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Mohsin Ali
Monash University Malaysia, mohsin.ali121@gmail.com

Urooj Anwar
Monash University Malaysia, urooj.anwar@monash.edu

Mudeer Ahmed Khattak
- *Malaysia*, mudeerkhattak@gmail.com

Muhammad Umar Islam
Asia Pacific University of Technology and Innovation - Malaysia, umar.islam@staffemail.apu.edu.my

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DIGITALIZATION AND ECONOMIES OF OIC COUNTRIES

Mohsin Ali*, Urooj Anwar**, Mudeer Ahmed Khattak***, and Muhammad Umar Islam****

*Corresponding author. School of Business, Monash University Malaysia, Malaysia.
Email: mohsin.ali@monash.edu
**School of Business, Monash University Malaysia, Malaysia.
***Department of Business Administration, IQRA University, Islamabad, Pakistan
****Asia Pacific University of Technology and Innovation, Malaysia.

ABSTRACT

We investigate whether digitalization plays any role in enhancing the economic growth of the Organization of Islamic Countries (OIC). Our results indicate that digitalization positively impacts the economies of OIC countries. As for policy implication, this study recommends governments of OIC member countries to invest in digital infrastructure to foster economic growth.

Keywords: Digitalization; Economic growth; OIC member countries.
JEL Classifications: O33; O40; O50.

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I. INTRODUCTION

In the last couple of decades digitalization has become a very important part of our daily life. Knowingly or unknowingly, we consume far more digital technologies today than ever in human history (Rapke and Christensen, 2013). This has also changed the way economic activities operate in today's age. From doing banking transactions to hiring a cab all is done via digital technologies. This is expected to have an impact on the overall economy (Warhurst and Hunt, 2019).

This impact is basically to be ascribed to the advancements in Information and Communication Technologies (ICT). More specifically, the advancements are more evident in the case of internet and mobile phone technologies that started developing new products, processes, and environments. Countries are now bound to adopt technological changes as they are now regarded as one of the essential mechanisms for economic and social development (Acemoglu and Robinson, 2013). The ICT is also regarded as an important source of economic growth (Arendt, 2015).

A large literature documents that enhancements in digital infrastructure generate economic growth (Madden, 1998; Canning, 1999; Bjorkroth, 2003). Ward and Zheng (2016) argue that despite the growing role of digitalization in economic and social progress, its impact is dependent on the level of economic development of an individual country. Thompson and Garbacz (2011) argue that enhancement in broadband infrastructure impacts low-income economies more as compared to economies with higher income.

The literature suggests that the enhancements in digital infrastructure are helping to reduce the income gap between economies (Arendt, 2015; Steinmueller, 2001). Digitalization could also be a double-edged sword, as in a few countries, it has brought in pre-mature industrialization especially in low-income countries (Rodrik, 2018). This makes it very interesting to study how digitalization impacts economies, especially the developing economies.

In this study, we examine the impact of digitalization on OIC economies. Most of these economies are low-income economies. Our goal is to examine whether digitalization has positively impacted the economic growth of OIC countries. There are studies that have examined the causal effects of digitalization on economic growth. Some show a one-way causality (Beil *et al.*, 2005), while other studies document bi-directional causality (Pradhan *et al.*, 2014; and Shiu, and Lam, 2008). This is probably due to possible endogeneity issues as prior studies do not account for the dynamism of economic growth and infrastructure development relationship. For this reason, in this study, we employ the Generalized Methods of Moments (GMM) to address endogeneity issues. The neoclassical growth model posits that long-term economic growth can be attributed to exogenous factors such as capital accumulation, population growth, and technological progress (Solow, 1956). In the state of equilibrium in the Solow model, no growth is observed in terms of per capita capital, consumption, or output. The phenomenon of growth was elucidated through the consideration of exogenous factors, including population growth and technological advancements. In Mankiw's (2003) analysis, it is posited that the Solow model attributes the sustained improvement in living standards to technological advancements exclusively. The subsequent advancements in growth theories, as formulated by Barro *et al*. (1991), Barro and Sala-i-Martin (1992), Lucas

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(1988), Grossman and Helpman (1991), and Barro and Sala-i-Martin (1995), have deviated from the aforementioned basic model by incorporating the concept of endogenous technological change. Furthermore, there is a contention that the proliferation of contemporary technology not only impacts economic progress and advancement, but also influences various outcomes such as life expectancy, levels of democracy, health outcomes, poverty rates, and literacy.

The role of digitalization in fostering economic growth in developing countries has been a subject of debate. Scholars such as Dahlman *et al*. (2016) argue that digitalization plays a crucial role in driving economic growth by enhancing capital and labour productivity, reducing transaction costs, and facilitating access to global markets. Emerging technologies have the capacity to enhance accessibility to goods and services, resulting in reduced price points. It is possible for developing economies to potentially achieve a transition to a developed economy status through a process commonly referred to as leapfrogging. The proliferation of mobile phones in developing nations has facilitated the availability of long-distance communication, despite limited investments by governments in fixed telecommunications infrastructure. Mobile banking is an illustrative instance that has effectively enhanced the accessibility of financial services for a significant proportion of individuals experiencing poverty, primarily as a result of limited presence of traditional banking institutions in rural regions. In the region of Sub-Saharan Africa, Kenya serves as an illustrative case where the implementation of mobile banking has facilitated a transition for individuals from agricultural pursuits to non-farm enterprises. This transition holds the potential to contribute to an increase in per capita consumption levels and a reduction in poverty rates over time.

According to Rodrik (2015), the advent of technological advancements has resulted in a phenomenon known as deindustrialization in numerous developed nations. This trend is particularly evident in the declining proportion of employment within the manufacturing sector. Indeed, a decline in the overall employment proportions within the manufacturing industry has been observed in the United States since 1950. The United Kingdom serves as an additional illustration of a high-income nation that has experienced significant deindustrialization.

Interestingly, a comparable pattern has been observed in developing and least developed nations, wherein they too have undergone deindustrialization in terms of both employment and value added. This phenomenon is particularly perplexing, particularly in the context of economically disadvantaged nations. According to Rodrik (2018), the impact of the current situation has been comparable in both low-income countries and middle-income countries within Sub-Saharan Africa, despite the significant disparity in industrialization levels between the two groups. The phenomenon under discussion is commonly referred to as "premature deindustrialization". Scholars argue that this trend is particularly prevalent in low-income countries, which tend to have lower levels of development and are often dependent on manufacturing products at prevailing market prices. Trade liberalisation and globalisation have led to a phenomenon where low-income countries tend to engage in the importation of manufacturing products, primarily driven by their limited comparative advantage in this sector.

Sub-Saharan African nations such as Ghana, Nigeria, and Botswana have been identified as instances of premature deindustrialization, as discussed by Rodrik (2018). Although these nations have experienced economic expansion, their growth trajectory deviates from the conventional path of industrialization. According to the observations made by Ajakaiye *et al*. (2016), the Nigerian economy has undergone a transition from an agrarian-based economy to a tertiary service-based economy, bypassing the intermediate stage of industrialization. However, despite the advancements in ICT, the need for a highly skilled workforce remains crucial as a complementary element of production. It is worth noting that skilled labour is particularly scarce in Sub-Saharan Africa.

The advent of digital technologies has brought about significant changes in the value chain of various sectors, enabling small businesses to effectively operate within a dynamically managed supply chain across multiple locations and with a global workforce (Manyika and Roxburgh, 2011). There is a prevailing argument that Global Value Chains (GVCs) play a significant role in facilitating the transfer of technologies to developing nations. The emergence of Global Value Chains (GVCs) has been facilitated by the advancements in ICT, enabling firms in developed economies to leverage the cost advantages offered by developing countries. Rodrik (2018) has demonstrated that the anticipated benefits of GVCs for facilitating the integration of developing countries into the global market have not materialised. Furthermore, there has been a notable decline in employment, particularly in the Sub-Saharan African region, during the period spanning from 1995 to 2013.

The advancement of ICT has led to the emergence of electronic commerce (e-commerce), which is believed to offer a distinctive avenue for Small and Medium Enterprises (SMEs) in developing and least developed nations to gain entry into global markets. The adoption of mobile money and improved internet connectivity in various African economies has resulted in the emergence of novel digital business practices on the continent (ITC, 2015). According to the International Trade Centre (ITC, 2015), domestic digital businesses, specifically domestic e-commerce, have experienced significant growth in Africa. In contrast, international e-commerce has not shown the same level of development and remains relatively weak in the region. The primary factors contributing to Africa's relative underdevelopment in the field of international e-commerce are predominantly institutional in nature, with the digital divide serving as an additional contributing factor. The impediments to e-commerce in Africa are believed to stem from various challenges, including government regulations that impose limits on transaction amounts, inadequate domestic and regional infrastructure, and political barriers (ITC, 2015). In the context of banking, the utilisation of credit cards in Africa's Least Developed Countries (LDCs) is observed to be merely 0.7 percent, in contrast to 1.8 percent in other regions of Africa and a significantly higher proportion of 45.9 percent in developed nations (UNCTAD, 2018). According to the United Nations Conference on Trade and Development (UNCTAD, 2018), the proportion of individuals with access to electricity in African LDCs is below 30%. This limited access to electricity also hampers the utilisation of ICT equipment and infrastructure. However, the presence of a dependable and cost-effective ICT infrastructure, such as high-speed broadband, is crucial for the successful implementation of e-commerce.

Banga and Te Velde (2018) raise inquiries regarding the potential of Sub-Saharan African economies to leverage the digital revolution to enhance their economic growth. The existence of a persistent digital divide between developed and developing nations remains evident, despite the widespread adoption of ICT that has contributed to global prosperity (Castells and Cardoso, 2006). Despite the significant advancements in ICT in Africa, a noticeable disparity in digital access and capabilities persists between Sub-Saharan Africa and other developing regions. Furthermore, the digital divide in Sub-Saharan Africa is characterised by notable disparities in digital competencies among various employment and education status cohorts, as well as between rural and urban regions, genders, and age groups (International Telecommunication Union (ITU), 2018; Nour, 2017). The deployment of broadband predominantly occurs in urban areas, and without the implementation of public measures, it is improbable that this circumstance will undergo significant alteration.

By the conclusion of the year 2016, the proportion of individuals utilising the internet in Africa amounted to merely 20%, in stark contrast to the global average of nearly 50%. In comparison to other global regions, Sub-Saharan African nations have exhibited a notable disparity in terms of internet accessibility. According to Banga and Te Velde (2018), the internet penetration rate, which refers to the percentage of the population with internet access, was lower in Sub-Saharan Africa compared to South Asia in 2016. According to the ITU (2018), various factors impede the process of digitalization in Sub-Saharan Africa. These include the elevated costs associated with ICT, as well as inadequate infrastructure and logistical challenges. The lack of a dependable electricity grid and sufficient energy resources indicates a limited level of preparedness for digital technologies. Figures 1 and 2 present the level of digitalization in different OIC countries based on the data related to the year 2020. We can see that high-income countries like UAE, Qatar, Saudi Arabia, Bahrain, Oman, and Kuwait have relatively higher broadband connections and mobiles per 100 inhabitants.

Figure 1.
Fixed Broadband Subscriptions

The figure shows fixed broadband subscription per 100 inhabitants of different OIC member countries for the year 2020.

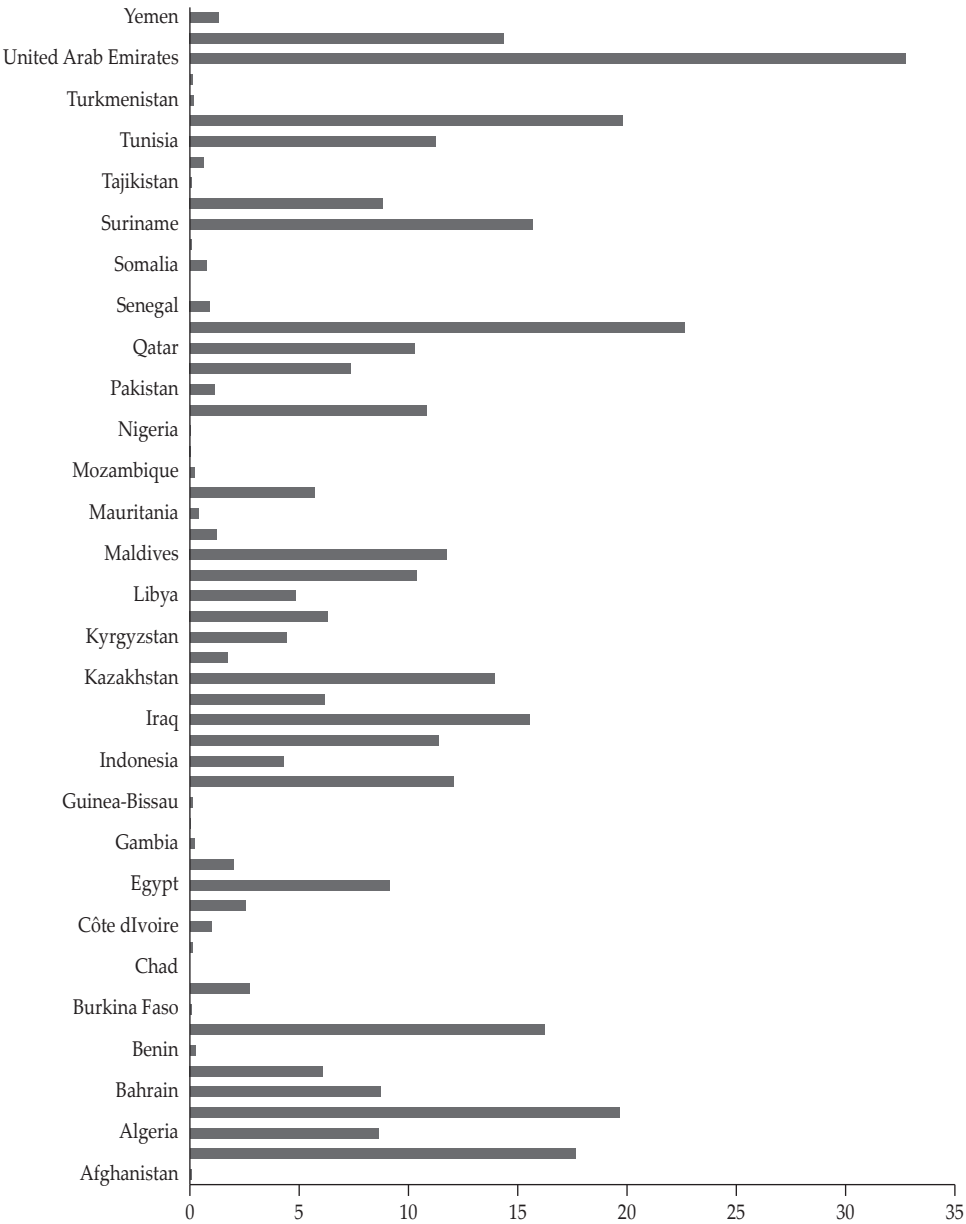

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Figure 2.
Mobiles Per 100 Inhabitants

The figure shows mobile phones owned per 100 inhabitants of different OIC member countries for the year 2020.

A significant portion of the populace experiences financial exclusion due to their unbanked status. This exclusion can be attributed to a range of factors, including elevated banking expenses, fees, and rigorous documentation prerequisites. As a result, the increasing prevalence of mobile phones has led to a corresponding rise in the popularity of mobile money services, which serves to address this void. Ghosh (2016) examines the relationship between mobile phone penetration

and India's economic growth, as well as its impact on financial inclusion. They document a positive association between mobile phone penetration and economic growth, along with significant effects on financial inclusion.

Certain countries in Sub-Saharan Africa, such as Tanzania and Kenya, have emerged as pioneers in the adoption and implementation of digital financial services. Financial inclusion has been observed in various countries through the utilisation of mobile money, as reported by the World Bank (2016). The aforementioned circumstance has had a significant impact on a substantial portion of the populace, particularly those who are economically disadvantaged and lack the means to engage with established financial entities such as banks. Mobile money has emerged as a robust tool widely utilised by the majority of individuals in these nations for diverse purposes, including the settlement of utility bills such as water and electricity, the acquisition of insurance products, international remittances, and credit services, among others. According to the Finscope survey conducted in 2013, it was found that in Tanzania, a mere 11 percent of the population, primarily concentrated in urban regions, had access to formal financial services by the end of year 2006. In contrast, it was observed that in the year 2016, over 50 percent of individuals had gained financial access through either banks or mobile money providers.

Safaricom (2018) reported that the number of M-pesa agents in Kenya has exceeded 156,000. The term "M-pesa" is derived from the Swahili language and translates to "mobile money". Mbiti and Weil (2011) conducted a comprehensive investigation on the utilisation and economic ramifications of M-Pesa in Kenya. Their findings indicate that the proliferation of M-Pesa users has resulted in a decline in informal savings, while concurrently enhancing the likelihood of individuals gaining access to formal banking services. In their study, Ouma *et al*. (2017) examined the correlation between the extensive utilisation of telephony in the provision of financial services and its impact on savings in specific economies within Sub-Saharan Africa. The researchers discovered that the utilisation of mobile phones not only enhances savings at the household level but also increases the volume and frequency of financial transactions.

The rest of the paper proceeds as follows. Section II explains the methodology, data, and variables. Section III presents descriptive statistics. Section IV discusses main findings and Section V provides some concluding remarks.

II. METHODOLOGY, DATA, AND VARIABLES

The primary methodology used in this study is generalized methods of moment GMM (Arellano and Bover, 1995 and Blundell and Bond, 1998). This methodology is extensively used when the time period is smaller than the number of cross-sections (Roodman, 2006). In the system GMM, in the level regression we use lagged first differenced variables as instruments. On the other hand, for the first-differenced regression, we use lagged-level variables as instruments. We consider all explanatory variables as weakly exogenous. We have also used ordinary least squares (OLS) and fixed effects estimator in our study to examine the robustness of our results. The dynamic panel growth equation used in this study is borrowed from Datta and Agarwal (2004) and it takes the following form:

$$GDPPCG_{it} = \alpha GDPPCG_{i,t-1} + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where *GDPPCG* represents the growth rate of GDP per capita, *X* represents a vector of variables that impact economic growth. Here besides traditional explanatory variables like Government Consumption (GC), Gross Fixed Capital Formation (GFCF), and Trade Openness (TO), we include three different proxies of digitalization i.e., internet usage, mobile, and broadband subscription. ε_{it} represents the error term which is assumed to be independently and identically distributed.

We have used a panel data set of 57 OIC member countries. We extracted data for variables like the GDP per capita (PPP adjusted), government consumption, trade openness, population growth, and gross fixed capital formation from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC). SESRIC is a publicly available database and is a subsidiary organ of the OIC. Their website is https://www.sesric.org. All data is collected in constant prices. On the other hand, the data for digitalization related variables like internet usage, subscription of mobile networks, and broadbands is collected from the International Telecommunications Union (ITU) database.

Our overall panel dataset encompasses time period of twenty-one years i.e., from 2000 to 2020. Most of the data on digitalization related variables is not available for the period prior to 2000. The definition of variables used in this study is presented in Table 1.

Table 1.
Variable Names and Definitions

This table presents definitions of different variables used in the study.

Variable name	Definition
GDP per capita growth (GDPPC)	GDP per capita is growth of gross domestic product divided by total population.
Trade Openness (TO)	The total of exports and imports measured as a share of gross domestic product.
Population growth rate (POP)	Annual population growth rate for year in comparison to last year
Gross fixed capital formation (GFCF)	Cost of land improvements, construction of roads, machinery.
Consumption by Government (GC)	Includes all current government spending on goods and services
Mobile subscription (Mobile)	Mobile-cellular telephone subscriptions per 100 inhabitants
Internet User (internet users)	Percentage of Individuals using the Internet
Broadband Subscriptions (BB)	Fixed-broadband subscriptions per 100 inhabitants

III. DESCRIPTIVE STATISTICS

In our study, the dependent variable, GDP per capita is measured in 2015 constant US dollars. We present correlation matrix of our variables in Table 2. We find that there is high correlation between mobile usage and internet i.e., 0.77, whereas the correlation between broadband subscription and mobile usage is 0.56. This shows

the relatively poor state of the broadband infrastructure in OIC member countries. Table 3 presents descriptive statistics of all variables used in this study. We report that the minimum GDPPC is only 95 dollars whereas the highest GDPPC is around 73,500 dollars. This shows a huge disparity in terms of per capita income in OIC member countries. The average income per capita of the countries under study is 6590 dollars. Among our main explanatory variables, on average mobile subscription is highest, followed by internet usage. The broadband subscription is only around 3% which is very low and shows poor broadband infrastructure in Islamic countries. Among other variables the average GFCF is around 23,100 million dollars and GC is around 13,200 million dollars.

Table 2.
Correlation Matrix

The table presents correlation between all variables used in this study. GDPPC represents gross domestic product per capita growth, GC represent government consumption, GFCF represents gross fixed capital formation, POP stands for population growth rate, TO represents trade openness, Internet represents internet users in the country, Mobile shows number of mobiles owned by per 100 inhabitants of the country, and BB represents broadband subscription per 100 inhabitants of a country.

Variables	GDPPC	GC	GFCF	POP	Trade	Internet	Mobile	BB
GDPPC	1							
GC	0.236	1						
GFCF	0.180	0.858	1					
POP	0.356	-0.056	-0.069	1				
TO	0.286	-0.063	-0.105	0.016	1			
Internet	0.511	0.346	0.291	-0.017	0.304	1		
Mobile	0.389	0.311	0.282	0.030	0.234	0.777	1	
BB	0.372	0.388	0.309	-0.082	0.243	0.808	0.565	1

Table 3.
Descriptive Statistics

The table presents descriptive statistics of all variables used in this study. GDPPC represents gross domestic product per capita growth, GC represent government consumption, GFCF represents gross fixed capital formation, POP stands for population growth rate, TO represents trade openness, Internet represents internet users in the country, Mobile shows the number of mobiles owned by per 100 inhabitants of the country, and BB represents broadband subscription per 100 inhabitants of a country.

Variables	Observations	Mean	Std. Dev	Min	Max
GDPPC	1197	6591	11629	95.612	73493.270
GC	1197	13200	25900	58.300	200000.000
GFCF	1197	23100	45700	31.700	349000.000
POP	1197	2.370	1.87	-6.852	19.360
Internet	1150	22.58	26.22	0.005	100.000
Mobile	1190	65.26	49.98	0.110	212.639
TO	1197	76.90	41.60	1.862	376.224
BB	925	3.10	4.93	0.001	32.811

IV. RESULTS AND ANALYSIS

In this section, we will present and discuss our main results. We have used the following three empirical approaches, the OLS, panel fixed effects, and the system GMM methodology. We report our results in Table 4.

First, we discuss results obtained using the OLS model to examine the impact of our independent variables (namely GFCF, GC, TO, Internet, Mobile, and BB) on GDPPC. These results are represented by model 1 in Table 4. We begin by testing endogeneity issues in our basic regression model. Particularly, we use the Durbin-Wu-Hausman test and document that a number of variables in our study have endogeneity issue and hence our results are inconsistent. So, therefore, to address the problem of the presence of endogeneity issues, we have estimated our regression model using the panel fixed effects and system GMM methods. Results obtained using the panel fixed effects and system GMM are represented by models 2 and 3, respectively. We report our diagnostic statistics to determine the appropriateness of the GMM model in the last six rows of the table. Our results show that there is no first or second order serial correlation. This implies that the lags used as instruments in the GMM equation are appropriate.

Table 4.
Effects of Digitalisation on OIC Economies

The table presents the main findings using the OLS (model 1), Fixed Effects (model 2), and System GMM (model 3) methods. In this table, GDPPC represents gross domestic product per capita growth, GC represent government consumption, GFCF represents gross fixed capital formation, POP stands for population growth rate, TO represents trade openness, Internet represents internet users in the country, Mobile shows number of mobiles owned by per 100 inhabitants of the country, and BB represents broadband subscription per 100 inhabitants of a country, FDI represents foreign direct investment. Covid represents a dummy variable taking value of 1 for year 2020 and 0 otherwise. AR represents autoregressive order. The p-values are reported in parentheses and significance levels are denoted with asterisk for ***p < 0.01, **p < 0.05, *p < 0.1.

Variables	Model (1)	Model (2)	Model (3)	Model (4)
	OLS	Fixed Effects	System GMM	System GMM
L.GDPPC			0.923***	0.746***
			(0.000)	(0.003)
GC	0.324***	0.123***	0.021	0.015
	(0.000)	(0.000)	(0.298)	(0.356)
GFCF	-0.041	0.234***	0.066*	0.034**
	(0.476)	(0.000)	(0.086)	(0.041)
TO	0.009***	-0.000**	0.001**	0.000*
	(0.000)	(0.046)	(0.040)	(0.063)
Internet	0.016***	0.002***	0.001***	0.005**
	(0.000)	(0.000)	(0.001)	(0.033)
Mobile	0.022	0.009	0.012**	0.058**
	(0.612)	(0.304)	(0.016)	(0.034)
BB	0.052***	0.015***	0.010**	0.011**
	(0.008)	(0.001)	(0.028)	(0.049)
FDI				0.361*
				(0.094)
Covid				0.512
				(0.833)
Constant	0.548	0.0574	-1.419**	-1.419**
	(0.251)	(0.915)	(0.030)	(0.029)

Table 4.
Effects of Digitalisation on OIC Economies (Continued)

Variables	Model (1)	Model (2)	Model (3)	Model (4)
	OLS	Fixed Effects	System GMM	System GMM
No of Observations	885	885	881	881
R-Squared	0.58	0.52		
No of Countries	57	57	57	57
AR (1) *p*-value			0.193	0.209
AR (2) *p*-value			0.443	0.679
Sargan *p*-value			0.265	0.360

In all three models, two of our proxies for digitalization, namely internet usage and subscriptions of broadband seems to have a positive impact on the economies of OIC member countries. The mobile subscription is found to be statistically significant only in the case of model 3. The OLS results indicate that internet usage contributes around 1.58% for every additional percentage increase in internet users. Broadband also has a positive and statistically significant coefficient. Both these variables are statistically significant at the 1% level. As far as other variables are concerned, GC and TO are found to be positive and statistically significant, whereas GFCF is found to be statistically insignificant.

Our results obtained using model 2 are consistent with model 1 based results. More specifically, we report that internet usage, broadband subscription, GC, and TO have a positive and statistically significant impact on the economic growth of OIC countries. The only insignificant variable is mobile usage.

Now, we turn to our results obtained using model 3. We find that proxies of digitalization, namely internets usage and mobile and broadband subscription have a positive and statistically significant impact on economic growth of OIC economies. Additionally, GFCF and TO are also found to be statistically significant but GC is found to be statistically insignificant.

In addition to the above mentioned three models, we have estimated the fourth model by including a variable FDI as another control variable and a dummy variable representing the COVID-19 pandemic period. We find that FDI has a positive and statistically significant effect on economic growth. The COVID-19 dummy variable is found to be statistically insignificant showing no impact of the pandemic on the discussed relationship.

The role of digitalization in enhancing economic growth is unquestionable. As far as our results are concerned, we find that internet contributes to the economy most, followed by the mobile usage. The role of broadband can also not be denied. Most of the OIC economies are underdeveloped economies which need to enhance their digital infrastructure.

V. CONCLUSION

In this study, we examine the role of diffusion of digitalization of economies and how it impacts economic growth. We choose the OIC countries as our sample and collected data for the period 2000-2020. In line with earlier studies, like Myovella

et al. (2020) and Appiah-Otoo and Song (2021), we find that internet usage, mobile and broadband subscription positively impacts the economy. Our study has implications for policymakers, the digital infrastructure needs to be enhanced so that it can foster economic growth. Improved internet and broadband would help businesses in OIC economies to explore opportunities and avenues. Our study has limitations in terms of proxies for digitalization (such as social media, robotics, IT education) and that is due to unavailability of data.

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