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Impact of Digitalization and GDP Growth on Instigating Entrepreneurship: The Moderating Effect of Human Capital
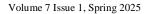
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Abstract

Digitalization has become an economic force in the modern era, restructuring traditional business models, approaches, and procedures. The embracing of widespread digital technology, along with continuous development of human capital, to promote entrepreneurship is a significant challenge. This paper investigates the effect of digitalization and GDP on entrepreneurship, as well as the moderating effect of human capital. For this purpose, fixed effect estimation technique was used on annual unbalanced panel data of 139 countries collected for a period of 9 years, that is, from 2011 to 2019. The findings show that digitalization has a positive and a statistically significant impact on entrepreneurship in the singleton model, as well as a positive and significant impact in all other models. Similarly, GDP growth also has a positive and significant effect across all the models. Human capital, proxied as tertiary school education, was also found to have a positive and significant impact on entrepreneurship. The analysis shows that the impact of digitalization is more significant in countries where tertiary education fosters the development of human capital, than in those countries that offer primary and secondary education. Furthermore, human capital also moderates the nexus between digital financial inclusion, economic growth, and entrepreneurship. The results of the regional comparison also depict that there is a strong positive and significant impact of all the proxies of digitalization and GDP growth on entrepreneurship in Europe and Central Asia, as compared to East Asia and the Pacific. These results show that the higher the level of digitalization, economic growth, and human capital, the higher the level of entrepreneurship.

Keywords: digitalization, digital financial inclusion, economic growth, entrepreneurship, financial development, human capital

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Introduction

In the modern era, most people rely on their technological competence, so shifting from traditional business models to digital ones is the key revolution in the modern business world (Li et al., 2023). Digital access to finance is among the most widely documented international developments (Duvendack & Mader, 2020; Mogaji & Nguyen, 2022; Tay et al., 2022). Digitalization is one of the most critical motivations behind world development (Jovanović et al., 2018). The foundational assumption of Digital Financial Inclusion or DFI is that the underprivileged or excluded should have access to official bank accounts and may use digital platforms to perform basic financial transactions for the smooth running of their business activities. A customized DFI program is needed to ensure that excluded and marginalized communities may fully grasp and experience the expected benefits (Tay et al., 2022). DFI empowers people from excluded and underprivileged areas with access to finance and digital technology in order to provide official financial services. These types of services ought to be tailored with consumers' requirements to provide them with maximum benefits at affordable prices keeping in view the sustainability of the suppliers.

The term 'digitalization' is used to describe the process of embracing and integrating digital technologies into numerous facets of business, society, or individual activities. It entails applying digital resources (such as tools, technology, and data) to convert analog activities into digital activities. Advancements in cellular and internet technology have opened new doors for the comprehensive growth of digitalization. In this context, this study examines how digitalization promotes entrepreneurship. The Internet, mobile phones, and ATMs are important for this purpose. For business transactions, mobile money transfers can provide financial access. ATMs are essential for an enterprise's cash withdrawals. ATMs and mobile phones rely on the Internet connection to make smooth transactions. The consequences of the usage of mobile phone services and digital transactions (Li et al., 2023) are now more frequent and significant than traditional financial services, which enhances the probability of savings and positively affects them (Ouma et al., 2017). Hence, digitalization constitutes the process of employing digital tools including mobile phones, the Internet, and ATMs to increase productivity and efficacy for proprietors and corporations. Indeed, it is important for every business since it can reduce

costs and opens up new avenues for expansion by providing easily accessible financial services while saving time.

Financial inclusion enhances the accessibility and usability of official financial services for individuals and businesses (Asif et al., 2023; Mpofu & Mhlanga, 2022). It also makes these services available to customers and enterprises (Demirgüç-Kunt et al., 2020). Modern microfinance emerged during 1990s and in the beginning of the 21st century. The expansion of Digital Financial Inclusion (DFI) influences economic growth through two main channels: increasing personal spending among individuals and encouraging local small and medium-sized business startups (Liu et al., 2021). Consequently, this study encourages digitalization by assessing the use of ATMs and mobile phones in conjunction with the Internet for business startups. Startups and initiatives may benefit from DFI. Activities associated with entrepreneurship lead to innovation (Chung et al., 2022; Peris-Ortiz et al., 2018) and competition (Li et al., 2023) which, in turn, result in increased productivity and efficiency (Aghion et al., 2006; Agarwal et al., 2010; Basheer et al., 2022; Carree & Thurik, 2010; Dutta & Meierrieks, 2021; Fritsch & Changoluisa, 2017). Innovation results in the production of valuable goods and services that contribute to the general well-being of societies.

Currently, DFI transforms a society by providing formal financial services to underrepresented groups. Mobile phones, internet access, and electronic transactions have driven the global transition from traditional to digital banking models. Digital tools including mobile banking and online payment platforms have made financial transactions easier and given entrepreneurs new opportunities. Reduced expenses and better financial services also help entrepreneurs to grow and innovate. In addition, the enhanced efficiency and productivity resulting from entrepreneurial endeavors contribute to an increase in the flow of money to satisfy the requirements of the society, raise the standard of life, and pay for educational and medical costs. Hence, this study aims to emphasize the significance of the nexus between human capital and digitalization in encouraging entrepreneurship. Scholarly investigations have been conducted to examine entrepreneurship at various levels, including the individual, organizational, and national levels (Dutta & Meierrieks, 2021; Wennekers & Thurik, 1999). Moreover, entrepreneurship is encouraged by financial factors at the country level (Fan & Zhang, 2017; Klapper & Love,

2011; Klapper et al., 2015; Leon, 2019; Munemo, 2018; Raoof et al., 2021). Entrepreneurship requires knowledge, skills, and creativity. Investing in education and skills fosters entrepreneurship. Human capital-rich entrepreneurs drive economic growth and creativity through market intelligence, risk assessment, invention, networking, and leadership.

Based on the above discussion, this study contributes to the prior literature through its several key findings. Firstly, this topic has yet to be addressed extensively in the related literature. DFI lowers bank and Fintech intermediation costs and increases underserved individuals' access to funding, benefiting consumers, suppliers, governments, and the economy. This study discusses continuing debates and national-level programs promoting DFI to increase entrepreneurial activity. Secondly, it highlights how the GDP growth of a country plays a significant part in instigating entrepreneurship in that country. Thirdly, the study highlights the role of education for entrepreneurs to develop human capital because it encourages them to innovate, show flexibility, cherish risk-taking, access resources, do problem-solving, and provide leadership. Lastly, the current study discusses the need for the development of financial ecosystem for entrepreneurs in order to promote entrepreneurship.

The shift from traditional to digital business models, driven by technology, is a major transformation in the modern business world. In this era of digitalization, DFI is of utmost importance, especially in entrepreneurial finance. Hence, this study hypothesizes the link between digitalization, GDP growth, and entrepreneurship. There is a substantial body of empirical and theoretical literature available which examines how financial development influences economic growth (Murari, 2017). However, the role of GDP growth in enhancing entrepreneurship has been addressed rarely. Interconnected dynamics of digitalization, economic growth, and education are key areas for scholarly focus since these foster an entrepreneurial environment. The complex interactions among these variables and their comprehensive impact on entrepreneurial activities have yet to be examined, especially with respect to the moderating influence of human capital. To achieve the major study objectives, the current study examines how digitalization and GDP growth affect startup initiatives. Furthermore, it reveals how human capital moderates these positive and significant relationships. Hence, this research fills the gaps in the literature by focusing on digitalization, GDP growth, and human capital development

by advocating for the policies to promote entrepreneurship and social well-being of the nation.

The remaining paper has the following structure. Section 2 conducts the literature review of existing studies to formulate the hypotheses of this study. Section 3 discusses the data and its sources, the analysis techniques, and the methodology. Section 4 shows in detail the empirical results of the study and the robustness of the results. Sections 5 and 6 highlight the study's limitations to guide researchers for further studies and implications for policymakers to design policies, respectively. Whereas, Section 7 concludes the study.

Literature Review

Schumpeter analyzed the dynamics of business enterprises, tied for innovation and expansion, using the notion of "creative destruction." This destruction is symptomatic of a continuous cycle of innovation in processes and products, where new production units challenge existing ones, ultimately driving outdated units out of the market (Ghazy et al., 2022; Richter et al., 2017). The current study uses disruptive innovation theory and digital entrepreneurship theory. The disruptive innovation theory, expounded by Clayton Christensen, stresses how new technologies disrupt old markets and businesses.

Entrepreneurs who use digitalization to their advantage frequently introduce disruptive technologies that challenge old business paradigms, either generating new markets or changing the current ones (Christensen, 2013). The digital entrepreneurship theory focuses on how digital technology affects entrepreneurship. It investigates how digitalization enables new sorts of entrepreneurship, business models, and prospects, taking into account aspects such as internet-based digital commerce, the use of digital marketing, and technology-driven innovation (Nambisan, 2017; Shane & Venkataraman, 2000).

This study describes how the rise of the digital economy has opened new avenues for business opportunities and accelerated the rate of creative destruction. The objective is to examine the role of digitalization as a tool for boosting entrepreneurship. For this purpose, the current study utilized three proxies for DFI, namely the number of ATMs per 100,000 adults, cellular subscriptions, and Internet users (as a percentage of the population). ATMs comprise a supply-side DFI parameter (Khera et al., 2022; Ozturk &

Ullah, 2022). The use of mobile phone financial services refers to individuals using their phones for various financial activities, including payments, money transfers, and savings. Mobile financial services make it easier for people to save money, make purchases, and start their own businesses, especially if they have already registered their phones with the telephone company for such services. Basic mobile investments and bank-integrated mobile savings are two of several ways to save money. Similarly, the use of the Internet concentrates on the access to the Internet, online activities and transactions, and the integration of technology, thus allowing the digitalization of businesses and e-commerce.

Mobile and internet users have the opportunity to participate in both the production and consumption of a specific product by using digital enterprises that operate within the framework of the sharing economy (Ghazy et al., 2022; Richter et al., 2017). The use of ATMs is interlinked with the banking industry which is rapidly moving towards the optimal use of digital financial services. Adopting proprietary digital platforms is a strategy that financial intermediaries, such as banks working in collaboration with FinTech companies, employ to enhance the quality of their payment, clearing, and settlement processes for routine business transactions. The banking industry is also promoting the use of POS in shopping malls, departmental stores, fuel stations, and other small businesses to implement the concept of DFI and to reduce the trend of carrying cash. This study, therefore, focuses on the number of ATMs and the use of mobiles and the Internet to ensure DFI at a large scale.
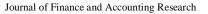
In their study, Tay et al. (2022) expounded that DFI is essential for everyone to ensure access to digital financial services and to promote sustainable GDP growth in order to achieve Sustainable Development Goals (SDGs). The use of digital financial services was revolutionized during the COVID-19 pandemic. The study found that developing countries, primarily Asian countries, embrace and expand DFI to support poverty reduction and contribute to the SDGs. The findings also showed that when it comes to digital financial services, there is still a gender gap, a wealth gap, and a rural/urban difference in developing nations.

Economic growth often acts as a stimulant for entrepreneurs in numerous ways based on their business potential, accessibility to resources, technological advancements, an appetite for risk-taking, supportive policies, and infrastructure, which are all necessary ingredients in a

successful business launch (Basheer et al., 2021; Han et al., 2024). Different aspects of growing economies come together to create a healthy environment in which entrepreneurial endeavors thrive. The current study, therefore, investigates the role of GDP growth in entrepreneurship. Extensive empirical and theoretical literature exists which describes the relationship between financial development and economic growth (Murari, 2017). Still, there remains a gap in the literature regarding the positive impact of GDP growth to boost entrepreneurship. The interrelated dynamics of digitalization, economic growth, and human capital are key in establishing a favorable environment for entrepreneurship. However, the complex interactions between these variables and their overall effects on entrepreneurial endeavors remain unexplored, particularly the moderating role of human capital.

A recent study "The Nexus between Financial Inclusion and Economic Development" targeted 27 economies of the European Union as complete and sub-samples and found that the relationship between financial inclusion and economic growth is positive and significant (Huang et al., 2021). Schumpeter and Redvers (1934) showed that the impact of finance on growth remains _ENREF_18 optimistic in the presence of innovative ideas, explaining the role of finance in the development of the endogenous growth model. Whereas, financial institutions help entrepreneurs to grow, while screening their potential projects via financial intermediation and mobilizing finance to support the most creative economic activities, as well as identifying the risk associated with such activities. A linear and positive association between financial development and growth is supported across the globe by the existing literature (Benczúr et al., 2019). The pioneering empirical examination of the nexus between finance and growth was made by Goldsmith (1959). The study used a sample of 35 countries and found a positive correlation between finance and growth. Some recent studies also support the positive association between finance and growth (Sharma, 2020; Türsoy & Faisal, 2018; Wirawan et al., 2020). However, a few studies have contested that the relationship between finance and growth is either negative or there is no relationship between them. Narayan and Narayan (2013) conducted their study across 65 countries and showed examples of negative or no association between finance and growth. They also found that credit from banks is negatively associated with growth, whereas the stock market also has no significant association with growth.

Furthermore, Ayadi et al. (2015) analyzed 11 Mediterranean countries and found that the banking sector is negatively related to economic growth. Financial inclusion refers to providing banking services and other financial products to assist lower-income people. It aims to include everyone in the economic system and restructures how everything is done in the financial sector. Financial services have the explicit goal of promoting entrepreneurial endeavors and the eradication of poverty. Dutta and Meierrieks (2021) found that the level of financial development determines the level of entrepreneurship across countries, including many Asian countries, using an instrumental approach to explain the relationship between entrepreneurship and financial development. Asteriou and Agiomirgianakis (2001) examined the relationship between human capital and economic growth by measuring human capital equated with the enrollment rate of primary, secondary, and higher education and found a causal relationship. Similarly, Qadri and Waheed (2014) investigated the economy of Pakistan and found that spending on education for human capital enhances productivity and economic growth.

To examine the impact of the productivity achieved through enhancing different levels of education resulting in both human capital development and economic development, there is a need to link entrepreneurship with digitalization and GDP growth at each level of education. This study, therefore, examines three stages of education for human capital development to answer the following question: Do digitization, economic growth, and human capital stimulate entrepreneurship across the globe? Dutta and Sobel (2018) conducted their study on two Asian countries, namely Pakistan and UAE, and one European country, namely Spain and found mixed results for the relationship between entrepreneurship and human capital. Hence, the existing literature depicts the potential to study in detail the impact of human capital on the formation of enterprises through access to financial capital (Dutta & Sobel, 2018). Policymakers and researchers should emphasize the development of the financial sector because the level of entrepreneurship encourages economic growth (Dutta & Meierrieks, 2021). Indeed, one of the economic pillars that contributes to a decrease in unemployment is the entrepreneurial spirit (Abaddi, 2024).

Based on the ideas presented above, an empirical study was conducted to investigate the nexus between digitalization, GDP growth, and human capital in the context of entrepreneurship. In this regard, the study

contextualized the above arguments to fill the relevant gap in the existing literature in order to promote the concept of DFI, economic growth, and human capital development. To conduct the empirical investigation, the following hypotheses were proposed.

H1: DFI and entrepreneurship are positively associated.

H2: There is a positive association between GDP growth and entrepreneurship.

H3: Human capital moderates the relationship between DFI, GDP growth, and entrepreneurship.

Data and Methodology

Following the methodology of Khera et al. (2022), Ouma et al. (2017), Ozturk and Ullah (2022), and Shen et al. (2021), the study employed three proxies for Digital Financial Inclusion or DFI: number of ATMs per 100,000 adults, mobile cellular subscriptions, and Internet users (as a percentage of the population). Many studies rely on financial indices, which only account for the impact of traditional financial services and do not take into consideration the digital components of financial inclusion. Financial inclusion entails the use of financial products and services, which are critical to achieving long-term economic development.

Digitalization further exacerbates the benefits of financial inclusion. Digitalization makes financial services available in remote places and removes time and travel obstacles in their provision. As a result, instead of the standard measure of financial inclusion, the study added DFI as a factor in this research. Although many previous studies used different indicators for financial inclusion such as the number of bank branches, number of debit cards, number of employees of financial institutions, number of bank accounts, and credit to GDP ratio, our concern is DFI. So, the current study employed ATMs, mobile subscribers, and Internet users as DFI proxies. This is because internet plays an important role in the proper functioning of ATMs, as well as in the usage of mobiles to transfer money, which is essential for entrepreneurship. The fixed effect estimation technique was used in this study by following the Hausman specification for analysis. Empirical analysis was performed to finalize the results by adopting both random and fixed effect estimation techniques of the panel data. The results of the Hausman test favoured the use of the fixed effect estimation technique.

Data Description

The secondary data of all the variables across the countries was extracted from two sources. The first was the World Development Indicators (WDI) database of the World Bank and the second source was the International Monitory Fund (IMF). The unbalanced panel data set of 139 countries was used for empirical evaluation. The data of 217 countries was obtained and cleaned by excluding the countries with less than three observations. After the cleaning process and matching the World Bank and IMF databases, 139 countries remained for analysis. Data was selected for a period of 9 years spanning from 2011 to 2019.

Table 1 presents the definitions (measurements) of the dependent variable, independent variables, and the control variables along with the sources of data collection.

Table 1

Definitions of Variables

Variables	Definitions	Source
1 LN_NBR	Natural logarithm of new business registration	Word Bank
2 ATMs	Number of ATMs per 100,000 adults	Word Bank
3 GDP	GDP growth (annual %)	Word Bank
4 FD	Financial Development Index	IMF
5 PSCENR	School enrollment, primary (% gross)	Word Bank
6 SSCENR	School enrollment, secondary (% gross)	Word Bank
7 TSCENR	School enrollment, tertiary (% gross)	Word Bank
8 INTUSR	Individuals using the Internet (% of the population)	Word Bank
9 LNMOBILESUB	Natural logarithm of mobile cellular subscriptions	Word Bank
10 FDI	Foreign direct investment, net inflows (% of GDP)	Word Bank
11 INF	Inflation, GDP deflator (annual %)	Word Bank

Note. Source: World Development Indicators, IMF

Table 2 presents the summary statistics of all the variables used for analysis. The total observations of ATMs proxied as one component of DFI

for this study are 833 across 139 countries. The number of mobile subscribers for this analysis is 1132 and the total number of the internet users is 1109. The secondary and tertiary school enrollment values are also small in number in the overall data set. All other variables have one thousand plus values, which is a reasonable number for analysis. The table shows the mean, standard deviation, skewness, kurtosis, and minimum and maximum values of each variable. The average value of entrepreneurship from 2011 to 2019 is 8.857 with a standard deviation of 2.079, along with the maximum value of 0.693 and the minimum value of 13.437. The average value of economic growth is 3.347 with a standard deviation of 3.013, along with a minimum value of -10.31 and a maximum value of 13.793.

Table 2

Descriptive Summary

Variables	Values	Mean	Std dev	Skewness	Kurtosis	Minim	Maxim
LN_NBR	1139	8.857	2.079	-0.668	3.906	.693	13.437
ATMs	833	51.247	38.057	0.959	3.833	.091	191.173
GDP	1138	3.347	3.013	-0.444	5.705	-10.31	13.793
PSCENR	977	104.679	10.502	0.923	6.476	72.99	149.957
SSCENR	826	92.459	26.483	-0.607	3.781	9.689	163.935
TSCENR	869	46.676	27.723	0.273	2.468	.593	148.531
FDI	1137	4.344	4.808	1.796	5.738	-1.094	18.828
INFL	1138	4.056	5.742	2.485	13.39	-8.977	37.095
INTUSR	1109	52.415	28.295	-0.199	1.795	0.9	99.653
MOBILESUB	1132	15.803	1.879	-0.525	2.842	10.947	18.645
FD	1139	0.359	0.224	0.751	2.611	.033	0.989

Note. Source: World Development Indicators, IMF

Table 3 shows the results obtained from the analysis of pairwise correlations performed between all the variables included in this study. The table below illustrates how each variable is related to entrepreneurship and how they are correlated with one another. The correlation matrix results suggest that there are no multicollinearity problems with the model variables. The variance inflation factor (VIF) addresses this multicollinearity concern.

Table 3

Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11
(1) LN_NBR	-										
(2) ATMs	0.461 (0.000)	-									
(3) GDP	-0.026 (0.38)	-0.321 (0.000)	-								
(4) PSCENR	-0.086 (0.007)	-0.174 (0.000)	0.108 (0.001)	-							
(5) SSCENR	0.386 (0.000)	0.624 (0.000)	-0.265 (0.000)	-0.007 (0.831)	-						
(6) TSCENR	0.399 (0.000)	0.629 (0.000)	-0.392 (0.000)	-0.201 (0.000)	0.743 (0.000)	-					
(7) FDI	-0.090 (0.002)	-0.015 (0.656)	0.162 (0.000)	0.018 (0.585)	0.030 (0.392)	0.041 (0.228)	-				
(8) INFL	0.002 (0.945)	-0.189 (0.000)	0.005 (0.855)	0.093 (0.004)	-0.146 (0.000)	-0.083 (0.015)	-0.035 (0.240)	-			
(9) INTUSR	0.428 (0.000)	0.672 (0.000)	-0.310 (0.000)	-0.215 (0.000)	0.794 (0.000)	0.712 (0.000)	0.033 (0.277)	-0.229 (0.000)	-		
(10) LNMOBILESUB	0.780 (0.000)	0.183 (0.000)	0.066 (0.025)	-0.085 (0.008)	0.001 (0.987)	0.079 (0.021)	-0.231 (0.000)	0.109 (0.000)	0.053 (0.079)	-	
(11) FD	0.589 (0.000)	0.744 (0.000)	-0.229 (0.000)	-0.141 (0.000)	0.648 (0.000)	0.584 (0.000)	0.035 (0.240)	-0.247 (0.000)	0.712 (0.000)	0.317 (0.000)	-

Note. The values in parentheses are standard error

Table 4 portrays the VIF results. Since all the VIF values in Table 4 are less than 10 and the mean VIF value is 2.426, it can be concluded that severe multicollinearity in the estimation is not a concern. So, all the variables of the study may be considered for analysis. Entrepreneurship positively correlates with the number of ATMs, internet users, and mobile subscribers, all proxies of digitalization. Human capital, equated with secondary and territory education, is also positively correlated. Whereas, primary education is negatively correlated with entrepreneurship. Othe other hand, Financial Development (FD) and Foreign Direct Investment (FDI) have a positive correlation with entrepreneurship. Further, the control variable, that is, inflation also has a positive correlation with entrepreneurship.

The Econometric Models

For this study, the following fixed-effect models were created using the traditional method.

$$\text{LN\_NBR}_{it} = \alpha_0 + \alpha_1 \text{ATMs}_{it} + \varepsilon_{it} \tag{1}$$

$$\text{LN\_NBR}_{it} = \alpha_0 + \alpha_1 \text{ATMs}_{it} + \alpha_2 GDP_{it} + \varepsilon_{it} \tag{2}$$

$$\text{LN\_NBR}_{it} = \alpha_0 + \alpha_1 \text{ATMs}_{it} + \alpha_2 GDP_{it} + \alpha_3 FD_{it} + \varepsilon_{it} \tag{3}$$

where LN_NBR represents new business registration which is a proxy for entrepreneurship, i is used for country, t represents time, α_0 is the intercept, ATMs is the number of ATMs in each country, PSCENR, SSCENR, and TSCENR represent primary, secondary, and tertiary enrolment used as proxies of human capital. FD is the Financial Development index (Institutions & Markets). $\sum_{j=1}^{j} X\text{j}_{it}$ represents an array of control variables, including Gross Domestic Product (GDP), Foreign Direct Investment (FDI), inflation, number of individuals using the Internet, mobile cellular subscriptions, and financial development, whereas ε_{it} is the error term representing the concept that there are some other factors which may affect the relationship but not included in the model. These models explain the effect of digitalization and GDP growth on the dependent variable. Similarly, the coefficients of all the independent variables are used to determine the extent to which these variables influence entrepreneurship (Table 5).

The econometric models are stated below.

$$\text{LN\_NBR}_{it} = \alpha_0 + \alpha_1 \text{ATMs}_{it} + \alpha_2 PSCENR_{it} + \varepsilon_{it} \tag{4}$$

$$LN\_NBR_{it} = \alpha_0 + \alpha_1 ATMs_{it} + \alpha_2 SSCENR_{it} + \varepsilon_{it} \qquad (5)$$

$$LN\_NBR_{it} = \alpha_0 + \alpha_1 ATMs_{it} + \alpha_2 TSCENR_{it} + \varepsilon_{it} \qquad (6)$$

The above models highlight the impact of digitalization on entrepreneurship at primary, secondary, and tertiary levels of school education (see Table 6).

The econometric models listed below include all the independent and control variables, focusing on human capital at different levels of education.

$$LN\_NBR_{it} = \alpha_0 + \alpha_1 ATMs_{it} + \alpha_2 GDP_{it} + \alpha_3 FD_{it} + \alpha_4 FDI_{it} + \alpha_5 INFL_{it} + \alpha_6 INTUSR_{it} + \alpha_7 LNMOBIESUB_{it} + \alpha_8 PSCENR_{it} + \varepsilon_{it} \quad (7)$$

$$LN\_NBR_{it} = \alpha_0 + \alpha_1 ATMs_{it} + \alpha_2 GDP_{it} + \alpha_3 FD_{it} + \alpha_4 FDI_{it} + \alpha_5 INFL_{it} + \alpha_6 INTUSR_{it} + \alpha_7 LNMOBIESUB_{it} + \alpha_8 SSCENR_{it} + \varepsilon_{it} \quad (8)$$

$$LN\_NBR_{it} = \alpha_0 + \alpha_1 ATMs_{it} + \alpha_2 GDP_{it} + \alpha_3 FD_{it} + \alpha_4 FDI_{it} + \alpha_5 INFL_{it} + \alpha_6 INTUSR_{it} + \alpha_7 LNMOBIESUB_{it} + \alpha_8 TSCENR_{it} + \varepsilon_{it} \quad (9)$$

The findings of these models examine the combined effect of digitalization proxied with ATMs, mobile subscriptions, and internet users, as well as GDP growth, along with other control variables including FD, FDI, and inflation, on entrepreneurship at the primary, secondary, and tertiary levels of education (see Table 7).

Results and Discussion

The current study aims to explore the influence of digitalization and GDP growth on entrepreneurship in selected economies. Further, it aims to investigate the moderating effect of human capital on the nexus of digitalization, economic growth, and entrepreneurship. Table 4 portrays the findings of VIF, whereas Table 5 shows the findings obtained using the fixed-effect estimation technique.

Table 4

VIF Values

	VIF	1/VIF
INTUSR	4.567	.219
SSCENR	3.638	.275
FD	3.178	.315
TSCENR	3.106	.322
DGTLZ	2.21	.452

	VIF	1/VIF
LNMOBILESU	1.47	.68
INFL	1.283	.779
GDP	1.277	.783
PSCENR	1.108	.903
Mean VIF	2.426	.

Table 5

Fixed Effect Results

Independent Variables	Entrepreneurship		
	(1)	(2)	(3)
ATMs	0.006***	0.007***	0.004***
	(0.001)	(0.001)	(0.001)
GDP		0.011***	0.012***
		(0.004)	(0.004)
FD			2.392***
			(0.501)
_cons	8.565***	8.491***	7.740***
	(0.072)	(0.077)	(0.175)
Observations	833	832	832
R-squared	0.027	0.038	0.068

Note. The values in parentheses are standard errors, whereas *** shows significance at 1%, ** at 5%, * at 10%

The VIF values range from 1.108 to 4.567, whereas the mean VIF value is 2.426, which is less than 10. The VIF values show that there is no strong correlation or multicollinearity among the predictors of this study. The results describe the estimated change in entrepreneurship due to digitalization. This study examines the impact of digitalization on entrepreneurship both separately and in relation with GDP growth. In the single impact model, the findings are favorable and statistically significant at 1% level. The results remain the same after including economic growth in the second and third model. The findings depict that entrepreneurship development is a direct result of greater digitalization. Also, GDP growth and financial development, along with digitalization, instigate entrepreneurship.

Table 6

Digitalization and Human Capital

Independent Variables	Human Capital		
	(1) Primary	(2) Secondary	(3) Tertiary
ATMs	0.006*** (0.001)	0.003* (0.001)	0.006*** (0.002)
PSCENR	-0.001 (0.003)		
SSCENR		0.007*** (0.002)	
TSCENR			0.014*** (0.003)
_cons	8.821*** (0.369)	8.227*** (0.184)	8.243*** (0.131)
Observations	734	626	643
R-squared	0.028	0.037	0.098

Note. The values in parentheses are standard errors, whereas *** shows significance at 1%, ** at 5%, * at 10%

Table 6 depicts the results obtained from the models that incorporate human capital at three different educational levels. The findings provide specific information regarding an estimated shift towards increased utilization of digital technology for entrepreneurship. The effect of digitalization is significant on entrepreneurship at 1% level of significance in the single impact model. This reveals that a higher level of digitalization instigates a higher level of entrepreneurship. The results also show a positive impact of ATMs and human capital, in relation with each level of education significant at 1%, 5%, and 10% levels of significance respectively, on entrepreneurship. Furthermore, the individual effect of human capital equated with primary school enrolment is negative and insignificant. Whereas, the effect of human capital is positive and significant at 1% level of significance when equated with secondary school enrolment. This effect is also positive and significant when tertiary school enrolment is taken as a proxy of human capital. These results suggest that digitalization and human capital are essential to take initiatives and to promote entrepreneurship. Therefore, the government should focus to invest in the development of human capital by promoting higher education, as well

as digitalization, for startups and new businesses.

Table 7

Effect of Digitalization and Economic Growth

Independent Variables	Entrepreneurship		
	(1) Primary	(2) Secondary	(3) Tertiary
ATMs	0.001	0.000	0.003**
	(0.001)	(0.001)	(0.002)
INTUSR	0.013***	0.010***	0.013***
	(0.001)	(0.002)	(0.002)
LNMOBILESUB	0.516***	0.525***	0.527***
	(0.082)	(0.088)	(0.093)
GDP	0.008**	0.015***	0.012***
	(0.004)	(0.004)	(0.004)
PSCENR	0.002		
	(0.003)		
SSCENR		0.001	
		(0.002)	
TSCENR			0.002
			(0.003)
FDI	0.005*	0.004	0.005*
	(0.003)	(0.004)	(0.003)
INFL	0.000	-0.003	0.004*
	(0.002)	(0.003)	(0.002)
FD	1.300***	0.458	1.078**
	(0.458)	(0.501)	(0.456)
_cons	-0.658	-0.175	-0.683
	(1.338)	(1.371)	(1.477)
Observations	728	620	639
R-Square	0.288	0.247	0.309

Note. The values in parentheses are standard errors, whereas *** shows significance at 1%, ** at 5%, * at 10%

Table 7 describes fixed effect results of DFI proxies at three levels of human capital. The results depict that internet usage and mobile subscriptions have a positive and statistically significant effect on entrepreneurship for countries offering primary, secondary, and tertiary school education. Whereas, ATMs are positive at three levels of education

but significant only for tertiary school education. This implies that the impact of digitalization is greater in all those countries where tertiary education is promoted to develop human capital, as compared to those only offering primary and secondary education. The effect of GDP growth is also significant and positive for entrepreneurship at 1% significance level. The results are also positive and partially significant for FD and FDI, which indicate that all these variables play a significant role in instigating entrepreneurship.

Table 8

Moderating Effect of Human Capital

New Business Registration	Interaction Effect of Human Capital			
	(1) Primary	(2) Secondary	(3) Tertiary	(4) Overall
ATMs	0.001 (0.003)	0.001 (0.003)	0.025*** (0.008)	0.032*** (0.012)
INTUSR	0.013*** (0.002)	0.013*** (0.002)	0.013*** (0.001)	0.009*** (0.002)
LNMOBILESUB	0.531*** (0.094)	0.531*** (0.094)	0.560*** (0.083)	0.634*** (0.103)
TSCENR	-0.000 (0.004)	-0.000 (0.004)		-0.004 (0.004)
TSCENRATM	0.000 (0.000)	0.000 (0.000)		0.000* (0.000)
GDP	0.013*** (0.004)	0.013*** (0.004)	0.007* (0.004)	0.017*** (0.005)
FD	1.135** (0.463)	1.135** (0.463)	1.251*** (0.455)	0.518 (0.506)
INFL	0.004* (0.002)	0.004* (0.002)	0.001 (0.002)	0.000 (0.003)
PSCENR			0.012*** (0.004)	0.011* (0.006)
PSCENRATM			-0.000*** (0.000)	-0.000** (0.000)
SSCENR				0.009*** (0.003)
SSCENRATM				-0.000** (0.000)

New Business Registration	Interaction Effect of Human Capital			
	(1) Primary	(2) Secondary	(3) Tertiary	(4) Overall
_cons	-0.640 (1.482)	-0.640 (1.482)	-2.227 (1.437)	-3.636** (1.816)
Observations	639	639	728	520
R-squared	0.306	0.306	0.295	0.292

Note. The values in parentheses are standard errors, whereas *** shows significance at 1%, ** at 5%, * at 10%

Table 8 shows the moderating effects of human capital on the nexus of digitalization, GDP growth, and entrepreneurship. The results indicate that while incorporating the interaction term with ATMs, the number of ATMs is strongly and positively related with tertiary education in the overall model, including all the proxies and interaction terms, whereas its association remains positive and insignificant with primary and secondary education. The use of the internet and mobile phones is strongly and positively related to entrepreneurship throughout the three levels of education. Furthermore, the interaction terms of ATMs with primary and secondary education are negative but significant. On the contrary, the interaction of tertiary education with ATMs remains positive and significant. Overall, the results show that human capital, along with tertiary education, moderates the relationship of digitalization, GDP growth, and entrepreneurship. The findings are supported by and related to the findings of existing studies (Alderete, 2017; Tahir & Burki, 2023; Xi & Wang, 2023).

Robustness Check

Robustness check was performed by dividing the dataset into different regions. For the comparative analysis of regions, this study used the regional classification developed by the World Bank and chose Europe and Central Asia to compare them with East Asia and the Pacific. Table 8 shows the comparison of the results from these regions.

The results indicate that Europe and Central Asia show more positive and significant results, as compared to East Asia and the Pacific region. The results depict that the number of ATMs and the use of the Internet and mobile phones are positively and significantly associated with entrepreneurship. Whereas, human capital is positively but insignificantly

related with primary education, but positively and significantly related with secondary and tertiary education. This shows that due to the increase of DFI, economic growth, and the enhancement of productive intellectual capital, entrepreneurship in Europe and Central Asia has been affected positively and significantly. Whereas, in East Asia and the Pacific region, internet usage and tertiary education have affected entrepreneurship positively and significantly. Comparatively, Europe and Central Asia are instigating more entrepreneurship through DFI, economic growth, and the betterment of educational system, as compared to East Asia and the Pacific region.

Table 9

Regional Comparison

Dependent Variable New Business Registration	Europe and Central Asia			East Asia and the Pacific		
	(1)	(2)	(3)	(1)	(2)	(3)
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
ATMs	0.008***	0.008***	0.008***	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)
INTUSR	0.012***	0.009***	0.010***	0.015***	0.013***	0.014***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
LNMOBILESUB	0.498**	0.591**	0.434*	-0.032	-0.011	-0.261
	(0.238)	(0.246)	(0.231)	(0.159)	(0.178)	(0.174)
GDP	0.020***	0.021***	0.018***	0.014	0.008	0.040***
	(0.006)	(0.006)	(0.005)	(0.011)	(0.012)	(0.012)
PSCENR	0.006			-0.007		
	(0.005)			(0.006)		
SSCENR		0.004*			-0.003	
		(0.002)			(0.004)	
TSCENR			0.006**			0.008**
			(0.003)			(0.004)
FDI	0.004	0.003	0.003	0.013	0.010	0.003
	(0.004)	(0.004)	(0.004)	(0.009)	(0.017)	(0.007)
INFL	0.005	0.000	0.004	-0.002	0.001	-0.002
	(0.004)	(0.005)	(0.004)	(0.005)	(0.007)	(0.004)
FD	0.569	0.782	0.357	1.143	1.011	1.997**
	(0.573)	(0.596)	(0.550)	(1.264)	(1.657)	(0.938)
_cons	-0.636	-1.873	0.841	9.000***	7.947***	11.837***
	(3.822)	(4.025)	(3.703)	(2.311)	(2.597)	(2.753)
Observations	286	274	281	100	69	74
R-squared	0.238	0.220	0.255	0.519	0.369	0.763

Note. The values in parentheses are standard errors, whereas *** shows significance at 1%, ** at 5%, * at 10%

Limitations and Future Directions

This study has several limitations in spite of its significant contributions. For instance, this study uses panel data from 139 nations, which may overlook specific regional dynamics and traits within each country. Future studies may consider incorporating more granular data to capture region-specific variations in the relationship between DFI and entrepreneurship. Further, the study focuses on the period from 2011 to 2019, which may not fully capture more recent digital breakthroughs and their impact on entrepreneurship. Future studies should consider incorporating more recent data to reflect the evolving digital landscape and its influence on entrepreneurship.

This research measures digitalization by equating it with the number of ATMs, usage of the Internet, and mobile subscriptions. Whereas, future studies can consider more components of digital financial inclusion to get more comprehensive results for entrepreneurship like payments, transfers, savings, credit, insurance, and securities. Furthermore, there is a need to check the robustness of the model by changing the proxies of both dependent and independent variables and to identify the endogeneity and serial correlation problems. Future studies should also have the potential for methodological improvement to obtain more efficient results for entrepreneurship. Moreover, they need to delve into the precise mechanisms that interact to influence entrepreneurship through digitalization, economic growth, and human capital. Future studies could overcome these limitations by doing more in-depth examination, capturing recent trends using up-to-date data, and investigating the underlying mechanisms behind the observed associations. More research should be conducted to highlight the role of specific digital technologies and their applications in entrepreneurship, as well as the impact of cultural and institutional factors on entrepreneurship, providing valuable insights for a more comprehensive understanding of the complex dynamics at work.

Practical Implications

The findings suggest the practical implications of this study for government, educational institutions, and the industry going through digitalization and promoting entrepreneurship. Firstly, to prepare potential entrepreneurs for the digital economy, governments should prioritize human capital development through initiatives such as skill-building

programs and continuing education. Public-private partnerships can facilitate the efficient use of resources and may foster collaboration between academia, policymakers, and other stakeholders. Secondly, the study highlights the potential of entrepreneurship to drive sustainable GDP growth and innovation in the modern era. Therefore, embracing digital transformation and prioritizing human capital development, particularly through higher education, can contribute to long-term economic prosperity. This research guides the policymakers and officials to open new horizons to access digital financial services, especially for deprived people. It also motivates to take initiatives to boost the economy and financial ecosystem. Practical implications of the findings provide valuable guidance for the academia and all the stakeholders looking to foster entrepreneurship and to stimulate sustainable growth, while navigating challenges and finding opportunities offered by digitalization.

Conclusion

This study empirically examines the relationship between digitalization, GDP growth, and entrepreneurship. The findings indicate that digitalization has a statistically significant and positive effect on entrepreneurship. Similarly, GDP growth positively influences entrepreneurship and human capital moderates the relationship between digitalization, GDP growth, and entrepreneurship. These findings lead to accept hypotheses 1, 2, and 3 of the study. The enhancement of digitalization should be one of the most important objectives of the government across countries. Even with the cumulative concern for the importance of digitalization, only a small number of studies have examined its impact on entrepreneurship. The current study shows that digitalization and GDP growth instigate entrepreneurship and human capital, while tertiary school enrolment significantly moderates their relationship. The findings guide policymakers, researchers, and the academia to increase the level of entrepreneurship across the countries around the globe.

Conflict of Interest

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

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