The impact of the digital economy on economic diversification in Algeria: Empirical study (2000-2022)

أثر الاقتصاد الرقمي على التنويع الاقتصادي في الجزائر: دراسة قياسية (2000-2022)

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Abstract:

This study aims to measuring the impact of determinants Digital Economy on Economic Diversification in Algeria, using ARDL, based on annual data covering 2000 -2022 period.

The result showed that the error correction coefficient was negative and significant (-1.932). This indicates that there is a long-run cointegration between HHI and determinants of Digital economy. And estimate revealed a mobile cellular subscription service (MCS =0032) and Internet (INTE=0.001) have a positive effect in the long run with economic diversification. That because as Internet services help with broader access to markets. But in return Imports of technological goods (RTIC) have a negative impact on economic diversification with (-0.12) in long term.

Key words: Digital Economy, Economic Diversification, Algeria.

JEL Classification : C23, O3, O47.

الملخص:

تهدف هذه الدراسة إلى قياس أثر محددات الاقتصاد الرقمي على التنويع الاقتصادي في الجزائر باستخدام *ARDL*، خلال الفترة 2000-2022.

وأظهرت النتيجة أن معامل تصحيح الخطأ سلبا ومعنويا (-1.932). وهذا يدل على وجود تكامل مشترك طويل المدى بين *HHI* ومحددات الاقتصاد الرقمي. وكشفت التقديرات أن مؤشر البنية التحتية الرقمية ومؤشر النفاذ الى خدمات الاتصال لهما تأثير إيجابي على على التنويع الاقتصادي. وذلك لأن خدمات الإنترنت تساعد في توسيع نطاق الوصول إلى الأسواق. اما ايرادات خدمات الاتصال لها تأثير سلبي بنسبة (-0.12) على المدى الطويل.

الكلمات المفتاحية: الاقتصاد الرقمي، التنويع الاقتصادي، الجزائر.

تصنيف JEL: C23, O3, O47

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1. Introduction

Digital innovations are changing our world by reducing geographical distance and bringing people closer together. From the perspective of development, dialogue is essential to the process of making decisions and creating policies. Digital technology can be used by people, organizations, and governments to increase economic growth and diversify their sources of income. Particularly developing countries are in a good position to benefit from the potential of the digital economy and take part in the Fourth Industrial Revolution. Using digital technology will boost creativity, provide new information, boost competitiveness, and create the connections needed to spur economic progress.

The ICT industry, which comprises producers and service providers, as well as businesses and ICT consumers in their daily operations are all included in the term "digital economy." It's described as the network created by the suppliers and consumers of everyday technologies and digital information. These technology and content are widely used and indispensable to practically all societal and economic activities. They make it possible for governments to provide services, for businesses to be creative and successful, and for citizens to communicate and exchange knowledge.

Building robust ICT and physical infrastructure is essential to the structural shift of the economy towards a digital one. Infrastructure makes development less expensive, enabling market operations by both local and foreign companies. For example, the digitalization of ICT infrastructure results in positive externalities. Networks include the internet, mobile phones, and satellite technologies. This article's main objective is to emphasize the significance of digital technology in today's society. development. For countries with limited resources, the digital economy opens them new possibilities. resources to strengthen global ties and get access to talents, information, and technological advancements.

1.1.Research Problematic:

Hence, one crucial question arises here, **what is the impact of the digital economy on the economic diversification in Algeria for the period 2000-2022?**

1.2.Hypothesis

Digital economy has a significant positive impact on economic diversification in Algeria for the period 2000-2022.

1.3.Structure: This search will be divided into:

- Introduction;
- Literature Review;
- Model, Methods, Data;
- Conclusion and Discuss results.

2. Literature review:

- ✓ **Nassima Bouri ,Digital Applications: True Means of Communication and digital Transformation** (bouri, 2019)

This study focused on highlighting the role of digital applications as a powerful means of communication and digital transformation because It enables brands to achieve their overall communication goals. different growth Technologies have changed the strategies of production, distribution, brokerage and even consumption of products and services. In digital marketing, these digital applications allow Brands to interact with a large number of Internet users and promote themselves in digital form environment. The main objective of this article is to explain the relationship between management Companies and digital and computer applications in economic and administrative activities, such as well as the position of the Algerian regime in this context

- ✓ **Kenza Teniou , Mohammed Dehane, Digital Competence and Digital Gap in Arab World**(kenza, 2019)

This paper discusses about the digital gap or digital divide. it focus to understand the digital gap in the world in general and in the Arab world in particular. More specifically, it aims to measure the digital divide in the Arab world using the developed ICT Index that published by the International Telecommunication Union (ITU). The method of this index is to measure digital gap in three dimensions: the ICT access, ICT use and ICT skills. Talking about the digital gap leads us to talk about digital competence and digital literacy. In this regard, this study showed the importance of digital competence for work, learn and even live in today's world. Finally, the results show that: the digital gap one of the most important challenge in the Arab countries; digital competence is a requirement of the digital economy and its absence widens the digital divide; and the digital divide between developed and Arab countries is widening, and therefore strategies must be developed to address them.

- ✓ **Clovis Freire, Economic diversification: A model of structural economic dynamics and endogenous technological change**(Freire, 2019)

This study showed that economic diversification is important for poor developing countries to create job opportunities and strengthen the economy Development. Empirical economic literature has identified

several stylized facts about this pattern of diversifying economies, but developing explanations for those patterns, in general, has It was only loosely related to economic theory about growth, trade, technological and structural change Conversion. Making this communication is important because it can inform policy makers about development Countries design and implement policies to promote diversification. This paper presents a A model of structural economic dynamics and endogenous technological change that can replicate the empirical rules related to economic diversification

- ✓ **Amer Al-Roubaier, Allam Hamdan(&) , and Adel M. Sarea, Economic Diversification in a Digital Economy**(Amer Al-Roubaier, 2020)

This paper briefly discusses the impact of economic diversification on development. Many of the developing countries are lacking to some of the basic managerial, technical, scientific and financial resources needed to restructure the economic system and reduce high dependency on international trade. High economic dependency subjects the economy to high degree of instability, and therefore, there is urgent need for building resilient economy to stand against external shocks. Economic diversification broadens the productive structure by enabling the economy to produce variety of goods and services instead of a single commodity. Recent advancement in digital technologies provides new opportunities for developing countries to participate in the global economy and sustain development. Digital technologies allow knowledge sharing and exchange ideas which encourage entrepreneurship and attract foreign direct investment. Developing countries can utilize digital technologies not only to bring people and regions together, but also to promote collaboration and gain access to global value chains. Digital technologies empower individuals and enterprises to benefit from the new economy through participation in the global markets and acquire knowledge, information and technology. Integration into the global economy allows developing countries to accelerate the process of economic transformation and speed up the process of participation in the digital economy. Digital technologies could increase the country readiness and support economic diversification. Knowledge sharing and information dissemination provide new opportunities for decision makers to build capacity for development. Connectivity enables the economy to make appropriate choices to ensure that global integration facilitates technology transfer, innovation diffusion and knowledge creation. Weak productive structure has been responsible for economic volatility in most developing countries. In particular, countries in the Middle East and North Africa, lack of economic

diversification has contributed to high unemployment and low level of industrialization. Digital technologies allow governments to formulate effective strategies and construct policies that ensure inclusiveness and improve equity in allocation of resources among regions for the benefit of all people.

- ✓ **Svetlana Nosovaa, Anna Norkinaa , Svetlana Makarb , Galina Fadeichevac Digital transformation as a new paradigm of economic policy**(Nosovaa, 2021)

This study analyzes the conceptual provisions related to solving problems related to the introduction of digital technologies and the formation of a digital economy based on them, reveals the dynamics of digital transformation and its impact on business processes and the interaction of states, business and civil society in the context of modern economic policy. We reviewed the policy of the Russian state in terms of overcoming both the existing and potential economic consequences of the COVID-19 pandemic based on published expert assessments. Our results confirmed that overcoming the current turbulent state of the digital economy in Russia requires: firstly, the development of digital entrepreneurship or the digital sector as the "core" of the digital economy, where digital technologies are created; secondly, the removal of restrictions on the movement of resources caused by the COVID-19 pandemic, as a result of the consistent implementation of a coordinated strategy for the digitalization of the economy, based on global cooperation in the field of economic policy; third, the process of reproduction of the social product, where production - distribution – exchange - consumption interact, should take place at the level of world standards; fourth, to introduce the "digital style"in economic policy through building technological chains and diversified connections; fifth, to develop artificial intelligence, the essence of which is to"break" the matrix logical chains and diversified connections; fifth, to develop artificial intelligence, the essence of which is to"break" the matrix

3.Theoretical framework:

- **Economic Diversification in a Digital Economy:**

Definitions are always a reflection of the times and trends from which they emerge. One can see this in the technologies encompassed. Early definitions focus specifically on the internet, reflecting its emergence during the 1990s as a mainstream technology, at least in the global North. Later definitions add new technologies such as mobile and sensor networks, and cloud computing data. Or they opt for the more generic notion of « digital technologies » as per the simple definitions.

The "digital economy" is sometimes defined narrowly as online platforms, and activities that owe their existence to such platforms, yet, in a broad sense, all activities that use digitized data are part of the digital economy: in modern economies, the entire economy.(kenza, 2019)

The Digital transformation is considered as the main force of development and growth in the present century and the future, so that theories have developed to practice the different digital activities, the most important are: Joseph Schumpeter innovation theory, Varian theory, and Roll Katz and Potalez Kotorubis theory.

Schumpeter expressed his opinion about the study of economic growth theory in 1911, as he focused on innovation and renewed that depends on modern technology 1065 Volume VII, n°02 in economic activity, which increase the national income of the country. He considers that the growth is pushed in acceleration due to the new inventions that enter the commercial field and make new investments which give suddenly an increase in national.

Schumpeter developed the theory of creative demolition and considers that the innovation has an advantage to merchandise in terms of the cost criteria or the special product, and exploiting this advantage generates a flow of profits rewarding the expenses and costs but this advantage is temporary until a new it is replaced by a new one, this is the demolition side. Therefore, the technological innovation makes both of creation and destruction of the value, but the balance is positive if the role is played correctly. Schumpeter theory is one of the explanations of economic development in relation of economic growth, which focused on demolition in sense of dismantling the old economy and replacing it by new economy through advanced industrial innovation that works on reviewing experimental data and statistics of macroeconomic in the new form, which is digitization.(Madani .D, 2021)

The new economy, also referred to as a knowledge-based economy, depends more on the power of the brain than the natural capital. Dynamism is among the important features of the knowledge economy, which requires continuous investment in human capital, ICTs, R&D and innovation. Lifelong learning and training are necessary for reducing the risk of labor market disruption and strengthening the capacity for knowledge creation and innovation. Governments must build effective strategy to diversify the economy by investing in the new economy (Amer Al-Roubaier, 2020)

4. Model, Methods, and Data

4.1. Empirical Model

In order to account the impacts of role of determinants of Digital Economy on Economic Diversification in ALGERIA, the model for the study is hereby specified as follows:

$$HHI_t = \beta_0 + \beta_1 RTIC_t + \beta_2 INT + {}_t\, \beta_3 MCS_t + \beta_4 FTS_t + \\ + \varepsilon_t \dots\dots (1)$$

Where β0 is the intercept. β1, β2, …… β4 respectively are the estimation coefficients to be estimated. It is the error term. Subscripts i and t denote country and year (i = 1, 2,3 ; t = 1, 2,..., 23). The definitions of variables are presented in Table.

Table .1: Definitions and data sources

Variable	symbol	Measurement	expected	Source
Economic Diversification	HHI	Herfindahl-Hirschman Index	Dependent variable	UNCTAD
Fixed telephone subscriptions	FTS	Fixed telephone subscription growth rate % (per 100 people)	+	BW
Mobile cellular subscriptions	MCS	Individuals using Mobile cellular subscriptions (% of population)	+	BW
Fixed broadband subscriptions	INTE	Individuals using the Internet (% of population)	+	BW
Technology Revenue	RITC	Revenue, communication services %	+	SESRIC

Source: Authors

4.2 Data and Estimation Techniques

To investigate the relationship between Digital economy and Economic Diversification, this the study employs data for ALGERIA over the period 2000 to 2022, with a total. Data are collected from the World Bank (2024) and UNCTAD United Nations Conference on Trade and Development (2024). Also, SESRICO Organization of Islamic cooperation (statistical, economic and social research and training center for Islamic countries)

This paper employs various relevant methodologies to examine the impact of determinants of financial development on economic growth. Estimation techniques used include investigating stationarity using KPSS test, as well as using ARDL model for long-run estimates and short-run parameters.

5. Empirical Results

5.1. Results of Unit Root Test

To investigate the stationary and determine the integration level of the selected variables, we employed developed test, The KPSS

- H0: variable has not unit root
- H1: variable has unit root

Table. 2. KPSS unit root tests

variable	model	.LM-Stat	Critical value of 5% at	Order of integration
At level				
FTS	Intercept	0.10	0.46	I0
	Trend and intercept	0.09	0.14	
MCS	Intercept	0.37	0.46	I0
	Trend and intercept	0.09	0.14	
HHIC	Intercept	0.34	0.46	I0
	Trend and intercept	0.12	0.14	
INT	Intercept	0.63	0.46	/
	Trend and intercept	0.17	0.14	
RTIC	Intercept	0.42	0.46	I0
	Trend and intercept	0.09	0.14	
At First Difference				
INT	Intercept	0.31	0.46	I1
	Trend and intercept	0.11	0.14	

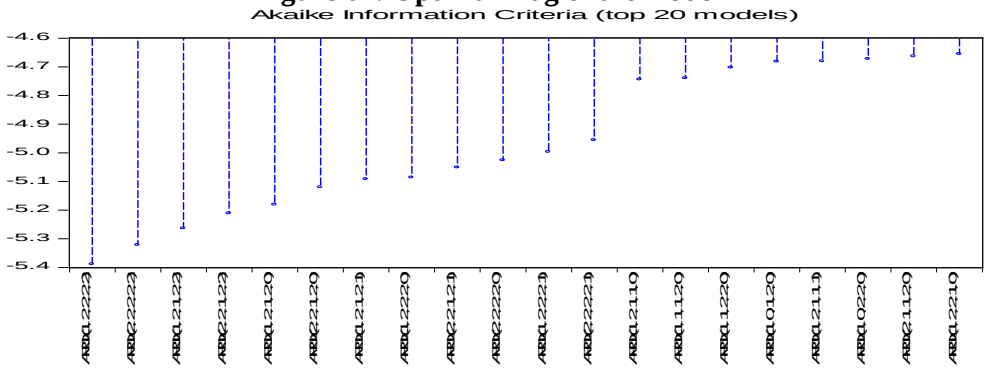
Source: Eviews 09

Table 2 summarizes the results of the KPSS unit root tests on the level and first differences of the variables. The results suggested that all the series are stationary at level except INT at first differences.hence, the unit root test confirms that the ARDL approach can be applied for the cointegration relationship.

5.2. ARDL model

To assess the long-term relationship between the variables, we utilized the auto-regressive distributed lag (ARDL) bound testing approach to cointegration, as proposed by Pesaran et al. (2001). Recent studies have shown that the ARDL model is a preferred method for estimating cointegration relationships due to its reliability and applicability, regardless of whether the underlying regressors are I(0) or I(1).

Figure 01: Optimum lag of the model



Source: Eviews09

The above figure shows us Optimum lag is (1, 2, 2, 2, 2)

Table 03: Short term ARDL model estimation

Dependent Variable: HHIC Selected Model: ARDL(1, 2, 2, 2, 2) AdjRsq= 0.900760 DW= 2.179435 Prob F(0.000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
HHIC(-1)	-0.932035	0.395397	-2.357213	0.0505
RTIC	0.183938	0.055134	3.336195	0.0125
RTIC(-1)	-0.055860	0.033554	-1.664762	0.1399
RTIC(-2)	0.113110	0.034800	3.250311	0.0141
INT	-0.011382	0.002356	-4.831133	0.0019
INT(-1)	0.013185	0.004176	3.157660	0.0160
INT(-2)	-0.003984	0.003034	-1.312955	0.2306
MCS	-0.062379	0.017145	-3.638277	0.0083
MCS(-1)	-0.042029	0.015702	-2.676685	0.0317
MCS(-2)	0.041966	0.012856	3.264263	0.0138
FTS	-0.198191	0.081485	-2.432246	0.0453
FTS(-1)	-0.016484	0.053711	-0.306891	0.7679
FTS(-2)	0.148751	0.070970	2.095968	0.0743
C	1.091762	0.227618	4.796461	0.0020

*, **, *** The statistical value of t-statistic, meaning that the parameter is significant, whether at the level of 1%, 5%, or 10%, respectively.

Source: EViews

The table above presents the results of the short-term estimation, demonstrating a Fisher probability of 0.001 that indicates the quality of the model and the ability of the independent variables, including f Fixed telephone subscriptions; Mobile cellular subscriptions; Fixed broadband subscriptions; Technology Revenue, to explain 90.07% of the variation in the dependent variable representing Economic Diversification. Notably, some variables show probability levels below 1%, 5%, or 10%. To check the existence of a long-term relationship, we must do an ARDL Bounds test

Table 04: ARDL Bounds Test

Test Statistic	Value	Signif	I(0)	I(1)
F-statistic K	**9.366107**	10%	2.45	3.52
		5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06

Source: Eviews 09

The results of the limits test presented in the table above indicate that the calculated F-value of 9.36 exceeds the maximum tabulated values at significance levels of 10%, 5%, 2.5%, and 1%. Therefore, we reject the null hypothesis of no long-term cointegration relationship and accept the alternative hypothesis that there is a cointegration relationship between the variables in the study. This suggests that there exists a long-term equilibrium relationship between the variables, and hence, we can estimate the model parameters in the long run.

Table 05: long-term model parameters

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq(-1)	-1.932035	0.395397	-4.886314	0.0018*
Cointeq = HHIC - (0.1248*RTIC -0.0011*INT -0.0323*MCS -0.0341*FTS + 0.5651)				
Long Run Coefficients				

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTIC	0.124837	0.034823	3.584893	0.0089*
INT	-0.001129	0.000197	-5.724674	0.0007*
MCS	-0.032319	0.012709	-2.543030	0.0385**
FTS	-0.034121	0.062983	-0.541754	0.6048
C	0.565084	0.005287	106.882416	0.0000*

*, **, *** The statistical value of t-statistic, meaning that the parameter is significant, whether at the level of 1%, 5%, or 10%, respectively.

Source: Eviews09

The error correction coefficient, which is negative (-1.932035), has a probability value of 0.001, which is less than 5%. This indicates that the condition is significant and confirms the presence of a long-term cointegration relationship between the dependent variable (HHI) and the independent variables. Additionally, the coefficients estimated in the long run were statistically significant at 10% and 5% levels. Except FTS.

5.3. Validity test of the model

Table 06: test of validity

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.796365	Prob. F(2,5)	0.2583
Obs*R-squared	8.780368	Prob. Chi-Square(2)	0.0124
Heteroskedasticity Test: ARCH			
F-statistic	0.877946	Prob. F(1,18)	0.3612
Obs*R-squared	0.930129	Prob. Chi-Square(1)	0.3348
Ramsey RESET Test			
	Value	**df**	**Probability**
t-statistic	0.431204	6	0.6814
F-statistic	0.185937	(1, 6)	0.6814

Source: Eviews09

Based on the test results presented in the table above, we can see that the probability values are greater than 5%. As a result, we accept the null hypothesis, indicating that the model is free from standard issues

related to the homogeneity of the residual variance. Therefore, we can assume that the variance of the residuals is constant across different values of the predicted variable, indicating the absence of heteroscedasticity.

6. Conclusion and discussion

This research examines the relationship between the determinants of the digital economy and economic diversification in Algeria. During the period 2000-2022. The experimental results of the study can be summarized as follows:

- The adjustice coefficient is 90.07%. This is evidence that the independent variables (fixed telephone subscriptions FTS, mobile telephone subscriptions MCS, Internet usage INT, revenues from communication services RTIC) were able to significantly explain the dependent variable, which is the Herfindahl-Hirschman coefficient HHIC , and also that The model gave statistical quality such that the Fisher probability value was estimated at 0.000, and the error correction coefficient also appeared to us with a negative value of -1.932035 and statistically significant at 1%, which reflects to us the existence of a long-term equilibrium relationship between the study variables and the strength of restoring balance from the short term to the term. Long quickly. The estimation coefficients also showed us that statistical significance in the short run appeared with all variables, but in the long run it did not appear only with FTS. Below we will provide an interpretation of the variables individually:
- The variable INT, which expresses the individuals who use the Internet (% of the population), appeared to us when estimating the short- and long-term equation for the time period extending from the years 2000-2022, with a negative sign and statistically significant at 1%, so that the indicator has an inverse relationship with the coefficient Herfindahl–Hirschman HHIC for economic specialization is 0.01 and 0.001 in the short and long run, respectively. This has a positive impact on economic diversification in Algeria, as Internet services help with broader access to markets, as they allow companies to reach new markets across the world without the need to have branches everywhere. This makes it easier for companies to expand their operations and diversify sources of income. Companies can also use social media and other electronic platforms to communicate with their customers and business partners across the world, which enhances cooperation and opens opportunities for new partnerships and joint projects.

- • The MCS variable, which expresses the growth rate of mobile phone subscriptions % (per 100 people), appeared to us when estimating the short- and long-term equation for the time period extending from the years 2000-2022, with a negative sign and statistically significant at 5%, so that the indicator has an inverse relationship with The Herfindahl–Hirschman coefficient (HHIC) for economic specialization is 0.06 and 0.03 in the short and long run, respectively. This has a positive impact on economic diversification in Algeria. This positive impact of mobile phone subscriptions on economic diversification can be explained by providing access to communications and the Internet in all areas, even isolated ones. This enables individuals and companies to communicate easily, access information, and market their products more widely, which contributes to enhancing trade and diversifying the economy by stimulating small and medium businesses, promoting innovation, and creating job opportunities.
- The variable FTS, which expresses the growth rate of fixed-line telephone subscriptions in % (per 100 people), appeared to us with an inverse relationship in the short term only at a significance level of 5%, where the higher the growth rate of fixed-line telephone subscriptions by one unit, the lower the Herfindahl-Hirschman coefficient for the economics major HHIC B. 0.19 This reflects positively on economic diversification. Fixed telephone subscriptions are an indicator of digital infrastructure, and their positive impact on economic diversification lies in providing fast and reliable access to communications and the Internet for individuals and businesses alike. Providing this infrastructure encourages business growth and innovation, and enhances communication and trade exchange between local and international companies. It also contributes to enhancing job opportunities and improving the standard of living by enabling people to better access education, health and e-commerce services, which enhances economic diversification.
- The variable RTIC, which expresses the growth rate of communications services revenues in percent, appeared to us when estimating the equation in the short and long term with a positive sign of 0.18 and 0.12, respectively, at a significance level of 1%. That is, there is a positive relationship between RTIC and the Herfindahl-Hirschman coefficient for economic specialization and an inverse relationship with economic diversification. This is possible if costs of communication services rise or revenues of communication services

decrease, as this may negatively affect communications and trade, thus reducing economic diversification enabling growth.

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