**
FG	.001	.001	0.68	.497	.004	.002	
GI	.003	.001	2.54	.011	.001	.005	**
Constant	-.182	.141	-1.29	.197	-.459	.095	

Mean dependent var	0.000	SD dependent var	0.999
Overall r-squared	0.137	Number of obs	834
Chi-square	45.213	Prob > chi2	0.000
R-squared within	0.047	R-squared between	0.165

*** p<.01, ** p<.05, * p<.1

4.9 Regression results with moderation

Moderator regression analysis as well is conducted with moderator variable, with the help of which the potential role, which moderator exerts in the interaction of the independent variable (FD,TI,FI,and FG) and dependent variable (Decon), is explored. The degree of economic growth called (FD) pertains closely with Decon with the coefficient value of .003 (p=0) hence, it is interpreted that the improvement of financial development is associated with a ready increase in the digital economy. Technology innovation (TI) is also very correlative and highly significant with digitilizations which is between TI and lower .duilitization coefficient of.01 (p<.001) it suggests higher level of technological innovation causes the stronger digital economy. In this model, Financial Inclusion (FI) is negatively related to Dexcon with a coefficient estimate of 0 and a t-value of -2.26 with a significant relation at level 0.03. Hence, financial inclusion is linked with a reduction of the digital economy in this model.

The FG does not turn the Decon either way on large scale as the relationship is found out to be nearly zero by examining, where the coefficient estimate is of .002 and the value of p with it is of .116. Likewise, the moderator variable, Literacy Rate (LR), represents the opposite relationship with the level of development of digital economy and the negative and statistically high significant association but with the coefficient of -.002 (p = 0) implying higher literacy rates means weaker digital economy. The constant term represents the point of regression line of the equation where the intercept value of Decon is when all other independent variables are zero. In this example, the stationary factor is .028--even though it is statistically insignificant (p = .84). The model is able to explain the most stories in the digital economy, (Overall R-squared = 0.173) with the within-group R-squared (0.058) meaning the size of the cosidered by the observed independent variables, and the between-group R-squared (0.213) that reflects the portion of entity's heterogeneity Overall, the model suggests that financial development, technological innovation, financial inclusion, and literacy rate play important roles in shaping the digital economy, with literacy rate acting as a significant moderator in this

relationship. The chi-square test for overall significance is statistically significant ($p < .001$), indicating that the model as a whole is useful in explaining the variation in Decon.

Table No 9: Regression results with moderation

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.002	0	3.78	0	.001	.003	***
TI	.01	.002	5.15	0	.006	.014	***
FI	0	0	-2.15	.032	0	0	**
FG	.002	.001	-1.57	.116	-.005	.001	
LR	-.002	.001	-4.16	0	-.003	-.001	***
Constant	.028	.141	0.20	.84	-.248	.305	

Mean dependent var	0.000	SD dependent var	0.999
Overall r-squared	0.173	Number of obs	834
Chi-square	56.513	Prob > chi2	0.000
R-squared within	0.058	R-squared between	0.213

*** p<.01, ** p<.05, * p<.1

4.10 Regression results with mediation and moderation

The method of regression analysis takes into accounts the contributions of a sequence of mediator variables (GI) and moderator variables (LR) between the independent variables (FD, TI, FI, and FG) and the dependent variable (Decon), in the joint presence of the mediator variable and the moderator variable. The result reveals that Financial Development has a positive and a significant relationship with the Digital Connectivity, with β*.001 ($p = .01$). That is, in each increment of Financial Development there is an increase of the Decon. Besides that, the Relationship between TI (innovation technologies) and Decon is also overly positive and meaningful as well and the coefficient is .01 ($p<.001$) implying higher technological innovation indicates a more digital economy. An opposite correlation is found for Financial Inclusion (FI) with Decon, where the R-squared value is 0.031 and the p-value < .05 shows that all else being equal, the presence of FI reduces the digital economy in this model. Consequences of financial globalization (FG) are considered positive and statistically significant together with the coefficient of .002 ($p = .015$), which reveals that economic digitalization positively depends on the higher degree of financialization.

Also the control variable, Education L (EL), is the negative case with a probability of -.02 ($p = 0$), suggesting that a country with higher literacy rate will experience a weaker digital economy. Besides, capital the mediator variable, which shows a positive and significant interaction, the abbreviation is GI, with a coefficient of .003 ($p = .015$), implying an improved digital economy and more governmental intervention. The unchanging term suggests the regression equation is intercepted at the anticipated value for Decon when all independent variables are zero successively. For ease of understanding, -.049 is the constant here, but it is not statistically significant, as shown by an F-test with a p-value of .733. The model reflects a fairly small proportion of the total variance in the digital economy (Overall R-squared = 0.155), with the intragroup R-squared (0.066) showing the share of the explained variance based upon the independent variables observed and the between-group R-squared (0.183) being an explanation of the unexplored heterogeneity. A schematic diagram of which we may conclude

that financial development, technical innovation, financial inclusion, financial globalization, literacy rate, and the government interventions act together as the main factors affecting digital economy, especially literacy rate and the government intervention come into their significant moderating and mediating roles in this relationship. A chi-square goodness-of-fit test that attempts to discern whether overall model is useful or not has found to be statistically significant ($p < .001$).

Table No 10: Regression results with mediation and moderation

Decon	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
FD	.001	.001	2.58	.01	0	.002	***
TI	.01	.002	5.24	0	.006	.014	***
FI	0	0	-2.16	.031	0	0	**
FG	.002	.001	1.41	.015	.005	.001	**
LR	-.002	.001	-4.10	0	-.003	-.001	***
GI	.003	.001	2.44	.015	.001	.005	**
Constant	-.049	.145	-0.34	.733	-.333	.235	

Mean dependent var	0.000	SD dependent var	0.999
Overall r-squared	0.155	Number of obs	834
Chi-square	62.759	Prob > chi2	0.000
R-squared within	0.066	R-squared between	0.183

*** p<.01, ** p<.05, * p<.1

5. Conclusion

The study examined the relationships among financial development, technological innovation, financial inclusion, financial globalization, government intervention, and literacy levels, and their combined impact on the digital economy across 44 Asian countries from 2003 to 2020. The findings indicate that financial development significantly enhances the digital economy by providing essential infrastructure for digital transactions, increasing access to capital for tech firms, and fostering consumer confidence in digital platforms. Technological innovation emerges as a key driver, with substantial investments in R&D and support for tech startups leading to robust digital economic growth. Innovations in fintech, digital payments, and blockchain technology have made digital platforms more efficient, secure, and widely accessible. Financial inclusion has a profound effect by broadening access to financial services, especially for underserved populations, thus enabling greater participation in the digital economy through digital banking, mobile money services, and online credit facilities. Financial globalization positively impacts the digital economy by integrating financial markets and facilitating cross-border transactions, allowing for the transfer of capital, technology, and best practices, and opening up new markets for digital products and services. Government intervention is identified as a critical mediator. Effective regulatory frameworks, supportive policies, and investments in digital infrastructure by governments significantly enhance the digital economy. However, excessive intervention can stifle innovation and competition, highlighting the need for balanced government involvement to foster a conducive environment for digital growth. Literacy levels play a moderating role, with higher literacy rates enhancing individuals' capacity to effectively use digital technologies.

This includes understanding and leveraging digital financial services, participating in online markets, and engaging with technological innovations, making literacy a vital component in maximizing the benefits of financial development, technological innovation, financial inclusion, and globalization. Based on these findings, several policy recommendations are proposed. Policymakers should focus on strengthening financial systems to support the digital economy, including robust regulatory frameworks, fostering competition in financial services, and supporting fintech innovations. Governments should invest in technological R&D to drive innovation, establish tech hubs, provide grants for tech startups, and foster collaboration between academia and industry. Efforts to enhance financial inclusion should be prioritized, extending financial services to underserved populations through digital banking, mobile payment systems, and microfinance initiatives. Policies that encourage financial globalization, such as easing cross-border financial transactions and harmonizing regulations, can help integrate regional economies and boost the digital economy. Finally, governments need to strike a balance between regulation and freedom for innovation, providing necessary infrastructure and support while avoiding over-regulation.

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