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The Impact of Information and Communication Technology on Economic Growth in North African Countries (Algeria, Tunisia, Morocco, Egypt) During the Period 2000–2021

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Abstract---This study examines the relationship between Information and Communication Technology (ICT) indicators and economic growth in four North African countries—Algeria, Tunisia, Morocco, and Egypt—over the period 2000 to 2021, based on panel data obtained from the World Bank database. Appropriate econometric models were employed (Pooled OLS, Fixed Effects, and Random Effects), with the most suitable model determined using the Breusch-Pagan and Hausman tests. The findings indicate that the Random Effects Model is the most appropriate. Results show that both the number of mobile cellular subscriptions (MCS) and the ratio of communications and computers to service imports (CC) exert a positive and statistically significant influence on economic growth. By contrast, the percentage of internet users (IUI) has a negative and significant effect, while the percentage of fixed broadband subscriptions (FBS) was found to be statistically insignificant. The study concludes with several recommendations, most notably the adoption of integrated policies that emphasize the development of digital infrastructure and the strengthening of digital competencies, in order to maximize the economic impact of information and communication technologies.

Keywords---Information and Communication Technology, Economic Growth, North Africa, Panel Data, Mobile Phones, Internet.
JEL Classification: O33; O47; C23; L96; F63.

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Introduction

The relationship between Information and Communication Technology (ICT) and economic growth has emerged as one of the most critical themes in contemporary development economics. The rapid global spread of digital technologies has stimulated considerable research into their potential to foster economic advancement, particularly in emerging economies.

Within the North African context—marked by diverse economic structures and developmental challenges—understanding the specific mechanisms and the extent of ICT's contribution to economic growth is essential for formulating effective policies that promote sustainable development. Building on this premise, the present study seeks to review the existing literature and its principal findings, highlight research gaps regarding the ICT–growth nexus in the selected countries, and undertake econometric analysis to provide relevant recommendations.

I.1. Research Problem:

To what extent has Information and Communication Technology contributed to economic growth in North African countries (Algeria, Tunisia, Morocco, and Egypt) during the period 2000–2021?

I.2. Research Hypotheses:

- There is a significant positive relationship between the number of mobile cellular subscriptions and economic growth.
- There is a significant positive relationship between the percentage of internet users and economic growth.
- There is a significant positive relationship between the percentage of fixed broadband subscriptions and economic growth.
- There is a significant positive relationship between the ratio of communications and computers to service imports and economic growth.

I.3. Research Methodology:

This study adopts a quantitative analytical approach by employing appropriate econometric models to analyze static panel data covering the period 2000–2021 for a sample of four North African countries: Algeria, Tunisia, Morocco, and Egypt. Three models were applied to estimate the relationships among the variables:

- Pooled OLS Model
- Fixed Effects Model
- Random Effects Model

For model selection, two statistical tests were conducted:

- The Breusch-Pagan test, to distinguish between Pooled OLS and Random Effects.
- The Hausman test, to differentiate between Fixed Effects and Random Effects.

The analysis concludes that the Random Effects Model is the most suitable for the dataset under consideration.

I.4. Study Significance:

The significance of this study lies in its emphasis on the role of Information and Communication Technology in supporting economic growth in North African countries, particularly in light of the accelerating digital transformations reshaping the contemporary world. Its importance also derives from presenting an up-to-date quantitative analysis based on extended data (2000–2021) and rigorous econometric models, thereby clarifying the relationship between digital transformation and economic growth within a regional context that has not yet received sufficient scholarly attention.

I.5. Study Objective:
The primary objective of this study is to analyze the nature of the relationship between digital infrastructure and economic growth by assessing the impact of variables such as the number of mobile subscriptions, the percentage of internet users, broadband subscriptions, and imports of communication technologies on GDP per capita. This is carried out after testing the suitability of the applied econometric models in explaining this relationship, with the aim of producing results that can serve as a foundation for formulating economic policies designed to enhance the effective utilization of information and communication technologies in order to support growth and advance economic development.

II. Review of Previous Studies:

Extensive research has confirmed that information and communication technologies contribute to fostering economic growth through several key channels, including increased productivity, stimulation of innovation, and improved access to information and services. Nonetheless, the relationship between ICT and economic growth is multifaceted and influenced by factors such as income levels, infrastructure, and political conditions, which differ according to each country's specific context.

Despite the abundance of literature addressing this subject, notable research gaps remain, particularly with respect to the North African context. While general patterns have been identified, country-specific analyses—especially concerning nations such as Libya and Algeria—have been less extensively explored compared to Egypt, Morocco, and Tunisia.

This highlights the need for more detailed studies that disaggregate ICT components to capture their distinct effects and move beyond broad categories such as "internet use," shifting instead toward more specific applications and services. The following section presents a regional overview of the topic, along with a classification of studies based on mechanisms and outcomes.

II.1. Regional Insights:

- **European Union and Europe:** ICT infrastructure has been identified as a key driver of growth, though the magnitude of its impact varies according to both the technology and the country. (Mashadihasanli & Zülfikar, 2023; Toader et al., 2018)
- **Sub-Saharan Africa:** In this region, mobile phone penetration and broadband subscriptions significantly contribute to economic growth. A 1% increase in mobile phone subscriptions is associated with a 14.9% rise in real GDP, underscoring the transformative potential of mobile technology in these economies. (Wainaina, 2025)
- **ASEAN Tiger Cubs:** ICT infrastructure exerts a statistically significant positive impact on economic growth in countries such as Malaysia, Thailand, and the Philippines. The study recommends expanding access to ICT devices to ensure sustained economic growth. (Kamonpetch & Chou, 2024)
- **Arab World and North Africa:** ICT has a positive effect on economic growth in several Arab countries, including those in North Africa and the Arabian Peninsula, with substantial impacts derived from internet use and ICT investment. However, inflation has been found to negatively affect economic growth in these regions. (Hodrab et al., 2016)
- **Global Perspective:** ICT use—measured by the number of internet users, broadband subscriptions, and mobile subscriptions—shows a positive association with GDP per capita growth across 159 countries. This effect is more pronounced in high-income countries, suggesting that policies promoting ICT adoption can significantly boost economic growth in these areas. (Farhadi & Fooladi, n.d.)

II.2. Main Mechanisms and Outcomes:

- ✓ **Positive Impact on Growth:** Studies demonstrate that ICT infrastructure—encompassing mobile phones, broadband, and internet—exerts a strong and positive influence on GDP per capita and overall economic growth in regions such as the European Union, Asia, the Middle East and North Africa, Sub-Saharan Africa, and South Asia. (Bahrini & Qaffas, 2019; Benhassen, 2015; Farhadi et al., 2012; Kurniawati, 2021; Toader et al., 2018; Tripathi & Inani, 2020)
- ✓ **Negative Effects and Challenges (Low Education Levels and Brain Drain):** The economic effectiveness of ICT is undermined by factors such as low educational attainment and brain drain, which restrict the realization of potential benefits. (Abu Alfoul et al., 2024)
- ✓ **Differences by Technology:** Mobile and broadband technologies generate stronger positive effects compared to fixed telephone lines, which in some cases display negligible or even negative impacts, reflecting the global shift toward modern digital communications. (Bahrini & Qaffas, 2019; Mashadihasanli & Zülfikar, 2023; Wainaina, 2025)
- ✓ **Income-Level Differences:** High- and middle-income countries experience stronger growth effects from ICT investments than low-income countries. In lower-middle-income economies, the impact is often weaker, largely due to limited infrastructure and widespread digital illiteracy. (Farhadi et al., 2012; Kurniawati, 2021; Yousefi, 2011)

Table (1). Summary of ICT Components and Their Impact on Economic Growth

ICT Component	Impact on Growth	Regions / Countries
Mobile Phones	Strong Positive	Africa, Asia, Europe
Broadband Internet	Strong Positive	MENA Region, SSA, EU, Asia
Fixed Telephone	Weak / Negative	Global, SSA, Europe
Internet Use	Positive	Asia, MENA, EU

Source: Prepared by the researcher based on the findings of previous studies

III. Econometric Model and Data Used

This section addresses the measurement of the impact of Information and Communication Technology on economic growth in a sample of North African countries—Algeria, Tunisia, Morocco, and Egypt—over the period 2000–2021. Since the available dataset consists of time-series cross-sectional data, static panel models are employed, as they represent one of the most appropriate econometric approaches for analyzing this type of data.

III.1. Study Sample and Variables:

The study sample comprises four North African countries, selected on the basis of data availability for the relevant variables across the study period, 2000–2021 (see Appendix 1). Variables closely related to the topic were used, drawing on the approaches of numerous previous studies. The variables employed are defined as follows:

- **Dependent Variable (Economic Growth):**
  Economic growth is represented by GDP per capita, calculated as the gross domestic product divided by the midyear population, expressed in current US dollars. This variable is denoted as *GDPP*.
- **Independent Variables:**
  A set of independent variables were employed, namely:
  - **Number of Mobile Cellular Subscriptions (MCS):**

This variable refers to the number of mobile phone subscriptions, which are public mobile telephone services providing access to the public telephone network using cellular technology. It is denoted as *MCS*.

- **Percentage of Internet Users to Total Population (IUI):**

This variable reflects the percentage of internet users relative to the total population. The internet is defined as a global communications system enabling the exchange of information between smaller networks that interconnect computers worldwide. It is denoted as *IUI*.

- **Percentage of Fixed Broadband Subscriptions (FBS):**

This variable represents the percentage of fixed broadband subscriptions per 100 inhabitants, reflecting fixed subscriptions that provide high-speed access to the public internet. It is denoted as *FBS*.

- **Ratio of Communications and Computers to Service Imports (CC):**

This variable measures the share of communications and computers in service imports, which include telecommunications (wired and wireless), voice and video, computer equipment and related devices, and electronic components, excluding software. It is denoted as *CC*.

The following table presents definitions of all variables used:

Table (2). Definition of Variables Used in the Study

Variables	Definition	Symbol	Source
Dependent Variable	GDP per capita	GDPP	**World Bank (WDI)**
Independent Variables	Number of Mobile Cellular Subscriptions	MCS	
	Percentage of Internet Users to Total Population	IUI	
	Percentage of Fixed Broadband Subscriptions	FBS	
	Ratio of Communications and Computers to Service Imports	CC	

Source: Prepared by the researcher based on World Bank (WDI) data.

III.2. Specification of the Study Model:

The study includes a set of variables closely linked to the subject, based on those incorporated in previous studies addressing the same theme, with differences in certain aspects. Care was taken to ensure that this study includes all relevant variables without excluding any, thereby offering a distinct contribution compared to other studies. The specific characteristics of the North African sample and the availability of data were also taken into account. The general mathematical formulation of the model is as follows:

$$\boldsymbol{GDPP_{it} = c + \beta_{1j}\,MCS_{j(it)} + \beta_{2j}\,IUI_{j(it)} + \beta_{3j}\,FBS_{j(it)} + \beta_{4j}\,CC_{j(it)} + \varepsilon_{it}}$$

Where:

- β_{kj} = Model parameters,
-)i ;1……..n (= Cross-sections (countries),
- (t : 1……T) = Time,
- ε_{it} = Random error term.

III.3. Descriptive Analysis of Variables:

To obtain the key characteristics of the study data and develop an initial overview, measures of central tendency were examined for the period 2000–2021, as shown in Appendix 2. Examining correlations among variables also allows for identifying possible correlation pairs between them and ensuring that the model is free from the main problems that may arise in estimating panel data models. This was carried out through a correlation matrix using *EViews 12*, from which the following table was obtained:

Table (3). Results of the Correlation Matrix Between the Model Variables

CC	FBS	IUI	MCS	GDPP	Correlation
				1	GDPP
			1	0.737194	MCS
		1	0.843734	0.455166	IUI
	1	0.724370	0.727662	0.400691	FBS
1	0.498674	0.845723	0.741114	0.532127	CC

Source: Prepared by the researcher based on EViews 12.

From the above table, which presents the results of the correlation matrix between the model variables, it is generally clear that there is no strong relationship linking the dependent variable with all independent variables. The results can be summarized as follows:

- A moderate positive relationship exists between GDP per capita (GDPP) and the number of mobile cellular subscriptions (MCS).
- A weak positive relationship exists between GDP per capita (GDPP) and the percentage of internet users in the total population (IUI).
- A weak positive relationship exists between GDP per capita (GDPP) and the percentage of fixed broadband subscriptions (FBS).
- A moderate positive relationship exists between GDP per capita (GDPP) and the ratio of communications and computers to service imports (CC).

III.4. Estimation of the Study Model:

To reach the results and interpret them, static panel models were employed, namely the pooled regression model, the random effects model, and the fixed effects model. The following table presents the results of estimating the static panel models for the data of the North African country sample:

Table (4). Results of Estimating the Static Panel Models

Variables	Estimated Models		
	Pooled Regression	**Fixed Effects**	**Random Effects**
Constant	1780.197*	1076.489*	1780.197*
MCS	29.59343*	39.13073*	29.59343*
IUI	-36.86283*	-36.13268*	-36.86283*
FBS	-23.37400	-50.69195	-23.37400
CC	130.7135*	163.5620	130.7135*
Overall Statistics	9.763241 (0.000000)	7.563667 (0.000000)	45.52147 (0.0000)
R-squared	0.117966	0.460348	0.686894
DW statistic	0.822864	1.376259	0.460401

(*) Parameter significant at 5%

Source: Prepared by the researcher based on EViews 12 outputs.

From Table (4) above, which presents the results of estimating the three static panel models for the data of the North African sample (the pooled regression model, the fixed effects model, and the random effects model), it appears that all variables are statistically significant, with the exception of the variable representing the percentage of fixed broadband subscriptions (FBS) across all models, in addition to the variable representing the ratio of communications and computers to service imports (CC) in the fixed effects model.

The results further indicate that all three models are statistically significant overall, as the probability values of the Fisher statistic are less than 5% in every case. Referring to the coefficient of determination

(R^2) to assess the extent to which the independent variables account for variations in the dependent variable, the random effects model shows the highest explanatory power, with an R^2 value of 0.686894. By contrast, the R^2 values for the fixed effects and pooled regression models were 0.460348 and 0.117966, respectively.

III.5. Tests of Model Comparison:

After estimating the three static panel models, the subsequent step involves comparing them using diagnostic techniques such as the Breusch-Pagan test and the Hausman test, in order to identify the most appropriate model for analysis and discussion.

To distinguish between the pooled regression model and the random effects model, the Breusch-Pagan test was applied, based on the following hypotheses:

H_0: The appropriate model is the pooled regression model

H_1: The appropriate model is the random effects model

Table (5). LM Breusch-Pagan Test

Test Hypothesis			
Test	**Both**	**Time**	**Cross-section**
Breusch-Pagan	99.20830	2.644694	96.56360
Prob.	(0.0000)	(0.0000)	(0.0000)

Source: Prepared by the researcher based on EViews 12 outputs.

From Table (5), it is evident that Prob < 5%, which leads to accepting the alternative hypothesis, indicating that the random effects model is the appropriate specification. Accordingly, the next step is to compare the random effects model with the fixed effects model.

For this comparison, the Hausman test is conducted. While econometric reasoning often suggests that the fixed effects model is more suitable for cross-sectional data across countries, verification requires applying the Hausman test to determine which model—fixed effects or random effects—is more appropriate for estimation.

The Hausman test is based on the following hypotheses:

H_0: The appropriate model is the random effects model

H_1: The appropriate model is the fixed effects model

The results of the Hausman test are presented in the following table:

Table (6). Results of the Hausman Test

Prob	Chi-Sq df	Chi-Sq Statistic	Test Summary
0.1502	4	6.741373	Cross-section random

Source: Prepared by the researcher based on EViews 12 outputs.

From Table (6) above, which presents the results of the Hausman Test, the probability value of this test reached 0.1502, which is greater than 0.05. Accordingly, the alternative hypothesis is rejected, and the null hypothesis is accepted, indicating that the random effects model is the appropriate one for the data of the sample of North African countries.

III.6. Discussion of the Results and Conclusions of the Appropriate Model (Random Effects Model):

The random effects model for the data of the North African countries sample is considered the optimal and most suitable model in analyzing the effect among the estimated models. Accordingly, based on the estimation results, the estimated equation for this model can be written as follows:

$$GDPP_{it} = 1780.197 + 29.59343\ \text{MCS} - 36.86283\ \text{IUI} - 23.37400\ \text{FBS} + 130.7135\ \text{CC} + \varepsilon_{it}$$

Based on the above, the most appropriate model for this study is the random effects model. Consequently, the results and conclusions will be discussed in accordance with this model, and can be summarized in the following table:

Table (7). Results Analysis

Independent Variables	Significance	Match	Interpretation
MCS	Significant Positive (29.59343) (0.0000)	Matches expectations	It was expected that an increase in the number of mobile cellular subscriptions would lead to higher economic growth. The current study confirmed a statistically significant relationship between mobile subscriptions and economic growth, indicating that this variable has an impact on economic growth. The rise in mobile subscriptions enhances communication and connectivity. Greater access to mobile services improves communication among individuals, businesses, and governments, leading to higher productivity, facilitating trade, supporting information exchange, and encouraging innovation across sectors—all of which stimulate economic growth.
IUI	Significant Negative (-36.86283) (0.0000)	Contradicts expectations	A positive relationship was expected between the percentage of internet users and economic growth. However, the current study found an inverse relationship between these two variables. This can be explained by low technological skills: if the percentage of internet users is relatively low compared to the total population, this may reflect insufficient technological skills among the population. The lack of technological education, training, and digital awareness limits the ability to use the internet effectively and fully benefit from its economic potential. This may also be explained by the digital divide and inequality, since low internet usage may indicate a digital gap between social and economic classes. When internet access is limited to wealthier and more educated groups, it exacerbates social and economic disparities, thereby negatively affecting economic growth.
FBS	Not Significant (-23.37400) (0.5878)	Contradicts expectations	It was assumed that there would be a positive relationship between the percentage of fixed broadband subscriptions and economic growth. However, the current study concluded that no relationship exists between these variables. This may be due to greater attention being directed toward developing other infrastructure, as governments and institutions in the North African countries under study may prioritize developing infrastructure such as roads, ports, and public facilities instead of expanding fixed telecommunications infrastructure. Moreover, emphasis on improving business conditions, investment climate, and attracting foreign investment influences infrastructure investment priorities.

Independent Variables	Significance	Match	Interpretation
CC	Significant Positive (130.7135) (0.0051)	Matches expectations	It was expected that an increase in the ratio of communications and computers to service imports would contribute to higher economic growth, and this was confirmed by the current study. This may be attributed to improvements in communication and trade, since a higher share of communications and computers in imports can enhance connectivity and provide technological tools for information exchange and trade. Such an increase may facilitate import and export operations and improve access to global markets, thereby stimulating economic growth.

Source: Prepared by the researcher.

IV. Conclusion

Information and communication technologies have demonstrated varied effects on economic growth in North Africa. Elements directly linked to mobile infrastructure and equipment (MCS) and (CC) have shown a clear contribution to growth, whereas human use (IUI) has not consistently translated into economic benefits in the absence of adequate skills and supportive policies. Furthermore, fixed infrastructure (FBS) has not received sufficient investment to generate a noticeable economic impact.

In the case of Algeria, greater emphasis is required on expanding government digital programs to cover inland and remote regions, ensuring digital equity. At the same time, creating a more attractive and open investment environment for international technology firms is essential, which can be achieved by streamlining procedures and offering incentives for strategic partnerships.

For Tunisia, accelerating the advancement of the digital economy necessitates the sustained implementation of the "Tunisie Digitale" vision, with particular attention to strengthening the financial technology (FinTech) sector. This sector serves as a vital driver for enhancing financial inclusion and promoting innovation within banking services.

Regarding Morocco, continued development of the "Maroc Digital 2020+" strategy remains important. Supporting small and medium-sized enterprises in adopting digital transformation through financial, technical, and training incentives is crucial to making digitization a powerful tool for improving competitiveness.

As for Egypt, sustaining digital transformation requires reinforcing the role of e-learning platforms and expanding the digitization of government services. In addition, greater integration of technology into villages and rural areas through initiatives such as "Hayah Karima" would help reduce the digital divide and support more inclusive development.

Appendices:

Appendix (1): North African Countries Used in the Study

No.	Country	Code
1	Algeria	ALG
2	Tunisia	TUN
3	Morocco	MAR
4	Egypt	EGY

Source: Prepared by the researcher

Appendix No. 2: Descriptive Analysis Matrix of Variables

Date: 12/03/23 Time: 00:44
Sample: 2000 2021

	GDPP	MCS	IUI	FBS	CC
Mean	3122.336	75.45835	32.01744	5.225000	3.147720
Median	3227.483	91.13219	28.46500	4.528018	2.413616
Maximum	5610.733	137.4593	88.13032	13.23843	12.20667
Minimum	1016.254	0.279451	0.491706	0.923574	0.000258
Std. Dev.	1078.808	44.22283	24.72629	2.664407	3.106632
Skewness	4.05E-05	-0.511064	0.423597	0.786966	0.923737
Kurtosis	2.679711	1.785752	2.030318	3.172452	2.997551
Jarque-Bera	0.376144	9.236862	6.079408	9.192334	12.51493
Probability	0.828555	0.009868	0.047849	0.010090	0.001916
Sum	274765.5	6640.335	2817.535	459.8000	276.9993
Sum Sq. Dev.	1.01E+08	170142.3	53190.87	617.6187	839.6509
Observations	88	88	88	88	88

Source: Prepared by the researcher using EViews 12 software.

Appendix No. 3: Pooled Regression Model

Dependent Variable: GDPP
Method: Panel Least Squares
Date: 12/03/23 Time: 00:35
Sample: 2000 2021
Periods included: 22
Cross-sections included: 4
Total panel (balanced) observations: 88

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MCS	29.59343	3.011068	9.828216	0.0000
IUI	-36.86283	7.062375	-5.219607	0.0000
FBS	-23.37400	40.73331	-0.573830	0.5676
CC	130.7135	43.03914	3.037085	0.0032
C	1780.197	154.0494	11.55601	0.0000

Root MSE	600.2166	R-squared	0.686894
Mean dependent var	3122.336	Adjusted R-squared	0.671804
S.D. dependent var	1078.808	S.E. of regression	618.0311
Akaike info criterion	15.74609	Sum squared resid	31702882
Schwarz criterion	15.88685	Log likelihood	-687.8282
Hannan-Quinn criter.	15.80280	F-statistic	45.52147
Durbin-Watson stat	0.461501	Prob(F-statistic)	0.000000

Source: Prepared by the researcher using EViews 12 software.

Appendix No. 4: Fixed Effects Model

Dependent Variable: GDPP
Method: Panel Least Squares
Date: 12/03/23 Time: 00:37
Sample: 2000 2021
Periods included: 22
Cross-sections included: 4
Total panel (balanced) observations: 88

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MCS	39.13073	7.782432	5.028085	0.0000
IUI	-36.13268	10.51238	-3.437154	0.0011
FBS	-50.69195	50.87469	-0.996408	0.3229
CC	163.5620	66.59082	2.456224	0.0169
C	1076.489	558.5223	1.927388	0.0585

Effects Specification

Period fixed (dummy variables)

Root MSE	547.0796	R-squared	0.739878
Mean dependent var	3122.336	Adjusted R-squared	0.634991
S.D. dependent var	1078.808	S.E. of regression	651.7724
Akaike info criterion	16.03797	Sum squared resid	26338053
Schwarz criterion	16.76992	Log likelihood	-679.6709
Hannan-Quinn criter.	16.33286	F-statistic	7.054003
Durbin-Watson stat	0.421410	Prob(F-statistic)	0.000000

Source: Prepared by the researcher using EViews 12 software.

Appendix No. 5: Random Effects Model

Dependent Variable: GDPP
Method: Panel EGLS (Period random effects)
Date: 12/03/23 Time: 00:36
Sample: 2000 2021
Periods included: 22
Cross-sections included: 4
Total panel (balanced) observations: 88
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MCS	29.59343	3.175457	9.319423	0.0000
IUI	-36.86283	7.447945	-4.949396	0.0000
FBS	-23.37400	42.95715	-0.544124	0.5878
CC	130.7135	45.38886	2.879859	0.0051
C	1780.197	162.4598	10.95777	0.0000

Effects Specification	S.D.	Rho
Period random	0.000000	0.0000
Idiosyncratic random	651.7724	1.0000

Weighted Statistics

Root MSE	600.2166	R-squared	0.686894
Mean dependent var	3122.336	Adjusted R-squared	0.671804
S.D. dependent var	1078.808	S.E. of regression	618.0311
Sum squared resid	31702882	F-statistic	45.52147
Durbin-Watson stat	0.461501	Prob(F-statistic)	0.000000

Unweighted Statistics

R-squared	0.686894	Mean dependent var	3122.336
Sum squared resid	31702882	Durbin-Watson stat	0.461501

Source: Prepared by the researcher using EViews 12 software.

Appendix No. 6: LM Breusch-Pagan Test

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	96.56360 (0.0000)	2.644694 (0.1039)	99.20830 (0.0000)

Source: Prepared by the researcher using EViews 12 software.

Appendix No. 7: Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	6.741373	4	0.1502

Source: Prepared by the researcher using EViews 12 software.

References

1. Abu Alfoul, M. N., Khatatbeh, I. N., & Bazhair, A. H. (2024). The Effect of ICT Usage on Economic Growth in the MENA Region: Does the Level of Education Matter? *Economies*, 12(10), 267. https://doi.org/10.3390/economies12100267
2. Bahrini, R., & Qaffas, A. (2019). Impact of Information and Communication Technology on Economic Growth: Evidence from Developing Countries. *Economies*. https://doi.org/10.3390/ECONOMIES7010021
3. Benhassen, L. (2015). Impact of Information Technology and Communication on Economic Growth. https://consensus.app/papers/impact-of-information-technology-and-communication-on-benhassen/5597b1311e2455cfa8a64c445de9f286/
4. Farhadi, M., & Fooladi, M. (n.d.). The Impact of Information and Communication Technology Use on Economic Growth.
5. Farhadi, M., Ismail, R., & Fooladi, M. (2012). Information and Communication Technology Use and Economic Growth. *PLoS ONE, 7*. https://doi.org/10.1371/journal.pone.0048903
6. Hodrab, R., Maitah, M., & Smutka, L. (2016). The Effect of Information and Communication Technology on Economic Growth: Arab World Case. *6*(2).
7. Kamonpetch, P., & Chou, T.-C. (2024). The Impact of Information and Communications Technology on Economic Growth: Empirical Evidence from ASEAN Tiger Cub Countries. *SSRN*. https://doi.org/10.2139/ssrn.4720896
8. Kurniawati, M. (2021). Analysis of the Impact of Information Communication Technology on Economic Growth: Empirical Evidence from Asian Countries. *Journal of Asian Business and Economic Studies*. https://doi.org/10.1108/JABES-07-2020-0082
9. Mashadihasanli, T., & Zülfikar, H. (2023). The Impact of Information and Communication Technologies on Economic Growth: The Case of Selected European Countries. *Journal of Research in Economics*. https://doi.org/10.29228/jore.28
10. Toader, E., Fîrţescu, B., Roman, A., & Anton, S. (2018). Impact of Information and Communication Technology Infrastructure on Economic Growth: An Empirical Assessment for the EU Countries. *Sustainability*. https://doi.org/10.3390/SU10103750
11. Tripathi, M., & Inani, S. (2020). Does Information and Communications Technology Affect Economic Growth? Empirical Evidence from SAARC Countries. *Information Technology for Development, 26*, 773–787. https://doi.org/10.1080/02681102.2020.1785827
12. Wainaina, M. (2025). Impact of Information Communication Technology (ICT) on Economic Growth: Sub-Saharan Countries (2000–2022). *International Journal of Economics*. https://doi.org/10.47604/ijecon.3149
13. Yousefi, A. (2011). The Impact of Information and Communication Technology on Economic Growth: Evidence from Developed and Developing Countries. *Economics of Innovation and New Technology, 20*, 581–596. https://doi.org/10.1080/10438599.2010.544470