

From Digital Development to Effective Governance: Evidence on The Mediating Role of Fintech Adoption

1. Abdul Manan, 2. Abdul Razzaq, 3. Kiran Afzal

1. MPhil scholar QASMS, Quaid I Azam University, Islamabad, Pakistan

mananali78600@gmail.com

2. Assistant professor, QASMS, Quaid I Azam University, Islamabad, Pakistan

arazzaq@qau.edu.pk (Corresponding author)

3. Senior Auditor, PMAD, Ministry of Defence, Pakistan

kiran.afzal15@gmail.com

Abstract

The current study aims to analyze the effect of the digital economy and financial literacy on government effectiveness, with the use of fintech adoption as a mediation channel for transforming structural capabilities into governance results. While there is considerable literature available on digital transformation, financial literacy, and government effectiveness, there is relatively little empirical research on the use of fintech adoption as a means to operationalize structural capabilities into governance results in a consistent framework. To fill this research gap, NIE and DOI theories are used to elaborate on how the capabilities in the digital infrastructure and financial sector facilitate the process of governance by reducing institutional friction via the adoption of fintech systems.

In the current study, panel data of 82 countries is used for the period 2000-2024. A two-stage System GMM estimator is used to deal with issues of endogeneity, persistence, and unobserved heterogeneity. The estimation technique uses internal lag instruments, control of instrument proliferation, and several post-estimation diagnostic tests (Hansen test for overidentifying

restrictions and Arellano-Bond serial correlation tests). The indirect effect model of mediation is used for the dynamic panel data framework.

The results show that both the digital economy and financial literacy have positive effects on government effectiveness. Moreover, the adoption of fintech positively affects the performance of governance and partially mediates the relation between the digital economy, financial literacy, and government effectiveness. It can be stated that digital technologies and financial literacy are not enough for enhancing governance without using them as effective tools of digital financial systems that increase transparency, administrative effectiveness, coordination, and service delivery.

This research contributes to the theory of governance and digital transformation through an institutional approach to explain the mechanism of digital-financial capabilities that affect governance through fintech adoption. The implications of the research findings for governance and regulation policies are to develop an institutional strategy for governance that would incorporate development of the digital economy, financial literacy, and fintech ecosystems.

Keywords: Digital economy, Financial literacy, Government effectiveness, Fintech adoption, Institutional performance, System GMM

1. Introduction

The concept of government effectiveness has turned out to be one of the most significant institutional dimensions in terms of sustainability and economic development in both developed and developing countries. This concept is connected with the quality of governmental services and its ability to implement policies effectively, efficiency of its administration, and its ability to provide public services and goods (Kaufmann et al., 2011). Effective government ensures economic development, social welfare, high levels of regulation quality and institutional stability while the lack of efficient institutions is usually associated with such issues as corruption, inefficiency of administration, policy failures, and low level of trust in governments (Acemoglu & Robinson, 2013).

In recent times, the development of the digital economy has brought significant changes in the operational landscape of governments and other institutions. The digital economy is defined as economic and administrative operations carried out using digital technologies, digital infrastructure, data systems, internet connections, and digital platforms (Bukht & Heeks, 2017). The development of digital technologies has changed the ways in which governments provide

public services, handle information, interact with citizens, and coordinate their operations. Digital technologies have the potential to increase transparency, shorten administrative time frames, reduce costs, and increase efficiency in public administration by automating processes and analyzing data in real time (Margetts & Dunleavy, 2013).

Empirical studies generally point out that digital transformation positively affects governance outcomes due to better coordination and service delivery in administrations (Gong & Yang, 2024; Yang et al., 2024). Analogously, digital governments are linked with higher efficiency of institutions, more accountability and effective regulation (United Nations, 2024). At the same time, governance benefits of digitalization are not inevitable and universal. There are many countries that still suffer from inefficient institutions despite the fact that there are significant digital investments made there. It is known from the literature that digital assets do not necessarily lead to improvements in governance as long as their integration into institutional mechanisms is not achieved (Guenduez et al., 2025).

Together with digital transformation, financial literacy has become another factor that is essential for the economic involvement of people and for the functioning of institutions. Financial literacy can be described as a set of knowledge and competencies that people possess to comprehend financial concepts, analyze financial information, and use financial services properly (Lusardi & Mitchell, 2014). People who have financial literacy are more likely to make use of financial services and participate in various public programs related to finance. On a macroeconomic level, financial literacy promotes financial inclusion, economic engagement, and responsiveness, which can lead to better performance and governance of institutions (OECD, 2020). Moreover, research shows that financial literacy helps citizens to use digital financial systems and contributes to economic modernization (Morgan & Long, 2020).

However, despite the abundance of literature on topics related to digital economy, financial literacy, and governance, there are several crucial gaps that need to be filled both theoretically and empirically. The first one is that the previous research focused only on digital economy and financial literacy separately from each other and did not analyze their combined impact on government effectiveness. Moreover, previous studies concentrated mostly on either financial inclusion, technology adoption or organizational efficiency rather than on governance and its results using institutional performance indicators. Furthermore, current studies are mostly based on single country analysis and static modeling that does not reveal much about the

dynamics and endogeneity of the process under discussion. Finally, there is scarce cross-country evidence on the process by which digital and financial skills transform into governance success. Specifically, fintech adoption was rarely considered as an intermediate channel for governance.

The importance of fintech adoption as a mediation channel lies in the fact that the mere presence of digital infrastructure and financial literacy might not lead to greater institutional efficiency, unless such infrastructure and financial literacy are used via the wide adoption of digital finance. Fintech adoption allows for rapid transaction, verification, payment, financial management, and service delivery (Gomber et al., 2018). Such an application can serve to minimize information asymmetries, foster administrative coordination, promote transparency, and build up the capacity of the state. Thus, fintech adoption can act as a channel of transmission for digital economy development and financial literacy into improvements in governance.

Yet, it can be noted that the connection among the development of the digital economy, financial literacy, and governance effectiveness may not be straightforward or self-evident. Based on the available institutional and technology adoption literature, one can argue that structural digital and financial capacities lead to better governance performance only if they are successfully realized via the adoption of appropriate technologies (North, 1990; Rogers et al., 2014). In this sense, the adoption of fintech becomes a significant transmission mechanism whereby structural capacities transform into tangible governance results. The implementation of fintech systems allows for faster financial transactions, real-time validation, digital payments, increased transparency, and more effective mechanisms of public service delivery (Gomber et al., 2018). As a result, even the most developed countries with regard to digital infrastructure and financial literacy may still demonstrate poor governance performance because of inefficient diffusion and institutional utilization of fintech systems. Hence, the adoption of fintech is likely to act as a mediator in the discussed relationship.

But there can be no direct or automatic link between digital economy development, financial literacy, and governmental effectiveness. Previous research on institutional development and technology adoption shows that the development of digital and financial capacities will yield any improvement in governance only in case they are actually operationalized through technology adoption processes (North, 1990; Rogers et al., 2014). In this context, the diffusion of fintech technology can be considered a vital channel for converting digital and financial

capacity into actual gains for the governance process. Fintech adoption helps to speed up financial transactions and verification, facilitates digital payments, provides higher transparency, and creates more effective mechanisms for delivering services to the population (Gomber et al., 2018). As a result, even in case of highly developed digital infrastructure and high level of financial literacy, poor results in terms of governance can be achieved if fintech technology is not properly diffused and utilized.

In the theoretical perspective, this study incorporates the two theories of New Institutional Economics (NIE) and Diffusion of Innovations (DOI). The NIE theory posits that institutional effectiveness enhances when there is a reduction in transaction costs, information barriers, and coordination inefficiencies, facilitated by an effective institutional arrangement (North, 1990). Under this paradigm, digital economy growth and financial literacy can be viewed as institutional facilitators, contributing to more effective institutional arrangements. Nevertheless, according to NIE theory, mere structural capability may not be enough for institutional effectiveness without operational embedding of these capabilities. The DOI theory adds a further dimension to the above argument in that it discusses how technological innovation diffuses in society and institutions based on factors like usefulness and ease of use (Rogers et al., 2014). In this case, fintech adoption can be considered as the process of diffusion.

In light of the foregoing, the current research explores the effects of digital economy and financial literacy on government effectiveness, and, at the same time, the mediating effect of fintech adoption. Panel data on 82 countries for the period of 2000-2024 is used and analyzed in this study employing a two-step System Generalized Method of Moments (System GMM) estimator to control endogeneity, dynamic persistence, and unobserved heterogeneity. This research makes several contributions to literature. First, the study develops a holistic framework of governance integrating digital economy, financial literacy, and fintech adoption in one institutional context. Second, the study considers fintech adoption as a mediating factor that explains how digital and financial abilities influence governance. Third, the current study presents the evidence based on the dynamics of countries using advanced panel techniques instead of traditional static tools. Finally, this study expands the governance literature by highlighting the institutional mechanisms of digital-financial transformation and its impact on government effectiveness.

The rest of the paper is structured as follows. The next section will provide the review of relevant literature and hypothesis of the study. The following sections will discuss the theoretical framework, methodology, results, discussion, and conclusions.

2. Theoretical Analysis and Hypothesis Formulation

The research on the effectiveness of governments is increasingly demonstrating that modern governance results are not only influenced by formal institutions, but also by how digital capabilities, public-sector innovation, and financial capacity interact. The literature review in this study is thus split into three thematic blocks: digital economy and governance, financial literacy and institutional performance, and FinTech adoption and institutional efficiency. Through these themes, the review highlights three causal mechanisms: information transparency, reduction in transaction costs, and digital service provision, in which digital-financial transformation can reinforce government effectiveness.

2.1. Theoretical foundation

2.1.1. New Institutional Economics (NIE)

In this research, the approach is predominantly based on the New Institutional Economics (NIE) for analyzing the role of the development of digital economy and financial literacy in government effectiveness. The NIE concept states that the institutions are defined as formal and informal rules determining the nature of economic and social relations and that institution quality is related to the capacity of an institution to minimize the transaction costs, information asymmetries, and coordination failures (North, 1990).

From the point of view of the NIE concept, digital economy development can be regarded as an institution enabler contributing to the improvement of information flows, minimization of the administrative costs, and better coordination among governments, firms, and citizens. Digital technologies help governments in better processing of information, provision of services, and increased transparency of administrative activities. As noted earlier, previous research indicated that digitalization contributed to the improvement of the institutional quality through reduction of bureaucracy inefficiencies (Margetts & Dunleavy, 2013; Yang et al., 2024).

Likewise, financial literacy can be considered an institutional capability that would allow people to conduct themselves successfully within the context of formal financial institutions and public sector programs. Being financially literate, people will use formal financial services,

know about public financial programs, and engage in economic activity to promote institutional development (Lusardi & Mitchell, 2014). According to the theory of NIE, increased financial literacy lowers informational costs for communication between governments and citizens and leads to institutional efficiency.

Nevertheless, according to NIE, institutional resources and capabilities by themselves do not guarantee better results from government activity. The availability of digital infrastructure and financial literacy opens up opportunities for institutional development, which should be realized through specific processes that help stakeholders communicate effectively (North, 1990). Hence, an intermediate institutional process is needed to transform digital and financial capabilities into observable improvements in the efficiency of the government.

2.1.2. Diffusion of Innovation (DOI) Theory

The diffusion process of the transmission will be explained using the theory of Diffusion of Innovations (DOI). According to DOI, the gains from technological innovations come into existence when innovations are adopted and become integrated into organizational and social processes (Rogers et al., 2014). Therefore, according to the theory, the value of technological resources is achieved only when they are widely adopted to produce behavioral and institutional impacts.

In this research, the adoption of fintech is the innovation that contributes to digital economy development and financial literacy and thus results in better governance practices. Fintech involves integration of digital technology and financial services that enable digital payments and transactions, verification and financial management systems (Gomber et al., 2018). Their diffusion makes it possible to increase administrative efficiency and improve accessibility of services.

According to the DOI theory, there is an increased possibility of adopting innovation by users who have the ability to comprehend technology innovation (Rogers et al., 2014). As such, nations with high degrees of financial literacy will adopt more fintech innovations as the citizens will be able to use the financial innovations in the digital world. Similarly, nations that have more advanced digital economies will offer the technological resources needed to diffuse and use the fintech innovations.

2.1.3. Integrating NIE and DOI

Integration of NIE and DOI gives a holistic interpretation of the connections that have been observed in this research. In this regard, NIE helps in understanding the reason why digital economy development and financial literacy create an institutional environment that will ensure effective governance due to reduced information asymmetry, lower transaction cost, and coordination problem (North, 1990). The role of DOI is to show that fintech adoption is the transmission process of these capabilities into governance outcomes.

Digital economy development provides the required technology platform for innovations' diffusion, while financial literacy improves the capacity of citizens and institutions to use digital financial innovations. In this regard, through the process of diffusion and adoption of fintech innovations, these capabilities are translated into efficient administration, better transparency, good service provision, and institutional coordination. Therefore, fintech adoption serves as the transmission process between digital economy development and financial literacy in ensuring government effectiveness.

Table 1: Theoretical Mapping Table

Variable	Theoretical Foundation	Role in Framework
Digital Economy	NIE	Institutional enabler that reduces information and transaction costs
Financial Literacy	NIE	Institutional capability that facilitates effective participation in formal systems
Fintech Adoption	DOI	Innovation diffusion mechanism and mediator
Government Effectiveness	NIE Outcome	Institutional performance outcome
Digital Economy and Fintech Adoption	DOI	Infrastructure supports innovation diffusion
Financial Literacy and Fintech Adoption	DOI	Knowledge facilitates innovation adoption
Fintech Adoption and Government Effectiveness	NIE + DOI	Operational mechanism translating capabilities into governance outcomes

The integrated framework thus implies that the effectiveness of government will not be enhanced merely due to the existence of digital technology infrastructure and financial literacy among citizens. The improvement in the effectiveness of governance would come from the realization of digital finance operations, which allow for effective interactions within the

institutions. It would be, therefore, assumed that the adoption of fintech would mediate between digital economy development and financial literacy.

2.2. Digital Economy and Governance

The digital economy is the increasing use of digital infrastructure, data, platforms, and networked technologies to economic and administrative activity. Its application in governance research is best conceptualized as digital governance and digital state, which does not just interpret the state as a regulator, but as a platform builder, data steward, and integrator of integrated public services (Ye et al., 2025). In this sense, digital transformation has the potential to increase state capacity through interoperable systems, real-time information flow, and more user-friendly public administration. Recent evidence supports this view. Yang et al. (2024) demonstrate that digital transformation positively impacts the efficiency of governmental work, particularly when the coordination between departments is robust, and Zhang et al. (2024) conclude that the openness of the public data can positively influence the working of governmental functions and that the digital economy (Asian Development Bank, 2025) can serve as a significant tool in the given process. Similarly, OECD (2026) states that fully digital government relies on digital-by-design systems, data-driven public sector, openness, and proactiveness, and these aspects are closely connected to increased productivity and improved public services (Zhang et al., 2024).

The connection between digital economy and government effectiveness can be explained by several causal mechanisms. First, digital systems enhance information transparency and make procedures, records, and administrative actions more visible and traceable. Second, they minimize transaction costs through computerization of routine operations, decreasing processing time and simplifying interagency coordination. Third, they enhance the digital service provision through the provision of faster, more accessible, and citizen-focused services by the governments (Asian Development Bank, 2025). The United Nations (2024) also stresses that digital government can enable the implementation capacity faster when states invest in digital transformation, create skills and alleviate digital divides. This means that the digital economy does not influence governance by the virtue of technology itself but instead influences governance because digital tools reconfigure the way information is processed, the method through which services are provided and the way citizens relate to the institutions of the states (Bhatti et al., 2025).

However, the literature also indicates that the governance payoff of digitalization is conditional as opposed to automatic. Not every digital reform produces equivalent public value, as their efficiency is contingent on institutional capacity, interoperability, organizational capabilities, and the diffusion of innovation in the public sector. Guenduez et al. (2025) demonstrate that the social organizations adopt various approaches to digital innovation, and these vary in their ability to generate both internal and external public value. Similarly, Yang et al. (2024) observe that coordination plays a pivotal role in transforming digital transformation into real efficiency improvements. This implies that digital investment is not enough: in places where institutions are disjointed, lack skills, or are poorly coordinated, digital tools can be cosmetic and not revolutionary. Thus, the most persuasive way to understand the literature is that a better digital economy will probably enhance the efficiency of the government when the digital resources are assimilated in competent institutions and converted to actual administrative and service-delivery gains (Prete, 2022).

H1: Digital economy significantly impacts government effectiveness.

2.3. Financial literacy and Institutional performance

Financial literacy is the knowledge and skills that help individuals to manage financial information or utilize formal financial services and make sound economic choices (Lusardi & Mitchell, 2014). Its applicability in the field of governance is more than just the finance of households because financially literate citizens can understand more policy signals and interact with formal institutions and react to public programmes. Hosen et al. (2025) reveal a positive role of financial literacy in financial stability between countries, and Spivak et al. (2024) suggest that government policy and national financial education plans play a significant role in converting financial literacy into overall societal results. Salahodjaey and Sadikov (2025) show more recently that financial literacy enhances the governance of the community and reduces disparities in the provision of public services. Collectively, these works indicate that financial literacy can enhance institutional performance through decreasing information asymmetry, enhancing policy adoption, and enhancing more accountability by the population (Yurtkur et al., 2025).

But literature is incomplete because most studies have associated the financial literacy to inclusion, stability, or individual behaviour and not to the government effectiveness of the government. Nogueira et al. (2025) demonstrate that literacy outcomes in OECD countries depend on the level of educational attainment and human development and assert that the

institutional value of financial literacy is contingent and not automatic. This implies that financial literacy would best improve government effectiveness when it boosts citizen capacity, formal financial involvement, and better communication between the state and the society. Thus, instead of focusing on financial literacy as a strictly individual quality, this research frames it as a more general institutional asset that may lead to improved governance results (Gonçalves et al., 2025).

H2: Financial literacy significantly impacts government effectiveness.

2.4. Fintech Adoption as a Mediating Mechanism

FinTech adoption is the application of digital financial technologies in economic and administrative systems, including mobile payments, digital lending, transactions on platforms, and real-time financial interfaces (Del Sarto & Ozili, 2025). It is not just another explanatory variable in this study; it is placed as to how the development of the digital economy and financial literacy is converted into improved governance results. In a TOE-based framework, Rebekah and Afjal (2025) demonstrate that the impact of digital transformation on organizational performance can be mediated by FinTech adoption. Similarly, Senyo et al. (2024) argue that digital transformation facilitated by governments in the FinTech ecosystems can reduce the institutional voids by developing more integrated, coordinated, and scalable digital financial systems. These studies propose that FinTech is important because it operationalizes the available digital and financial capacities rather than keeping them as passive structural resources (Almubaydeen et al., 2025).

Although the development of digital economy and financial literacy may contribute to better institutional outcomes, such governance consequences might not come about automatically due to poor technological implementation mechanisms. From an institutional perspective, structural resources generate enabling conditions, while governance changes will be achieved once such resources are operationalized through a technology that improves coordination and efficiency (North, 1990). In this case, the use of fintech operates as a mediator between the development of digital and financial capabilities and the governance outcomes. Fintech uses the digital economy and the financial literacy through the application of the digital payment platforms, transaction through platforms, automatic validation systems, and financial services delivery process (Gomber et al., 2018). Diffusion theory of innovation further states that the value of technological capability is dependent on the extent to which the innovation is diffused in the institutional setting (Rogers et al., 2014). Therefore, countries that have developed digital

economy and financial literacy will realize governance improvements when there is good diffusion of fintech technologies.

There is also some recent empirical support for the mediating effects of fintech adoption on institutional and organizational performance. According to Senyo et al. (2024), fintech adoption by the government creates fintech ecosystems that eliminate institutional inefficiencies and enable better coordination of the financial and administrative systems. Similarly, according to Rebekah and Afjal (2025), fintech adoption mediates the link between digital transformation and organizational performance through the facilitation of operational efficiency and digital integration. This demonstrates that the adoption of fintech is not only a technological output but also an institutional mediator for the impact of digital finance.

Uddin & Barai (2026) find that FinTech adoption is linked to reduced risk and greater stability, yet its efficiency impacts differ between institutional settings, suggesting that regulation, infrastructure, and organizational preparedness influence the outcomes. This is what makes the adoption of FinTech a particularly significant mediating variable: it is the digital economy and financial literacy that can enable the improvement to take place, yet it is FinTech that translates the improvement into actual institutional performance (Mohsin Raza et al., 2024). The most compelling conclusion can be that the adoption of FinTech will tend to enhance government efficiency when transformed into faster, more transparent, and more efficient processes of government and financial resources through digital and financial transformation (Mashoene et al., 2025; Subhani et al., 2024).

H3: Fintech adoption mediates the relationship between digital economy and government effectiveness.

H4: Fintech adoption mediates the relationship between financial literacy and government effectiveness.

3. Research Methodology

The paper uses a quantitative research design to test how the digital economy and financial literacy influence the effectiveness of the government and explore the mediating effect of FinTech uptake. The methodological framework aims to provide consistency between research objectives, theoretical assumptions and methodology. The research is theory-based whereby the testable hypothesized relationship between variables is conducted using cross-country panel data and sophisticated econometric methodologies. The quantitative design is right since

the study is based on the measurable macroeconomic variables and statistical techniques to evaluate causal links among variables and present empirically generalizable results (Creswell & Creswell, 2017).

A research design used in the study is explanatory research design to examine causal relation between explanatory variables and governance results. This design enables the study to explore direct and indirect relationships of variables and to consider the mechanism by which digital transformation and financial capability can determine institutional performance. The explanatory design also allows the study to determine short-run and long-run relations by taking advantage of panel data methods as the government effectiveness is a variable that is not only dependent on the structural factors but also dynamic (Wooldridge, 2010). The empirical study draws on secondary data sources that are sourced on internationally accepted world databases to be reliable and cross-country comparative.

The dependent variable is the government effectiveness, and the measures are the government effectiveness index invented by the World Bank that records the quality of public services, ability to implement policies, and the performance of the institutions (Kaufmann et al., 2004). The indicator is very popular in governance studies and gives an all-inclusive institutional quality measure. The most important independent variables are the development of digital economy and financial literacy. The indicators of access and use to measure the digital economy include internet penetration and broadband connectivity that are used to measure the degree of digital infrastructure and technological integration in an economy (Rezk, 2025). Furthermore, the financial literacy is measured using education-based and financial knowledge indicators reflecting individuals' ability to understand and use financial services (Yurtkur et al., 2025), financial capacity, and involvement of individuals in financial systems (Lusardi & Mitchell, 2014). Increased financial literacy increases the economic involvement and institutional performance through better financial decision-making and resource distribution. The mediating variable is the FinTech adoption measured by digital financial usage indicators, including mobile payments and online transactions, as these indicators reflect the effective use and spread of digital financial technologies used, rather than the availability of technology (Yurtkur et al., 2025). Control variables that are also part of the study include urbanization, trade openness and gross domestic product per capita to establish the differences in economic development, population structure and global economic integration which can contribute to governance outcomes.

In order to empirically test for the mediator role of fintech adoption, the study takes into consideration the dynamic mediation framework under the System GMM estimation method. The dynamic mediation framework is based on the theory that the development of the digital economy and financial literacy not only directly but also indirectly affect government effectiveness via fintech adoption. The dynamic mediation model estimates: (i) the direct effects of the development of the digital economy and financial literacy on government effectiveness, (ii) the effects of the development of the digital economy and financial literacy on fintech adoption, and (iii) the effects of fintech adoption on government effectiveness in the presence of the explanatory variables. The significance of the indirect mediation path will be determined via the coefficient transmission analysis under the dynamic panel data framework. System GMM estimation is appropriate due to the existence of endogeneity and reverse causality in governance and technological adoption models (Roodman, 2009).

The sample comprises 82 countries, which are observed during the period of 2000-2024. The countries are chosen based on the available data and its consistency throughout all the variables used in the analysis. The sample was restricted to countries where over 70 percent of the necessary data was available during the study period, and missing data in the sample retained were filled with average data. The timeframe selected shows how the digital transformation and financial innovation gain more significance in determining the performance of governance and the quality of institutions. The panel structure of data gives cross-sectional as well as time-series variation with which the study can regulate the unobserved country-specific heterogeneity and capture temporal dynamics (Baltagi, B. H., 2008). The research uses dynamic panel data estimation to provide estimations of proposed relationships. The government effectiveness is anticipated to have persistent characteristics over time, and the explanatory variables can be endogenous because of reverse causality, measurement errors or bias in omitted variables. The traditional estimation techniques like pooled ordinary least squares or fixed effects model can give biased estimations given such circumstances. Consequently, the paper uses the System Generalized Method of Moments (System GMM) estimator by Arellano and Bover (1995) and Blundell and Bond (1998).

System GMM estimator is suitable in panel data with a huge number of cross-sectional units and comparatively lower time dimensions. The estimator eliminates the unobserved heterogeneity, simultaneous bias, and dynamic association by taking lag values of explanatory variables as internal instruments. System GMM uses a combination of equations in levels and first differences to enhance efficiency in the estimation and give the same estimates of

parameters (Roodman, 2009). This method is specifically appropriate to investigate institutional performance and the indicators of governance which are usually stable and determined by the previous results. To make empirical results reliable, there are several diagnostic tests that are performed.

The variance inflation factor is used to check the extent of multicollinearity among the explanatory variables to ensure that the explanatory variables are not too closely correlated. Excessive multicollinearity can create errors in the estimation of coefficients and lead to less accurate statistical inference (Gujarati, 2009). To also determine the interdependence that exists between countries, cross-sectional dependence tests are also conducted that may occur because of the global economic shocks or policy spillovers. The panel unit root tests are used to test the stationarity of the variables to prevent spurious regression outcomes. The panel cointegration tests are also used to test the presence of long run equilibrium relationship among variables. These steps are taken to make sure that the estimated relationships are meaningful economic associations, and not statistical artifacts (Pedroni, 1999). Under the framework System GMM, another post-estimation diagnostic test is done to confirm the specification of the model. Serial correlation tests investigate the issue of whether the error terms are correlated through the passage of time, whereas over-identification tests test the validity of the instrumental variables utilized in the estimation process. The tests prove the consistency of the model and reliability of the estimated parameters (Arellano & Bond, 1991).

$$GE_{sit} = \beta_0 + \beta_1 DE_{it} + \beta_2 FL_{it} + \beta_3 FINTECH_{it} + \mu_{it} + C1URB_{it} + C2TO_{it} + C3GDP_{it} + \mu_{it}.$$

In the above econometric model, Government effectiveness is a dependent variable denoted by GE. Digital economy and financial Literacy are independent variables presented by DE and FL, while FINTECH is a mediating variable. URB, TO, and GDP are control variables in this study, showing Urbanization, trade openness, and GDP. The i and t are time series and cross-sectional data, respectively, which are used to indicate panel data.

4. Results And Discussions

4.1. Descriptive statistics

Table 2 presents the descriptive statistics of the study variables, including government effectiveness (GE), digital economy (DE), financial literacy (FL), fintech adoption (FINTECH), urbanization (URB), and trade openness (TO). The findings rest on 2,050

observations, which show a balanced panel dataset with enough observations to conduct an empirical analysis.

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GE	2050	3.204	5.073	-9.482	14.818
DE	2050	0	2	-1.269	10.822
FL	2050	0.536	0.663	-0.111	3.479
FINTECH	2050	6.639	2.801	0.013	11.998
URB	2050	70.641	17.382	18.196	100
TO	2050	96.274	64.683	19.56	442.62

The dependent variable is government effectiveness (GE), which has a mean of 3.204 and a standard deviation of 5.073, meaning that there is a big variation in the quality of governance across countries and over time. The lowest -9.482 and highest 14.818 are additional proofs of broad differences in government performance in the sampled countries. The standard deviation of the digital economy (DE) is 2 with an average of 0, and this indicates a moderate dispersion of the digital economic activities. The variation of -1.269 and 10.822 indicates the variation in the digital infrastructure and ICT-related activities in countries. The mean of financial literacy (FL) is 0.536 with a standard deviation of 0.663, which means that the sample has comparably low but level financial knowledge and financial services utilization. Financial awareness and access differ in the variation between -0.111 and 3.479 across economies.

The mediating variable, fintech adoption (FINTECH), has a mean value of 6.639 and a standard deviation of 2.801, indicating that there is a high dispersion in the technological financial adoption among countries. The lowest figure is 0.013 and the highest number is 11.998, which means that there are still countries with low fintech penetration, whereas others are characterized by high adoption rates. The control variables include urbanization (URB) with an average of 70.641 and a standard deviation of 17.382, implying that most of the sample countries are highly urbanized with a significant variation. The mean of trade openness (TO) is 96.274, and the standard deviation of trade openness (TO) is relatively large (64.683), which implies the existence of wide discrepancies among the levels of economic integration between nations (19.56 to 442.62). Generally, the descriptive statistics demonstrate that there is significant variability in all variables, that is why the dataset is suitable in terms of the panel regression analysis. The large variations and standard deviations indicate that countries are not homogenous, and this explains why superior econometric methods should be employed to explore cross-country disparities and dynamic connections.

4.2. Correlation and VIF

Table 3 shows the correlation and Variance Inflation Factor (VIF) between the key study variables, such as digital economy (DE), financial literacy (FL), and fintech adoption (FINTECH) and their relationship with government effectiveness (GE). Through this analysis, the strength of the relationship among variables can be tested, and possible multicollinearity issues can be identified.

Table 3: Correlation and VIF

Variables	VIF	GE	DE	FL	FINTECH
DE	1.01	0.31	1		
FL	1.03	0.34	0.09	1	
FINTECH	1.03	0.29	0.07	0.15	1

The findings reveal that there is a positive relationship between the digital economy (DE) and government effectiveness (GE) ($r = 0.31$), indicating that the more developed the digital economy, the higher the level of good governance. In the same way, financial literacy (FL) positively correlates with government effectiveness as well ($r = 0.34$), as it implies that higher financial literacy and access to financial services lead to higher institutional effectiveness. Government effectiveness has a moderate positive correlation with fintech adoption (FINTECH) ($r = 0.29$), meaning that the more technologies are adopted by fintech, the more efficient the government is. The independent variables are correlated with each other in a relatively low level. The digital economy has a weak relationship with financial literacy ($r = 0.09$), with fintech adoption demonstrating weak associations with the digital economy ($r = 0.07$) and financial literacy ($r = 0.15$). These values show low correlation, which implies that there exist no strong linear relationships of the explanatory variables.

The Variance Inflation Factor (VIF) values further confirm the absence of a multicollinearity issue. The VIF of digital economy (1.01), financial literacy (1.03) and fintech adoption (1.03) are 10 times lower than the conventional value of 10, which means that multicollinearity is not a severe issue in the model. This implies that the explanatory variables are free enough to give credible coefficient estimates in regression analysis. In general, the correlation findings support positive correlations between the explanatory variables and government effectiveness, as theoretically anticipated by the research. Also, the low VIF values suggest that the model can pass the multicollinearity assumption, and the consequent econometric estimates are reliable and valid.

4.3. Cross-sectional dependency

Table 4 presents cross-sectional dependence (CD) test results of government effectiveness (GE), digital economy (DE), financial literacy (FL), and fintech adoption (FINTECH). The test is a test of whether cross-sectional units (countries) are interdependent because of shared economic or institutional shocks.

Table 4: Cross-sectional dependency

Variable	CD-test	p-value	average joint T	mean ρ	mean abs(ρ)
GE	2.175	0.03	25	0.01	0.39
DE	27.159	0	25	0.09	0.46
FL	15.44	0	25	0.05	0.32
FINTECH	250.13	0	25	0.87	0.87

The findings indicate that government effectiveness has a high level of cross-sectional dependence ($CD = 2.175$, $p = 0.03$), which demonstrates that the performance of governments in countries is dependent on some common international factors. In the same manner, the digital economy ($CD = 27.159$, $p = 0.000$) and financial literacy ($CD = 15.44$, $p = 0.000$) also demonstrate high cross-sectional dependence, which implies that technological advancement and financial literacy are interrelated in countries because of global dispersion and financial globalization. The most cross-sectional dependence ($CD = 250.13$, $p = 0.000$) is observed in the case of fintech adoption, and the correlation values are very high (mean $\rho = 0.87$), which means that financial technology development is highly interdependent internationally. The results validate that the condition of cross-sectional dependence exists in all the variables, which justifies the adoption of complex panel analysis methods of data that consider cross-country dependence to achieve accurate estimates.

4.4. Unit root test

Table 5 shows the findings of the Cross-Sectionally Augmented IPS (CIPS) unit root test that estimates the properties of stationarity of the variables considering cross-sectional dependence. It is important to have stationarity to prevent spurious findings of a regression as well as to enable good long-run estimation.

The results indicate that digital economy (DE), financial literacy (FL), and fintech adoption (FINTECH) remain at the level because the CIPS statistics of these variables are statistically significant at traditional levels. This means that the variables are not unit-rooted and will remain stable over time. However, the amount of Government effectiveness (GE) is weakly stationary at level at the 10 percent level of significance and strongly stationary after the first

difference of the value as shown by the highly significant CIPS value at I(1). This implies that there is a dynamically adjusted process of government effectiveness and that the latter needs to be first differenced to be made completely stationary. The results in general suggest a mixed order of integration between variables, the majority of which are stationary at level, and that government effectiveness is stationary after the first difference. The results are enough to carry out additional long-run research and embrace the use of relevant panel estimation models.

Table 5: Unit root test

Variables	CIPS	
	I(0)	I(1)
GE	-2.025*	-5.33***
DE	-2.609***	
FL	-2.342***	
FINTECH	-2.323***	

4.5. Cointegrating Test

Table 6 presents the outcomes of Pedroni and Westerlund panel cointegration tests the existence of the long-run equilibrium relationship between the variables of the study. Cointegration analysis identifies whether the variables Co-move over time regardless of minor movements in the short run.

Table 6: Cointegration test

	Statistics	p-value
Pedroni		
Modified Phillips-Perron t	2.2277	0.013
Westerlund		
Variance ratio	-1.7548	0.0396

The Pedroni test results indicate that the Modified Phillips-Perron t statistic (2.2277, $p = 0.013$) is statistically significant and therefore rejecting the null hypothesis of no cointegration. In the same manner, the Westerlund test also supports the occurrence of cointegration, since the statistic on the variance ratio is significant (-1.7548, $p = 0.0396$). In general, both tests present a solid correlation between government effectiveness, digital economy, financial literacy, and fintech adoption in the long run. It means that the variables fluctuate in the long run as one and proves the necessity of further analysis with the help of dynamic panel estimation methods.

4.6 Dynamic panel-data estimation (two-step system generalized method of moments (GMM))

Table 7 presents the estimation of the System GMM results of the direct effects of digital economy and financial literacy on government effectiveness with the mediating effect of fintech adoption.

Table 7: GMM and Mediation

VARIABLES	GMM	Mediation
	GE	GE
L.GE	0.916*** -0.0127	0.904*** -0.0066
DE	0.200*** -0.0102	0.196*** -0.00705
FL	0.0745* -0.0392	0.0754** -0.0294
FINTECH		0.0198*** -0.00298

The lagged dependent variable coefficient of the two models (L.GE) is a positive and significant number ($\beta=0.916$; $\beta=0.904$, $p < 0.01$), demonstrating the existence of high persistence in government effectiveness. This indicates that the quality of governance is dynamic, with previous institutional performance playing a major role in the present outcomes. Digital economy (DE) has a positive and statistically significant effect on government effectiveness under both specifications ($\beta = 0.200$; $\beta = 0.196$, $p < 0.01$). This discovery means that digital transformation enhances governance performance in terms of administrative efficiency, transparency, and delivery of services to the citizens, consistent with prior studies highlighting the role of digital infrastructure in improving institutional efficiency (Gong & Yang, 2024; Yang et al., 2024; Zhang et al., 2024). The fact that the coefficient decreased slightly when the adoption of fintech was considered indicates a partial mediation effect.

Financial literacy (FL) also shows a positive effect on government effectiveness, significant at the 10 per cent level in the baseline model and 5 per cent in the mediation level. This means that the economic participation and institutional engagement of the citizens increase with the increase in financial knowledge and this leads to better governance, as supported by evidence that financial literacy enhances institutional outcomes (Lusardi & Mitchell, 2014). Notably, the use of fintech has a positive and significantly strong impact on the government effectiveness ($\beta=0.0198$, $p < 0.01$), which validates its importance as a major transmission tool, as fintech

improves efficiency and financial inclusion (Senyo et al., 2024). The findings indicate that the development of the digital economy and financial literacy can partially improve governance through the adoption of financial technologies that increase financial inclusion, efficiency, and transparency of institutions.

The coefficient of the digital economy (0.196) is relatively higher than that of fintech (0.019) because of the different functions where digital infrastructure is a driving factor and fintech is a complementary mechanism (Senyo et al., 2024; Uddin & Barai, 2026). The results are quite indicative of the dynamic character of the government performance, positive effects of the digital economy and financial literacy, and the intermediary role of fintech usage in enhancing the performance of governance, and although fintech has a smaller magnitude, its statistical significance suggests that its incremental impact remains economically meaningful over time (Gomber et al., 2018).

Table 8: Diagnostic Tests for System GMM Estimation

<i>Test</i>	<i>Statistic</i>	<i>Value</i>	<i>p-value</i>
Arellano–Bond AR(1) (first differences)	<i>z</i>	-6.1	0
Arellano–Bond AR(2) (first differences)	<i>z</i>	2.24	0.075
Sargan test (overidentifying restrictions)	$\chi^2(108)$	127.8	0.094
Hansen test (overidentifying restrictions)	$\chi^2(108)$	80.13	0.879
Difference-in-Hansen: IV instruments (URB, TO, GDP)	$\chi^2(105)$	78.48	0.975
Difference-in-Hansen: Difference (null = exogenous)	$\chi^2(3)$	1.66	0.646

The diagnostic tests confirm model validity. AR(2) is insignificant, indicating no second-order serial correlation. The Hansen and Sargan tests suggest that the instruments are valid, while the Difference-in-Hansen test confirms their exogeneity. Overall, the System GMM model is correctly specified and reliable.

4.7. Robustness Check

To provide the credibility of the primary findings, robustness was analyzed through the quantile regression on the 25th, 50th and 75th quantiles of government effectiveness (Table 9). The findings affirm the accuracy and consistency of the base estimations.

Table 9: Quantile Regression

VARIABLES	25%	50%	75%
	GE	GE	GE

DE	0.806*** -0.0551	0.881*** -0.0672	0.483*** -0.0871
FL	2.429*** -0.166	2.919*** -0.203	2.597*** -0.263
Constant	-1.638*** -0.141	0.951*** -0.172	5.060*** -0.223

The digital economy (DE) has a positive and statistically significant impact on the effectiveness of the government at all quantiles ($\beta = 0.806$, $\beta = 0.881$, $\beta = 0.483$; $p < 0.01$). Whereas the size of the coefficient differs across the distribution, the direction and significance are the same. This validates that digital economy development is a steady factor that enhances the performance of the governance and lends credibility to the strength of the baseline System GMM outcomes. In the same way, the positive effect of financial literacy (FL) on the effectiveness of a government is also strong and of high significance ($\beta = 2.429$, $\beta = 2.919$, $\beta = 2.597$; $p < 0.01$). The stability of the coefficients and their uniform meaning suggest that the positive correlation between financial literacy and the level of governance is not affected by various model formulations or the distribution. Altogether, the robustness findings confirm the core empirical results as they show that the positive impact of digital economy and financial literacy on government effectiveness does not change depending on the level of governance performance. This makes the conclusions of the study more credible and reliable.

5. Discussion

Results of the research conducted confirm that digital economy growth and financial literacy are two important factors influencing the effectiveness of government activities. As was suggested in the developed hypotheses, both factors positively influence government effectiveness, and the effect of fintech use partially mediates this relationship. The obtained findings indicate that modern governance is increasingly affected by the use of digital and financial technologies for increasing institutional efficiency.

The positive relationship between digital economy and effectiveness of governance also corroborates the claim that digital technologies enhance the performance of institutions due to information asymmetry reduction, decrease in transaction costs, and improved coordination. The governments which exist within digitally developed environments can work with the information more effectively, provide better public services, and have increased transparency of decision-making processes. This is supported by the previous research which state that digital transformation helps to improve the efficiency of governmental institutions (Margetts

& Dunleavy, 2013; Gong & Yang, 2024; Yang et al., 2024). In the same way, Zhang et al. (2024) finds out that digital economy development leads to increased efficiency of governmental function due to improvement of information accessibility and administration effectiveness. The current study broadens this empirical evidence by showing that the benefits of governance from digital economy development are significant for both a cross-country analysis and a dynamic institutional environment.

The findings also show that financial literacy has a positive impact on the effectiveness of governance. This implies that people with higher levels of financial literacy create a conducive environment for governance through greater involvement in the financial system, enhanced responsiveness to policies and better implementation of public sector programs. Financial literacy improves the capacity of citizens to use financial services thus improving the interaction between governments and economic players. The findings are supported by the research carried out by Lusardi and Mitchell (2014) that shows that financial literacy provides broader economic impacts apart from personal financial outcomes. This is also supported by the evidence presented by OECD (2020) and Morgan and Long (2020). These authors show that financial knowledge plays a key role in improving financial inclusion and institutional development. While most studies in this field focus on household welfare and financial behavior, the current study shows that financial literacy can have institutional values by improving the effectiveness of governance.

One major contribution made by this study is through highlighting the role of fintech adoption as an important mediating factor between digital economy development and financial literacy on the one hand and government effectiveness on the other. It emerges from the results of this study that digitalization and financial skills alone will not suffice for producing positive effects on governance automatically. These two factors have to be transformed into effective systems through which the government, organizations, and citizens can interact effectively. This is where fintech adoption plays a crucial role. The above findings are aligned with the claim by Gomber et al. (2018) on fintech being a disruptive innovation that can revolutionize institutional and financial processes. The findings also conform to the view put forward by Senyo et al. (2024) on the need for fintech ecosystem for government-led digital transformation programs.

The findings in mediation contribute to our understanding of the reasons behind different levels of benefits accrued to governance through digital transformation in certain countries. Previous

studies have assumed a linear relationship between digitalization and governance. However, findings from this study reveal that success in digital transformation is influenced by the degree to which technology has been embedded within financial and administrative processes using fintech solutions. This observation serves to explain the varying governance outcomes of states with similar digital infrastructure. The governance gains that accrue from investment in technology may not be realized in an environment where there is low diffusion of fintechs.

Despite the statistical significance of the mediation effect, the value of the fintech parameter is relatively lower in comparison with the digital economy parameter. This may seem surprising at first sight since fintech can be described as a revolutionizing factor in public sector modernization. Nevertheless, this result is understandable from the theoretical perspective. The development of the digital economy can be regarded as a wider structural factor which includes digital infrastructure, connectivity, information system, and technological readiness. On the other hand, the application of fintech acts as a more focused institutional process which makes it possible for these capabilities to be channeled towards achieving administrative results. Thus, fintech plays a role in enhancing the effectiveness of governance through a more focused process of operation.

The results also have relevance in the existing controversies surrounding the relationship between technological change and governance quality. According to some researchers, technology adoption does not guarantee the improvement in governance but rather leads to new institutional problems associated with regulatory capabilities, cybersecurity issues, and digital divide (Mergel et al., 2019). Even though these worries are quite legitimate, the current results demonstrate that if fintech adoption is complemented by proper digital and financial capabilities, it can be a powerful tool for enhancing government effectiveness. Thus, the study supports a conditional rather than deterministic view of technological impacts on governance.

Theoretically, the research provides an empirical basis for the merger between New Institutional Economics (NIE) and Diffusion of Innovation (DOI) theories. As suggested by NIE, the emergence of the digital economy and financial literacy decreases information asymmetries and transactions cost faced by the institution (North, 1990). On the other hand, DOI theory shows how the diffusion of fintech innovation allows such structural capacities to produce concrete results of governance (Rogers et al., 2014). However, the major mediation effect indicates that the role of institutional resources is the creation of governance capacity, while the development of the former occurs when institutional resources are translated into

innovations which become popularized. Thus, the integration of institutional economics and innovation diffusion allows explaining the impact of digital and financial capacities on government effectiveness better.

The practical implications of these findings are no less crucial than the results themselves. Those who want to boost the efficiency of governance should not look at the development of digital infrastructure, financial literacy programs, and fintech as separate policy tools. On the contrary, all these elements must be considered as an integrated part of the overall governance approach. Digital infrastructure will not produce its maximum impact on governance without the right fintech policies and citizens' financial literacy. As a result, governments should encourage the adoption of interoperable digital payment systems, public-service digital platforms, financial education initiatives, and regulations that incentivize responsible fintech innovations. These kinds of policies may help improve transparency, deliver services better, foster collaboration among institutions, and ultimately lead to good governance results.

6. Concluding remarks and policy suggestions

6.1. Conclusion

In this research, the linkages between the development of the digital economy, financial literacy, fintech use, and government effectiveness were investigated using panel data comprising 82 countries during the period 2000 to 2024. Using the two-step System Generalized Method of Moments (System GMM) method, the research captured the dynamics of persistence, endogeneity, and unobserved heterogeneity to establish robust evidence on institutional factors of government effectiveness.

The evidence from the study shows that digital economy development as well as financial literacy have positive impacts on government effectiveness. The results reveal that nations that have developed digital ecosystems together with high financial literacy have an easier time enhancing efficiency and increasing transparency in government. Furthermore, more importantly, the results show that fintech adoption is part of the mediating effect of both relationships. The implication from such a result is that digital economic and financial capability do not necessarily mean better governance performance but rather, they manifest themselves through the adoption of fintech systems that help to conduct digital financial transactions, coordinate institutions and minimize information asymmetry.

The research provides an integrated institutional approach towards studying the relationship between digital economy and government performance. By bringing together the two approaches; New Institutional Economics (NIE) and Diffusion of Innovation (DOI), the research shows how the development of digital economy and financial capability are institutional enablers whereas fintech adoption is the institutional mechanism that makes them affect government performance. Such integration helps to move forward from past literature where these relationships have been studied separately.

6.2. Policy implications

There are significant policy implications for the findings too. Countries that wish to boost the effectiveness of their institutions need to formulate integrated policy frameworks that seek to foster development of the digital economy while enhancing the financial literacy of their populations and promoting the use of fintech in a responsible manner. Fostering development of digital infrastructure without accompanying it with policies that increase the capacity of citizens financially is not enough to ensure optimum governance outcomes. Similarly, financial literacy programs require the presence of digital financial ecosystem to help citizens take advantage of technological advances.

However, there are a number of limitations that need to be taken into account. The paper mainly pays attention to international evidence and utilizes the information regarding existing macroeconomic indicators, which does not entirely reflect the peculiarities of institutional environment and regulations in different countries. Also, it is important to note that the paper mainly considers the impact of fintech usage as the mechanism through which the link between digitalization and government effectiveness can be explained, and other institutional factors can influence the relation under discussion, namely digital public administration, regulatory quality, financial inclusiveness, and institutional trust. Future studies may continue the research in this area by analyzing other potential mediating or moderating channels, considering regional variation, and using additional estimation methods to verify the results obtained.

References:

- [1] Acemoglu, D., & Robinson, J. A. (2012). *Why nations fail: The origins of power, prosperity, and poverty*. Crown Business. <https://www.penguinrandomhouse.com/books/205014/why-nations-fail-by-daron-acemoglu-and-james-a-robinson/>
- [2] Almubaydeen, T., Alkabbji, R., & Fleifil, M. K. A. (2025). Effect of applying the artificial intelligence on the quality of accounting information in commercial banks (a field study). In A. M. A. M. Al-Sartawi, M. Al-Okaily, A. A. Al-Qudah, & F. Shihadeh (Eds.), *From machine learning to artificial intelligence: The modern machine intelligence approach for financial and economic inclusion* (Studies in Systems, Decision and Control, Vol. 572, pp. 787–803). Springer. https://doi.org/10.1007/978-3-031-76011-2_56
- [3] Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277–297. <https://doi.org/10.2307/2297968>
- [4] Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)
- [5] Asian Development Bank. (2025). *Harnessing digital transformation for good: Asian Development Policy Report 2025*. <https://doi.org/10.22617/SGP250163-3>
- [6] Baltagi, B. H. (2008). *Econometric analysis of panel data* (4th ed.). John Wiley & Sons. <https://www.wiley.com/en-us/Econometric+Analysis+of+Panel+Data%2C+4th+Edition-p-9780470518861>
- [7] Bhatti, M. A., Hussain, A., Ahmad, T. I., & Nawaz, M. A. (2025). E-government development and its role in enhancing government effectiveness and public sector governance. *Review of Applied Management and Social Sciences*, 8(1), 375–389. <https://doi.org/10.47067/ramss.v8i1.467>
- [8] Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143. [https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/10.1016/S0304-4076(98)00009-8)
- [9] Bukht, R., & Heeks, R. (2017). *Defining, conceptualising and measuring the digital economy* (Development Informatics Working Paper No. 68). Centre for Development Informatics, University of Manchester. https://hummedia.manchester.ac.uk/institutes/gdi/publications/workingpapers/di/di_wp68.pdf
- [10] Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications. <https://collegepublishing.sagepub.com/products/research-design-5-255675>
- [11] Del Sarto, N., & Ozili, P. K. (2025). FinTech and financial inclusion in emerging markets: A bibliometric analysis and future research agenda. *International Journal of Emerging Markets*, 20(13), 270–290. <https://doi.org/10.1108/IJOEM-08-2024-1428>
- [12] Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services. *Journal of Management Information Systems*, 35(1), 220–265. <https://doi.org/10.1080/07421222.2018.1440766>
- [13] Gonçalves, H., Pacheco, L., & Tavares, F. O. (2025). Government policies for promoting financial and fiscal literacy: Evidence from a questionnaire-based study. *Journal of Risk and Financial Management*, 18(11), Article 649. <https://doi.org/10.3390/jrfm18110649>

- [14] Gong, Y., & Yang, X. (2024). Understanding strategies for digital government transformation: A strategic action fields perspective. *International Journal of Information Management*, 76, Article 102766. <https://doi.org/10.1016/j.ijinfomgt.2024.102766>
- [15] Guenduez, A. A., Demircioglu, M. A., Mueller, E. M., & Cinar, E. (2025). Digital innovation strategies in the public sector. *Research Policy*, 54(8), Article 105274. <https://doi.org/10.1016/j.respol.2025.105274>
- [16] Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics* (5th ed.). McGraw-Hill Irwin. <https://searchworks.stanford.edu/view/7773794>
- [17] Hosen, M. E., Siddik, M. N. A., & Miah, M. F. (2025). Exploring the impact of financial literacy and financial inclusion on financial stability: An analysis using machine learning approaches. *Borsa Istanbul Review*. Advance online publication. <https://doi.org/10.1016/j.bir.2025.11.004>
- [18] Kaufmann, D., Kraay, A., & Mastruzzi, M. (2004). Governance matters III: Governance indicators for 1996, 1998, 2000, and 2002. *The World Bank Economic Review*, 18(2), 253–287. <https://doi.org/10.1093/wber/lhh041>
- [19] Kaufmann, D., Kraay, A., & Mastruzzi, M. (2011). The worldwide governance indicators: Methodology and analytical issues. *Hague Journal on the Rule of Law*, 3(2), 220–246. <https://link.springer.com/article/10.1017/S1876404511200046>
- [20] Lo Prete, A. (2022). Digital and financial literacy as determinants of digital payments and personal finance. *Economics Letters*, 213, Article 110378. <https://doi.org/10.1016/j.econlet.2022.110378>
- [21] Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, 52(1), 5–44. <https://doi.org/10.1257/jel.52.1.5>
- [22] Margetts, H., & Dunleavy, P. (2013). The second wave of digital-era governance: A quasi-paradigm for government on the Web. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 371(1987), Article 20120382. <https://doi.org/10.1098/rsta.2012.0382>
- [23] Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly*, 36(4), Article 101385. <https://doi.org/10.1016/j.giq.2019.06.002>
- [24] Morgan, P. J., & Long, T. Q. (2020). Financial literacy, financial inclusion, and savings behavior in Laos. *Journal of Asian Economics*, 68, Article 101197. <https://doi.org/10.1016/j.asieco.2020.101197>
- [25] Nogueira, M. C., Almeida, L., & Tavares, F. O. (2025). Financial literacy, financial knowledge, and financial behaviors in OECD countries. *Journal of Risk and Financial Management*, 18(3), Article 167. <https://doi.org/10.3390/jrfm18030167>
- [26] North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511808678>
- [27] OECD. (2020). *OECD/INFE 2020 international survey of adult financial literacy*. OECD Publishing. <https://doi.org/10.1787/145f5607-en>
- [28] Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, 61(S1), 653–670. <https://doi.org/10.1111/1468-0084.0610s1653>
- [29] Rebekah, E., & Afjal, M. (2025). Exploring the mediating role of FinTech adoption and digital transformation in enhancing bank performance: A TOE framework study using a hybrid SEM-ANN approach. *SAGE Open*, 15(4), Article 21582440251367149. <https://doi.org/10.1177/21582440251367149>

- [30] Rezk, W. M. (2025). The impact of digital economy development on total factor productivity in Saudi Arabia: A panel data analysis. *SAGE Open*, 15(4), Article 21582440251396315. <https://doi.org/10.1177/21582440251396315>
- [31] Rogers, E. M., Singhal, A., & Quinlan, M. M. (2014). Diffusion of innovations. In D. W. Stacks & M. B. Salwen (Eds.), *An integrated approach to communication theory and research* (2nd ed., pp. 432–448). Routledge. <https://www.taylorfrancis.com/chapters/edit/10.4324/9780203887011-35/diffusion-innovations-everett-rogers-arvind-singhal-margaret-quinlan>
- [32] Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, 9(1), 86–136. <https://doi.org/10.1177/1536867X0900900106>
- [33] Salahodjaev, R., & Sadikov, A. (2025). Financial literacy and environmental sustainability: A cross-country test. *Frontiers in Sustainability*, 6, Article 1514393. <https://doi.org/10.3389/frsus.2025.1514393>
- [34] Senyo, P. K., Karanasios, S., Agbloyor, E. K., & Choudrie, J. (2024). Government-led digital transformation in FinTech ecosystems. *The Journal of Strategic Information Systems*, 33(3), Article 101849. <https://doi.org/10.1016/j.jsis.2024.101849>
- [35] Spivak, I., Mihus, I., & Greben, S. (2024). Financial literacy and government policies: An international study. *Public Administration and Law Review*, (2[18]), 21–33. <https://doi.org/10.36690/2674-5216-2024-2-21-33>
- [36] Uddin, H., & Barai, M. K. (2026). Fintech adoption and bank risk, efficiency and stability: Evidence from panel data of selected Asian economies. *FinTech*, 5(1), Article 14. <https://doi.org/10.3390/fintech5010014>
- [37] United Nations Department of Economic and Social Affairs. (2024). *United Nations E-Government Survey 2024: Accelerating digital transformation for sustainable development*. United Nations. <https://desapublications.un.org/publications/un-e-government-survey-2024>
- [38] Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press. <https://mitpress.mit.edu/9780262232586/econometric-analysis-of-cross-section-and-panel-data/>
- [39] Yang, C., Gu, M., & Albitar, K. (2024). Government in the digital age: Exploring the impact of digital transformation on governmental efficiency. *Technological Forecasting and Social Change*, 208, Article 123722. <https://doi.org/10.1016/j.techfore.2024.123722>
- [40] Ye, W., Liu, X., Li, J., & Wu, R. (2025). Digital economy: The engine of public service efficiency. *Sustainability*, 17(11), Article 5223. <https://doi.org/10.3390/su17115223>
- [41] Yurtkur, A. K., Kilic, Y., Bagan, M. F., Dibooglu, S., & Cevik, E. I. (2025). The impact of financial literacy on financial development: A cross-country analysis. *Borsa Istanbul Review*, 25(Suppl. 2), 177–191. <https://doi.org/10.1016/j.bir.2025.10.017>
- [42] Zhang, D., Mu, Z., & Tan, Z. (2024). Effects of publicdata open on performance of government functions in China: The roles of digital economy and market economic system adopting the perspective of resource-based view. *Frontiers in Political Science*, 6, Article 1484579. <https://doi.org/10.3389/fpos.2024.1484579>