# INTER-REGIONAL COMPARISON OF FINANCIAL DEVELOPMENT: HOW WELL DOES THE ROLE OF DIGITALIZATION CONFORM TO THEORETICAL POSTULATIONS?

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***Abstract:*** The study compares financial development in emerging regions of the world. These regions are Mediterranean & North Africa (MENA), Latin America & Caribbean (LAC), and Sub-Saharan Africa (SSA). The purpose is to determine the role of digitalization in financial development over the period 2000-2023, and how well it conforms to theoretical postulations. The investigation is carried out by employing econometric techniques of generalized method of moments and auto-regressive distributed lag, which possess the capacity to minimize bias and produce reliable results. The estimation results reveal that the role of digitalization is positive and more pronounced in MENA compared to other regions. The role is complemented by fiscal and monetary policies, trade openness, institutional quality, and economic growth. Furthermore, the role is found to conform with the postulation of financial intermediation theory, but contradicts the postulation of financial disintermediation theory. All diagnostics show that the estimation results are consistent and useful for policy making. The findings thus suggest the need to fine-tune relevant policies that can enhance the role of digital technology and other variables in driving financial development. Such Policy adjustments may include relaxation of tariff on imported digital equipment, reduction in interest rate, and deregulation of exchange rate.

***Keywords:*** Financial development; digital technology; adoption of innovation; emerging economic regions

***JEL classification:*** O41, O31, L86, O55

# 1.    INTRODUCTION

The adoption of digital technology witnessed appreciable growth in the past two decades, leading to fundamental transformations in the pattern and scope of economic activities. The rapid growth is due to linkage of the technology with internet which serves as a super structure for financial and commercial activities (Dutta and Sarma, 2023; United Nations, 2020). The technology has been instrumental in enhancing financial transactions, financial inclusion, as well as access to trade and public services (United Nations, 2020). The technology has advanced further to incorporate artificial intelligence that completely changed how financial sector operates in handling overwhelming volume of data (Akiwumi, 2022). This advanced digital technology has thus become an important tool used in overcoming physical limitations, enhancing human capacity, and boosting productivity (Duin and Pederson, 2023). The technology is capable of analyzing large volume of data, anticipating future occurrences, and offering customized suggestions that are useful in decision-making and operational efficiency. Over the past two decades, the issue of digital transformation remained a prominent feature of the development process in emerging countries (World Bank, 2024). The evolution has been characterized by the widening of digital gap between developed and developing countries, which is a major concern to countries in emerging regions (United Nations, 2023). The gap is generally attributed to weak policies and lack of institutional support for adoption of advanced technology, as well as low level of economic activity to support technological advancement. This scenario elicited the concern of United Nations, which led to the creation of a task force to design a program aimed at bridging the global technological divide between developed and developing countries (Zhang and Chulkov, 2011).

In spite of the digital gap, emerging economic regions have continued to raise the level of digital adoption over the past two decades (see appendix 1). Within the period 2000-2023, Sub-Saharan Africa (SSA) raised its level of adoption from less than 5% to 40%, Latin America & Caribbean (LAC) raised it from less than 5% to 80%, while Middle East & North Africa (MENA) also raised the level from less than 5% to about 80% The adoption has enabled the financial sector to manage operations more efficiently, using specialized software and algorithms installed in computers and smartphones. The financial sector in these regions therefore witnessed visible changes in operations, though it still remains relatively unstable (see Appendix 2). This observation is corroborated by some researchers and analysts, such as Barefoot (2020), Kraus *et al.* (2021) and Khando *et al.* (2023), who provided insight

on the benefits of digital innovations to the financial sector. They argued that digital innovation has enormous potentials to make finance more inclusive and financial sector more competitive, but also carries great risk, hence its benefits and dangers are interwoven. In the same vein, Suprun *et al.* (2021) asserted that advanced digital technology has radically transformed financial activities with enormous risk. Such risk is basically attributed to high level of information asymmetry, leading to financial manipulation, falsification, and outright fraud. This argument was supported by Feyen *et al.* (2021), who envisaged that digital innovation can generate competition and anomalies that require proper management by regulatory authorities, in order to sustain financial stability. In the same vein, Uddin *et al.* (2023) argued that technological innovations expose banks to more operational risk, due to system failures arising from weak internal control and disruptive security threats that are inherent in the use of digital technology. Digitalization can, therefore, be considered to have both favorable and unfavorable effects on financial development.

In view of the foregoing, it is important to carry out further research studies that would provide more insight on how digitalization impacts the financial sector in developing regions of the world. Therefore, this current study attempts to investigate this issue in three emerging regions of the world (SSA, LAC, and MENA) where the World Bank is providing support in digital transformation.. More precisely, the study compares financial development across the regions with the purpose of ;
  (i)    determining regional disparities in the role of digitalization.
  (ii)   ascertaining whether or not the role of digitalization conforms to theoretical postulations.

The outcomes of these investigations will serve as additional contribution to the expanding literature on digital innovation and economic activities in developing countries. The investigation covers the period 2000-2023, based on data availability. The subsequent sections of this study comprise literature review, analytical methodology, empirical results, policy implications & options, and conclusion

## 2.    LITERATURE REVIEW

### 2.1.    Theoretical Perspectives of Digitalization and Financial Development

The theory of digitalization revolves around the factors that determine the process of digital technology diffusion. Davis (1989) proposed a theory that focused on two primary factors influencing adoption of digital innovation,

which are potential usefulness and applicability. In more precise terms, the theory stated that users are more attracted to the new technology because they perceive it to have appreciable utility and easy applicability. The advantage of this model lies in its capacity to predict users behavior in adopting the technology. Venkatesh *et al.* (2003) built on this theoretical foundation by positing that user behavior towards the new technology is directly determined by its anticipated performance and environment of the workplace. This theory provides a more elaborate understanding of how technology adoption takes place in different sectors, particularly financial sector services (Dwivedi *et al.*, 2019; Venkatesh *et al.*, 2012). The theory was later extended by Rogers (2003) and Rogers and Quinlan (2014) who categorize users of digital technology as early adopters, late adopters, and laggards, based on their readiness to adopt the technology. In literature, the three versions of the theory are identified as follow:

(i)   Technology acceptance model (TAM) by Davis (1989)
(ii)  Unified theory of acceptance and use of technology (UTAUT) by Venkatesh *et al.* (2003)
(iii) Diffusion of innovation theory (DOI) by Rogers (2003) and Rogers and Quinlan (2014)

These theories provide the basis for explaining the spread and adoption of digital technology in the financial sector (Raza and Shah, 2017; Najib and Fahma, 2020). The theories also form the foundation upon which digitalization creates new financial intermediaries to compete with conventional financial institutions (Suryono *et al.*, 2020; Gomber *et al.*, 2018). While the theories of digitalization explained the spread and adoption, they did not explicitly relate it to financial development, hence the need to present other theories linking digital innovation to financial development. The two major theories are:

(i)   Financial intermediation theory (Werner, 2016; Allen and Santomero, 1998)
(ii)  Financial disintermediation theory (Navaretti *et al.* 2018; Thakor, 2020).

The first theory links digital innovation to financial development through reduction in business costs and information asymmetry, thereby increasing efficiency of the financial sector in the mobilization and allocation funds. This theory has been given more prominence in recent times by Cull *et al.* (2018); Asongu *et al.* (2019), and Chen (2020). The second theory, on the other hand, linked digital innovation to financial development through creation of new

intermediaries in the financial sector that offer alternative schemes of financing with easier access and lower transaction costs, compared to traditional banks, thereby reducing financial deepening and development (Temelkov and Samonikov, 2018).

## 2.2. Empirical Studies on Determination of Financial Development

Several empirical studies have attempted to investigate financial development in relation to digital technology and other factors, using different methodologies. Kraus (2021) provided broad insight on the impact of digital technology by using the VOS viewer to conduct a systematic literature survey. The literature node showed fewer researches that considered digital transformation as the main driver of changes in financial system, compared to large number of researches that attributed changes in financial system to other factors. The survey also identified gaps that future researches need to fill, particularly the disruptive effect of digital innovations on the financial system. The need to investigate the key challenges of digital innovation to financial development was also observed in the survey of literature carried out by Khando *et al*. (2023). In a more in-depth study, Antwi and Kong (2021) investigated 55 developing market economies within the period 2000-2020, and found that digital adoption impacted financial development adversely from the perspective of mobile phone usage. In contrast, digital adoption from the perspective of internet usage, had favorable impact on stability of the sector. Given that digital technology has diverse impact on financial sector stability in emerging economies, the study recommended the need for policy makers to strengthen banking regulations that would enable the use of mobile phone and internet to sustain financial sector stability.

Alves (2024) used panel data for 25,000 public and private bank branches in Brazil, to show that adoption of digital technology led to the exit of about 6 percent of private banks from municipalities, as well as a reduction of 11 percent in bank branches within five years. Furthermore, bank credit and deposits were found to exhibit different reactions to digital innovation, which suggests that the new technology deeply reshaped the financial system by modifying how credit is allocated to industry and consumers. In another study, Ioannou and Wojcik (2022) carried out a study on the linkage between digital innovation (fin-tech) and financial sector in Brazil, Mexico, and Argentina. It was discovered that the innovation had limited impact on financial inclusion, but exacerbated the already high level of financial concentration. The study therefore concluded

that the impact of digital innovation is somewhat ambiguous. In contrast, a similar study of Latin America by Bakker *et al.* (2023) showed how fin-tech positively changed the financial sector in the region. The investigation was done by employing bank-level and country-level data, which revealed a significant boost in banking sector competition and financial inclusion. It concluded that financial sector regulators need to address the risks associated with the competition generated by the new innovation in order to sustain performance of the sector.

In Pakistan, Liu *et al.* (2024) carried out a study on the relationship between digital innovation and development of financial sector within the period 2006-2020, using the Tobit methodology. It revealed that the innovation enhanced banking efficiency, leading to increase in return on bank assets and profit. It was also discovered that the innovation played critical role in making state-controlled banks perform better than private sector banks in terms of efficiency. Furthermore, it acted as catalyst for low-efficient banks to catch-up with high-efficient banks. The study therefore underscored how digital revolution in the banking system of Pakistan led to significant efficiency gains. In a related study of digital innovation and financial development in 21 Sub-Saharan African countries during the period 1997-2019, Manasseh *et al.* (2024) used auto-regressive distributed lag (ARDL). The study found that adoption of the technology significantly enhanced financial development through the use of automated teller machines, mobile phone, and internet facilities. It was also discovered that several economic factors complemented digital technology in driving financial development.in the countries.

Aside from digitalization, empirical studies have also focused on the other variables affecting financial development. In a panel data study of Asian countries, Chau and Oanh (2023) investigated several variables influencing financial development. The GMM methodology was used in estimation, which produced results showing that policy uncertainty worsened financial system instability over the period 2008-2020. The study also showed that the ability to use mobilized capital and degree of bank concentration helped to cushion the unanticipated negative effect of policy uncertainty. A similar study of 26 Asian economies by Le *et al.* (2016) also used panel estimation techniques to revealed that quality of institutions encouraged financial deepening over the period 1995-2011. It was further revealed that trade and GDP growth aided financial development. In another study of eight Asian countries, covering the period 1995-2018, Ellahi *et al.* (2021) used the GMM technique to show that real GDP had significant positive effect on financial sector, while inflation

had negative impact. The study concluded by suggesting that inflation needs to be contained for the sector to maintain stability. Similarly, Abaidoo and Agyapong (2022) examined the role of institutions in facilitating financial stability in Sub-Saharan African region over the period 2001-2018, using panel data techniques, and found that the high quality of institutions helped to sustain growth of financial intermediaries in the region.

## 3. ANALYTICAL METHODOLOGY

### 3.1. Generalized Method of Moments Model (GMM)

Theoretically, the basic channel linking digitalization to financial development are represented in Financial intermediation theory (Werner, 2016; Allen and Santomero, 1998) that postulated positive effect of digital technology on financial development. In contrast, financial Disintermediation theory (Navaretti *et al.* 2018; Thakor, 2020) postulated that digital innovation disrupts financial development due to security threat, operational failures, and creation of unconventional institutions. Other factors have also been posited as key determinants of financial development, which include uncertainty in economic policies (Chau and Oanh, 2023), institutional quality, trade openness, and economic growth (Le *et al.*, 2016). Based on the preceding theoretical expositions, a benchmark model relating financial development to digitalization and other control variables is presented below.

$$FD_{it} = f[DG_{it}, MP_{it}, FP_{it}, IQ_{it}, TP_{it}, EG_{it}] \tag{1}$$

$$EG_{it} = \alpha_0 + \Sigma_{j=1}^{6}\alpha_j X_{it} + \mu_{it} \tag{2}$$

Equation (1) shows the functional relationship between financial development and digital adoption as well as other control variables, while equation (2) shows the empirical version with the parameters $\alpha_j$ and $\mu_{it}$ representing impact of the variables and error term, respectively. The dependent (endogenous) variable is FD (financial development), while j denotes the explanatory variables comprising DG (digital adoption), MP (monetary policy), FP (fiscal policy), IQ (institutional quality), TP (trade openness), and EG (economic growth). All the explanatory variables are represented by the vector X, with their parameter coefficients indicated as $\alpha_j$ *(j = 1, 2, ….., 6). The model is transformed to a GMM model by including lags of financial development as instrumental variables, viz;*

$$FD_{it} = \beta_0 + \Sigma_{j=1}^{6}\beta_j X_{it} + \Sigma_{j=7}^{N}\beta_j FD_{it-k} + \tau_{it} + \varepsilon_{it} \tag{3}$$

$$EG_{it} = \lambda_0 + \Sigma_{j=1}^{6}\lambda_j X_{it} + \Sigma_{j=7}^{N}\lambda_j FD_{it-k} + \omega_{it} \tag{4}$$

Under the following moment conditions:

(i)    $\mathcal{E}(w_{it}) = \mathcal{E}[F(FD_{it}, X_{it-1}, \lambda)] = 0$

(ii)   $\mathcal{E}(N'w_{it}) = \mathcal{E}(N'w_{it}, \lambda) = 0.$

(iii)  $V(\lambda) = w_{it}V(\lambda)'Q[Q'\Sigma V(\lambda)X]^{-1}Q'w_{it}(\lambda),$ where Q represents instrumental variables.

The GMM model was propounded by Arellano and Bond (1991) and expanded by Blundell and Bond (1998). The instrumental variables are included to minimize serial correlation and endogeneity bias in the model. The optimum number of instrumental variables in a GMM model is usually determined by using the Akaike information criterion (AIC). The unobserved country effects in the model is eliminated by using first differences of the variables in estimating the model. T*he* moment conditions are used to evaluate and ensure the model produces optimized parameter estimates.

## 3.2.   Auto-regressive Distributed Lag Model (ARDL)

Financial development can also be represented in an alternative and complementary ARDL model showing dynamic relationship between endogenous and exogenous variables, as propounded by Pesaran *et al.* (1999). The model contains variables in level form ($Z_{it}$), and lagged first differences ($\Delta Z_{it-1}$) which are included to eliminate serial correlation and endogeneity issues, as presented below

$$FD_{it} = \partial_0 + \partial_1 FD_{it-1} + \Sigma_{j=2}^{6}\partial_j Z_{it} + \Sigma_{j=7}^{11}\partial_j \Delta Z_{it-1} + \eta_{it} \tag{5}$$

Where:

$\partial_1$ = impact of lagged endogenous variable

$\partial_j$ = impact of explanatory variables in level form (j = 2, 3,….., 6)

$\partial_k$ = impact of first difference explanatory variables (k = 7, 8, ……, 11)

$\dfrac{1}{1-\partial_j}$ = long-run multiplier (j = 2, 3,….., 6)

Normality conditions: $FD_{it}$ = max ($\Sigma\Delta FD_{it}$, 0) and $Z_{it}$ = max($\Sigma\Delta Z_{it-1}$, 0).

Equation (5) shows the relationship between financial development and a vector of exogenous variables comprising the prime variable (FD) and control variables (DG, MP, FP, IQ and EG), with their coefficients ($\partial_j$). The propositions of positive relationships between financial development and the

exogenous variables also hold. The long-run multipliers indicate how change in explanatory variables work through direct and indirect channels, over time, to impact the dependent variable. The normality conditions are satisfied when the variables have zero expected errors in levels and first differences, making the parameter estimates to be optimized and unbiased.

## 3.3.  Estimation Techniques and Data

The preliminary estimation procedure involves the panel unit root test to determine suitability of the variables for estimation. In order to avoid biased and spurious estimation results, all the variables are empirically required to be stationary in levels or first differences (Engle and Yoo, 1987). The LLC test is employed in this study to determine the stationary status of variables. The technique was developed by Levin *et al.* (2002), and commonly used in panel data studies. The main estimation in the study is done by employing the GMM and ARDL techniques to determine the relationships between financial development and the explanatory variables. The GMM technique consists of system and robustness check estimators, while ARDL technique consists of Mean Group (MG) and Pooled Mean Group (PMG) estimators. These techniques are used based on their strong capacity to minimize the biases from serial correlation and endogeneity (Lee and Wang, 2015). The measurement of variables and sources of data are presented below in Table 1.

**Table 1: Variable Measurement and Sources of Data**

| Variable | Description | Measurement | Source of data |
|---|---|---|---|
| FD | Financial development | Ratio of broad money to real GDP | World Bank open data http://data.worldbank.og |
| DG | Digital adoption | Internet users (percentage of population) | |
| MP | Monetary policy | Real interest rate | |
| FP | Fiscal policy | Tax (percentage of profit) | |
| IQ | Institutional quality | Regulatory quality percentile rank index | |
| TP | Trade openness | Export plus import (percentage of GDP) | |
| EG | Economic growth | Real GDP growth | |

*Source:* Author's own work

Data for the sample of countries were sourced for the period 2000-2023. The sample comprises 45 countries in Sub-Saharan Africa (SSA), 33 countries

in Latin America & Caribbean (LAC), and 21 countries in Middle East & North Africa (MENA), making a total of 99 countries. The descriptive statistics of the data used are presented in Table 2, which are used to further justify their inclusion in estimation of the model. The mean values of the variables in SSA region fall within the range 3.8-55.1 with standard deviation 4.7-33.5, while LAC region has mean values in the range of 4.6-59.5 and standard deviation 2.5-37.1. Also, MENA region recorded mean values and standard deviations of 4.9-71.4 and 6.5-37.7, respectively. The non-negative mean values indicate that data for the variables are largely positive, while the standard deviation indicate that data in MENA region are more dispersed than LAC and SSA regions. Generally, the data set can be considered to be evenly spread in each region, which augurs well for panel model estimation.

**Table 2: Descriptive Statistics of Data**

| Variable | SSA: 45 countries Period : 2000-2023 Observations: 1,036 | | | | LAC: 33 countries Period: 2000-2023 Observations: 760 | | | | MENA: 21 countries Period: 2000-2023 Observations: 484 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Max | Min | Std dev. | Mean | Max | Min | Std dev. | Mean | Max | Min | Std dev |
| FD | 33.6 | 41.3 | 30.8 | 6.3 | 59.3 | 73.1 | 33.2 | 20.9 | 62.2 | 83.1 | 56.2 | 15.4 |
| DG | 16.7 | 36.4 | 1.2 | 17.7 | 31.1 | 76.3 | 4.2 | 37.1 | 36.6 | 77.1 | 2.2 | 37.7 |
| MP | 29.3 | 41.2 | -17.5 | 33.5 | 22.4 | 38.3 | -15.7 | 29.3 | 5.8 | 7.3 | -5.5 | 7.9 |
| FP | 54.2 | 73.7 | 47.3 | 21.2 | 47.0 | 48.9 | 45.6 | 2.5 | 34.5 | 45.7 | 32.1 | 6.5 |
| IQ | 13.4 | 27.1 | 8.5 | 9.8 | 59.5 | 68.7 | 55.2 | 6.9 | 43.3 | 65.2 | 49.1 | 16.1 |
| TP | 55.1 | 67.3 | 52.1 | 8.7 | 43.4 | 57.1 | 39.4 | 10.3 | 71.4 | 91.2 | 63.3 | 15.2 |
| EG | 3.8 | 6.6 | -2.2 | 4.7 | 4.6 | 7.3 | -6.6 | 8.1 | 4.9 | 7.8 | -4.4 | 6.7 |

*Source:* Author's own work

## 4.    EMPIRICAL RESULTS

### 4.1.   Panel Unit Root Test

The test was carried out to determine the stationary status of variables, in order to ensure they are suitable for estimation. The variables are required to satisfy the unit root conditions of I(0) or I(1), which means they should be stationary in levels or first differences to make them qualify for use in estimation. Results of the test are shown in Table 3, indicating that FD and IQ are level-stationary in MENA only, FP and TP are level-stationary in LAC only, while EG is level-stationary in all the regions. The variables that are not level-stationary across the regions are however stationary in first differences, as their estimated values exceed the critical minimum value of 2.12. All the variables are therefore highly suitable to be used in GMM and ARDL estimations.

**Table 3: Panel Unit Root Results**

| *Sample of countries: SSA (45), LAC (33), and MENA (21)* *Period: 2000-2023* | | | | | |
|---|---|---|---|---|---|
| *Variable* | *Levin-Lin-Chu unit root statistic (LLC)* | | | | |
| | *Level* | | | *First difference* | |
| | *SSA* | *LAC* | *MENA* | *SSA* | *LAC* | *MENA* |
| FD | 1.92 | 2..02 | 3.01* | 3.22 | 2.75 | - |
| DG | 1.34 | 1.66 | 1.87 | 2.72 | 3.44 | 3.28 |
| MP | 1.58 | 1.33 | 1.96 | 3.11 | 2.97 | 3.08 |
| FP | 1.77 | 2.99* | 1.73 | 2.93 | - | 2.79 |
| IQ | 1.19 | 1.45 | 2.68* | 2.29 | 3.64 | - |
| TP | 1.81 | 3.07* | 1.56 | 3.13 | - | 2.96 |
| EG | 2.98* | 3.24* | 3.09* | - | - | - |
| Critical value of LLC = 2.12 | | | | | | |

*Variable is stationary

*Source:* Author's own work

## 4.2.   Generalized Method of Moments Estimation Results

A close observation of results in Table 4 shows the effect of digital adoption (DG) on financial development in SSA (0.32), LAC (0.47), and MENA (0.69), which are all positive. However, the effect is significant at 1 percent in MENA, and significant at 5 percent in LAC and SSA, indicating that the impact of digitalization is stronger in MENA than other regions. Although the effect is significant in all the regions, SSA appears to lag behind others in adopting digital technology to foster financial development. These results clearly suggest that digitalization is an effective driver of financial development, though the performance differs across regions, which may be attributed to policy choices, technological awareness, and speed of adoption. The results also conform to the postulation of financial intermediation theory (Werner, 2016; Allen and Santomero, 1998), which states that digital adoption enhances financial development. On the other hand, the findings contradict the financial disintermediation theory that postulated unfavourable effect of digital adoption on financial development (Navaretti *et al.*, 2018; Thakor, 2020). The results also contradict the findings of some past studies, such as Antwi & Kong (2021), Ioannou &Wojcik (2022) and Alves (2024), where the impact of digital adoption on financial development was found to be ambiguous and insignificant.

The other explanatory variables maintained significant impact on financial development in all the regions. Monetary policy (MP) and economic growth (EG) had the most significant impacts of 0.43 and 0.59, respectively, in MENA. Fiscal policy (FP) and trade openness (TP) had the most significant impacts of 0.44 and 0.52, respectively, in SSA. Similarly, institutional quality (IQ) had the most significant impact of 0.51 in LAC. These results also show disparity in the performance of other variables that complemented digital adoption in driving financial development in all the regions. The significant effects of the instrumental variables ($FD_{-1}$ and $FD_{-2}$) show that they were able to minimized potential bias of serial correlation and endogeneity. This may be attributed to the optimal choice of instrumental variables, based on the reported Akaike information criterion (AIC) values of 13.75, 12.94, and 14.02 for the respective regions.

In summary, the results have provided clear insight on the purpose of this study as follows:

(i)    There is appreciable disparity in the role of digitalization across the regions, with MENA witnessing the most significant role, while SSA lags behind other regions.

(ii)   The results support the postulation of financial intermediation theory, but contradicts the postulation of financial disintermediation theory.

The diagnostics show chi-square statistics that are significant at 5 percent level, indicating a robust goodness-of-fit, hence the model is considered to have adequately explained the systemic change in financial development. The Sargan and A-B statistics suggest that the model is sufficiently optimized to produce reliable and consistent results. The p-values of statistics fall within critical range, which means there is no serious bias in estimated values of the model.

The robustness check is used to determine the resilience of explanatory variables in driving financial development. This was done by excluding some variables, to determine whether the impacts produced from the GMM estimation will change significantly or not, following Blundell and Bond (1998), Matemilola *et al.* (2012), etc. The test results in Table 5 show that all variables, particularly digital adoption, maintained their respective impact, regardless of the slight differences. The variables are therefore considered to be resilient in driving financial development and cannot be easily disturbed, which augurs well for policy making.

**Table 4: Estimation Results (GMM)**

| Dependent variable: FD | | | | | | |
|---|---|---|---|---|---|---|
| Explanatory variable | SSA countries | | LAC countries | | MENA countries | |
| | coefficient | t-value | coefficient | t-value | coefficient | t-value |
| Intercept | 1.05 | 6.19 | 0.98 | 5.96 | 0.87 | 4.11 |
| DG | 0.32 | 2.61 | 0.47 | 3.59 | 0.69** | 7.64 |
| MP | 0.39 | 2.97 | 0.40 | 3.18 | 0.43 | 3.41 |
| FP | 0.44 | 3.48 | 0.33 | 2.67 | 0.35 | 2.72 |
| IQ | 0.41 | 3.21 | 0.51 | 3.77 | 0.42 | 3.33 |
| TP | 0.52 | 3.86 | 0.38 | 2.89 | 0.30 | 2.48 |
| EG | 0.37 | 2.82 | 0.45 | 3.48 | 0.59 | 3.99 |
| $FD_{-1}$ | 0.54 | 3.91 | 0.31 | 2.55 | 0.53 | 3.84 |
| $FD_{-2}$ | 0.46 | 3.57 | 0.29 | 2.49 | 0.36 | 2.76 |
| Diagnostic Test | | | | | | |
| Pearson chi-square test for goodness of fit (critical p-value = 0.05) | 2.21 (0.024) | | 3.02 (0.031) | | 2.64 (0.029) | |
| Sargan test ($0.05 < p \leq 1$) | 5.87 (0.46) | | 4.99 (0.50) | | 6.03 (0.37) | |
| A-B 1st order correlation test ($0 < p < 0.1$) | 1.96 (0.09) | | 2.01 (0.05) | | 1.99 (0.07) | |
| A-B 2nd order correlation test ($0.25 < p \leq 1$) | 1.44 (0.52) | | 1.83 (0.47) | | 1.68 (0.54) | |
| Akaike (AIC) | 13.75 | | 12.94 | | 14.02 | |

** Significant at 1 percent level

*Note:* In diagnostic test p-values are in parenthesis. A-B stands for Arellano-Bond.

Variables: FD = financial development, DG = digital adoption, MP = monetary policy, FP = fiscal policy, IQ = institutional quality, TP = trade openness, EG = economic growth, $FD_{-1}$ and $FD_{-2}$ = lagged dependent variables used as instrumental variables.

*Source:* Author's own work.

## 4.3. Auto-regressive Distributed Lag Estimation Results

The ARDL model was also estimated to determine the relationships between financial development and the explanatory variables. In Table 6, the MG estimator produced results showing that digital adoption (DG) exerted a positive impact of 0.71 on financial development in MENA, which is significant at 1 percent level, while the values in SSA (0.39) and LAC (0.41) are significant at 5 percent only. Similarly, the PMG estimator shows the most significant coefficient values of 0.67 in MENA, followed by less significant values in SSA (0.32) and

**Table 5: GMM Estimation Results (Robustness Check)**

| Indep. variable | Excluded variable: MP | | | | | | Excluded variable: FP | | | | | |
| | SSA | | LAC | | MENA | | SSA | | LAC | | MENA | |
| | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intercept | 1.11 | 6.32 | 0.99 | 6.16 | 0.95 | 5.06 | 1.25 | 6.51 | 1.34 | 6.92 | 1.08 | 5.44 |
| DG | 0.40 | 3.15 | 0.37 | 2.77 | 0.68 | 8.02 | 0.56 | 3.82 | 0.46 | 3.40 | 0.62 | 7.11 |
| MP | - | - | - | - | - | - | 0.37 | 2.67 | 0.39 | 2.99 | 0.42 | 3.30 |
| FP | 0.51 | 3.66 | 0.46 | 3.39 | 0.39 | 2.81 | - | - | - | - | - | - |
| IQ | 0.38 | 2.98 | 0.40 | 3.18 | 0.36 | 2.64 | 0.43 | 3.30 | 0.34 | 2.57 | 0.39 | 2.91 |
| TP | 0.49 | 3.41 | 0.52 | 3.71 | 0.41 | 3.31 | 0.54 | 3.82 | 0.49 | 3.43 | 0.37 | 2.72 |
| EG | 0.50 | 3.55 | 0.44 | 3.56 | 0.52 | 3.62 | 0.31 | 2.51 | 0.53 | 3.74 | 0.48 | 3.38 |
| $FD_{-1}$ | 0.42 | 3.28 | 0.55 | 3.94 | 0.49 | 3.40 | 0.40 | 3.17 | 0.44 | 3.55 | 0.54 | 3.83 |
| $FD_{-2}$ | 0.35 | 2.62 | 0.33 | 2.72 | 0.28 | 2.56 | 0.38 | 2.73 | 0.41 | 3.22 | 0.36 | 2.64 |
| Sargan test | 3.19 (0.31) | | 2.84 (0.25) | | 3.05 (0.29) | | 2.55 (0.22) | | 2.96 (0.30) | | 3.11 (0.28) | |
| Sargan critical range for p-value: ($0.05 < p \le 1$) | | | | | | | | | | | | |

*Source:* Author's own work

LAC (0.48). The results clearly indicate the effectiveness of digitalization in driving financial sector in all regions, with MENA recording a considerably stronger effect, compared to LAC and SSA. Regardless of the disparity in performance, the results indicate that digitalization played appreciable role in financial development across the regions. Furthermore, the results conform to the postulation of financial intermediation theory, and contradict the financial disintermediation theory. The estimators also produced results showing that other variables had significant effect on financial development. Monetary policy and economic growth are observed to have the most significant effect in MENA, as fiscal policy and trade openness maintained the strongest effect in SSA, while institutional quality had the most superior impact in LAC. The results again suggest that the control variables complemented digital adoption in driving financial development. The lagged financial development ($FD_{-1}$) is significant in all the regions, suggesting a fairly good response of financial development to its own lag. The ARDL results are largely similar to the GMM results, which suggest that the effect of digital adoption and the other control variables are consistent, hence the results can be considered highly reliable.

The Wald test statistics indicate a rejection of null hypothesis which states that there is no relationship between dependent variable and the explanatory variables, based on the significant p-values at 5 percent level. Therefore, the systemic change in financial development was largely accounted for by

all the explanatory variables. Statistics of the Hausman test also indicate no substantial evidence of heterogeneity ($H_0$) in estimated results, which makes PMG estimator more superior compared to the MG estimator.

**Table 6: Estimation Results (ARDL)**

| Indep. variable | MG Estimator | | | | | | PMG Estimator | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SSA | | LAC | | MENA | | SSA | | LAC | | MENA | |
| | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat | coeff | t-stat |
| Intercept | 1.08 | 4.99 | 1.31 | 5.27 | 0.98 | 4.04 | 1.24 | 5.09 | 0.89 | 3.46 | 1.02 | 4.87 |
| DG | 0.39 | 2.11 | 0.41 | 2.32 | 0.71 | 8.22 | 0.32 | 2.02 | 0.48 | 2.25 | 0.67 | 7.23 |
| MP | 0.29 | 1.97 | 0.38 | 2.09 | 0.47 | 2.21 | 0.33 | 2.04 | 0.40 | 2.14 | 0.52 | 2.65 |
| FP | 0.51 | 2.55 | 0.40 | 2.12 | 0.35 | 2.16 | 0.58 | 2.96 | 0.45 | 2.05 | 0.47 | 2.20 |
| IQ | 0.31 | 1.98 | 0.43 | 2.86 | 0.45 | 2.15 | 0.29 | 1.97 | 0.36 | 2.17 | 0.50 | 2.58 |
| TP | 0.61 | 3.03 | 0.38 | 2.10 | 0.52 | 2.56 | 0.57 | 2.91 | 0.29 | 1.98 | 0.46 | 2.18 |
| EG | 0.46 | 2.19 | 0.50 | 2.57 | 0.55 | 2.86 | 0.51 | 2.61 | 0.54 | 2.70 | 0.60 | 3.04 |
| $FD_{-1}$ | 0.33 | 2.03 | 0.42 | 2.22 | 0.28 | 1.96 | 0.44 | 2.14 | 0.37 | 2.19 | 0.42 | 2.34 |
| Wald test (at 0.05) | 4.06 (0.008) | | 3.97 (0.011) | | 3.88 (0.009) | | 4.14 (0.007) | | 3.76 (0.013) | | 4.09 (0.006) | |
| Hausman test ($H_0$ = PMG, $H_1$ = MG): t-statistic = 0.91, p-value = 0.16 (p-value at critical 0.05 level) | | | | | | | | | | | | |

*Source:* Author's own work

These results are further buttressed by the long-run multipliers reported in Table 7, which are greater than one (unity) for digital adoption and the other variables. Generally, the long-run multipliers fall within the range of 1.23-2.50, indicating that the magnitude of total effect (direct and indirect) generated by each explanatory variable is considerably larger compared to the direct effects reported in Table 6.

**Table 7: ARDL Estimation Results (Long-run Multiplier Effects)**

| Explanatory variable | MG estimator | | | PMG estimator | | |
|---|---|---|---|---|---|---|
| | SSA | LAC | MENA | SSA | LAC | MENA |
| Intercept | - | - | - | - | - | - |
| DG | 1.64 | 1.69 | 2.17 | 1.92 | 1.47 | 2.56 |
| MP | 1.23 | 1.61 | 1.89 | 1.49 | 1.68 | 2.08 |
| FP | 2.04 | 1.69 | 1.54 | 2.38 | 1.82 | 1.89 |
| IQ | 1.45 | 1.75 | 1.82 | 1.41 | 1.56 | 2.0 |
| TP | 2.08 | 1.61 | 2.04 | 2.22 | 1.42 | 1.85 |
| EG | 1.85 | 2.0 | 2.22 | 2.05 | 2.17 | 2.50 |
| $FD_{-1}$ | - | - | - | - | - | - |

*Source:* Author's work.

## 5.    POLICY IMPLICATIONS AND OPTIONS

The estimation results clearly revealed that digitalization played appreciable role in driving financial development in the three emerging regions. This role was largely complemented by the other control variables. The salient policy implications of the results are presented below.

(a)  The disparity in the role of digitalization across the regions shows that MENA is far ahead of other regions in adoption of digital technology.

(b)  The role of digitalization conforms to the postulation of financial intermediation theory, which shows that digital technology is a potent driver of financial development.

(c)  The role of digitalization however contradicts the financial disintermediation theory, which seems to allay the fears in adopting digital technology.

(d)  The role of digital adoption in this study also does not conform to the previous study on Latin America countries (Brazil, Mexico and Argentina), where Ioannou and Wojcik (2022) found ambiguous impact.

    In view of the foregoing implications, it is important to proffer some policy options, which would help to enhance financial development, as follows;

(i)    Adoption of digital technology needs to be sustained in MENA and given more attention in LAC and SSA by reducing tariff on the import of digital equipment. This policy measure will provide more access to digital technology and enhance financial development.

(ii)   Fiscal policy should be reviewed by reducing taxes (personal and corporate), in order to enhance its role financial development.

(iii)  Monetary policy also needs to be reviewed by allowing market forces to determine interest rate, which will boost investments in financial market.

(iv)   Trade and exchange rate policies need to be reviewed by reducing trade barriers and allowing exchange rate to be determined by market forces, which will enhance foreign participation in financial markets.

(v)    Institutional quality can be improved by enforcing financial regulations and accountability, which can also boost financial development.

## 6.    CONCLUSION

Financial development in emerging regions was investigated in this study, with the aim of determining the role of digitalization, and how it conforms to

theoretical postulations. This is sequel to the growing trend of digital adoption driven by internet connectivity. This current study differs from the past studies by focusing on the comparison of emerging regions where the World Bank is providing support in digital transformation. The study therefore employed econometric techniques to determine the effect of digital adoption on financial development in SSA, LAC, and MENA. The estimation results revealed that digitalization remained a potent driver of financial development in all the regions, with exceptionally high impact in MENA compared to SSA and LAC. The role of digitalization also conformed to the postulation of financial intermediation theory. In the same vein, fiscal and monetary policies, trade openness, institutional quality, and economic growth had significant impact and complemented digital adoption in driving financial development.

These findings are quite revealing and thus require some policy measures to ensure sustainability of financial development. The main policy option entails a reduction in tariff on the import of digital equipment in order to increase the level of digital adoption. It is also important to enhance the effect of fiscal and monetary policies by cutting taxes and allowing market forces to determine interest rate. Similarly, the effect of trade and exchange rate can be enhanced through the relaxation of trade barriers and allowing market forces to operate in the foreign exchange market. Furthermore, it is important to raise the level of institutional quality by enforcing financial regulations and accountability. All these measures can lead to better operations, greater efficiency, and a boost in financial development. Finally, the study is expected to motivate further empirical studies on the role of digitalization in financial development of other emerging regions such as South East Asia (SEA), South West Pacific (SWP), etc.

## Disclosure statement

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(ii)  There is no conflict of interests in the research work.

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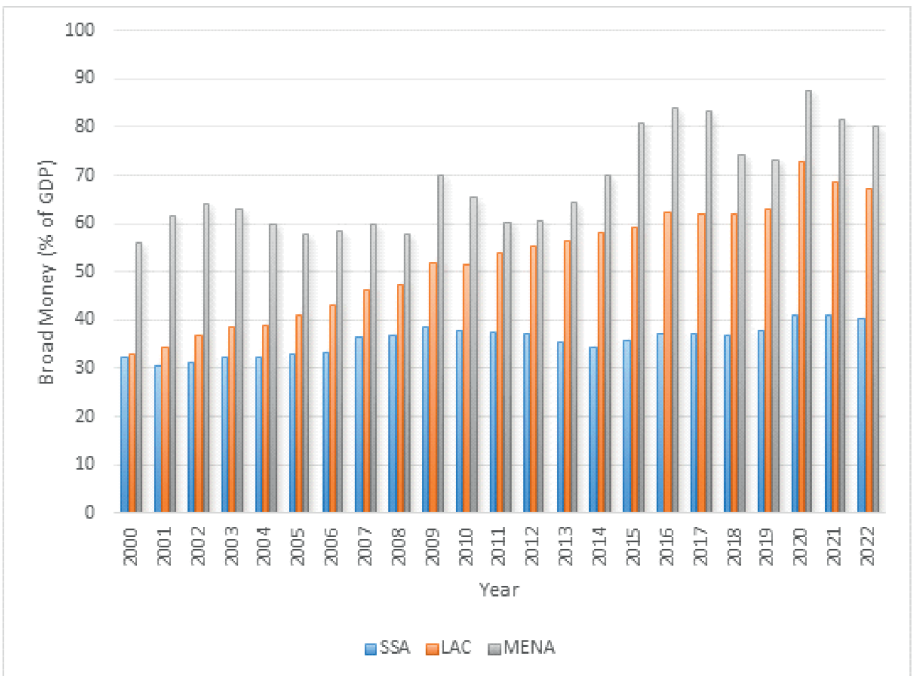
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**Appendix 1: Digital Adoption**
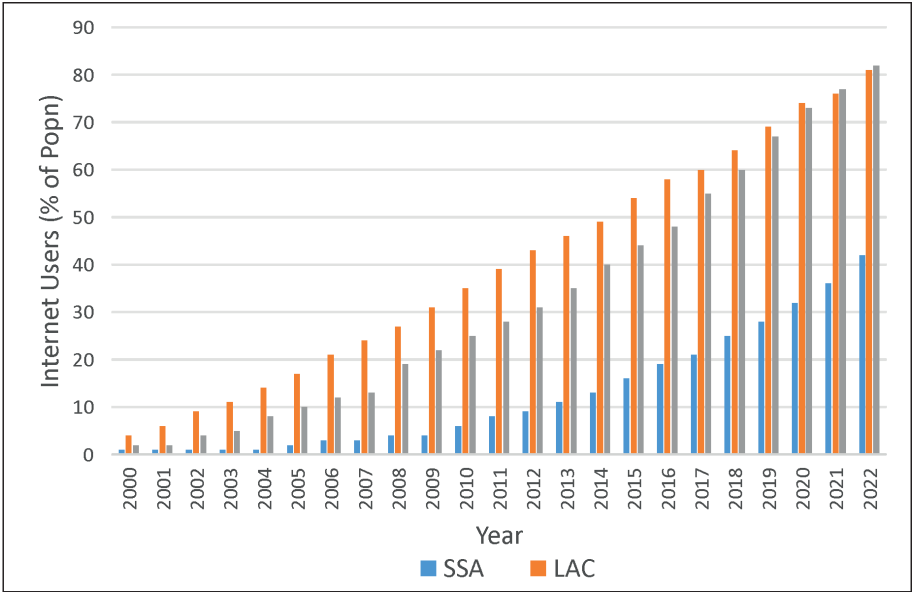


*Source:* Author's own work

**Appendix 2: Financial Development**



*Source:* Author's own work