
E-Governance as a Strategic Option for Establishing Economic Diversification in Algeria: An Analytical and Econometric Study for the Period 2005–2023.

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Abstract:

This study aims to measure the impact of e-governance on economic diversification in Algeria (2005–2023). The research adopts a descriptive-analytical approach to present the theoretical aspects, along with econometric methods to estimate the effect of the independent variables. The results revealed that the e-participation index of human capital is the most influential factor on economic diversification.

The study results revealed that e-governance is a fundamental pillar for achieving economic diversification in Algeria. Its role goes beyond modernizing public administration and reducing bureaucracy to improving the investment climate and attracting foreign capital, developing the digital services sector, and Enhancing the competitiveness of industrial and agricultural enterprises. It also supports non-hydrocarbon exports and opens opportunities for start-ups based on digital innovation as a new driver of economic growth.

Keywords: E-governance; Economic diversification; E-participation; Sustainable development.

Jel Classification Codes: H83, O11, O25, D72.

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1. Introduction :

In recent decades, rapid scientific and technological advances have become the main driver of national development and a key indicator of prosperity. This has highlighted the crucial role of information and communication technology (ICT) in shaping modern economic management strategies. Consequently, many countries have sought to build and utilise technological capital to enhance economic performance, leading to the rise of e-governance as a foundation for digital transformation in social and economic life. Through improved government services and stronger productivity across sectors, e-governance fosters economic growth and diversification, enabling countries to revitalize stagnant sectors and broaden their sources of revenue beyond traditional industries.

In this regard, the contributions of the economic thinker Robert Solow constitute the cornerstone in this context. His ideas centered on the new exogenous growth theory in the aftermath of 1956. He explained that the classical determinants of production, namely capital (K) and labor (L), explain only part of economic growth, while the larger unexplained portion he termed in his theoretical framework as the "Solow Residual," which indicates that technological accumulation in government performance and productive sectors enhances the competitiveness level of the production process while supporting the element of innovation and renewal in emerging and infant industries. This, in turn, can generate parity between booming industries in a country's economy and formerly stagnant industries, resulting in one of the most significant manifestations of economic diversity.

Theoretical intellectual contributions that focused on highlighting the importance of technological accumulations and acquired knowledge in productive sectors in influencing economic dynamics continued to evolve. The ideas of Paul Romer emerged in modern endogenous growth theories in 1986, which emphasize that in addition to the factors of labor and capital, the accumulation of knowledge resulting from the use of digitalization tools, technology, and information and communication technologies—which became abundantly available during that period of technological advancement and globalization—can contribute to increasing the flexibility of knowledge transfer between productive sectors. This contributes to raising the productivity rates of the institutional fabric, which translates into a qualitative leap in the field of production and economic diversification.

The economic thinker Joseph Stiglitz introduced new theories in the second decade of the third century (2010), explaining the relevance of technology flow for countries' economy, particularly emerging ones. He explained that developing countries' ability to use the accumulation of technological and knowledge capital is

insufficient to achieve economic growth and diversification in production fields; it also requires e-governance and efficiency in resource allocation across all productive sectors, thereby negating the process of unequal development in developing countries.

Algeria is considered one of the developing countries facing a dual challenge related to the necessity of liberating itself from the historical dependence on hydrocarbon revenues, while simultaneously responding to the profound transformations witnessed by the global economy due to the accelerating digital revolution. The excessive reliance on the hydrocarbon sector has made the Algerian economy more vulnerable to price fluctuations in international energy markets. Consequently, Algeria's actual intentions and political will have emerged toward the imperative of diversifying its economy through the involvement of technology and e-governance, which represents the optimal path to support this orientation. Transparency, accountability, and technological capital accumulation contribute to facilitating the process of engineering the relationship between economic actors and the state, which supports the development of infrastructure, the qualification of human resources, as well as supports emerging infant industries to move toward diversifying national income sources, which is the foundation of economic diversification in Algeria.

1.1 Study problem:

Considering the foregoing, the purpose of this study is to show Algeria's e-governance implementation project and its impact on economic diversification. Consequently, we submit the following fundamental question:

- **To what extent can e-governance provide strategic support for Algeria's economic diversification efforts?**

1.2 Sub-questions of the study:

To properly answer the problem of this study, we have decided to accompany it with the following collection of sub-questions:

- What are the requirements for transitioning to e-governance as a strategic option for influencing government performance?
- What are the mechanisms that can make e-governance a stimulating element for economic diversification?
- What is the role of e-governance in supporting emerging sectors in Algeria?
- What is the nature of the relationship between e-governance and economic diversification in Algeria?

1.3 Study Hypotheses:

To reach scientific solutions to the questions posed, our study seeks to test the validity of the following hypotheses:

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- The successful transition to e-governance in developing countries requires the availability of advanced digital infrastructure, as well as political will and the development of qualified human capital.
- The process of lowering bureaucracy, increasing transparency, and expanding e-participation of human resources in emerging countries serves as a catalyst for local and foreign investment, allowing for economic diversification.
- E-governance can contribute to the emergence of nascent sectors in Algeria and may allow for their development to optimal scales, which in turn enables the establishment of economic diversification.
- We hypothesize the existence of a statistically significant relationship between e-governance and economic diversification in Algeria.

1.4 Study Significance:

This study is significant as it bridges a theoretical gap in economic literature by examining how e-governance determinants including digital infrastructure, e-participation, transparency, government effectiveness, and anti-corruption laws affect economic diversification in Algeria. It provides an applied contribution by proposing a policy framework that leverages technology to reduce bureaucracy, boost domestic investment, and attract foreign direct investment (FDI), thereby fostering non-hydrocarbon growth. From an econometric perspective, it quantifies the relationship between e-governance indicators and diversification drivers during 2005–2023, a period marked by major institutional and economic shifts such as oil price fluctuations and digital reform initiatives. Thus, the study positions Algeria as a case model for assessing how e-governance can serve as a strategic pathway toward sustainable and resilient economic diversification.

1.5 Study Objectives:

This study seeks to achieve a set of objectives represented in:

- Examining the theoretical framework of e-governance and economic diversification.
- Highlighting the importance of developing countries' adoption of e-governance and estimating the level of its impact on the performance of productive sectors in a manner that allows for achieving economic diversification.
- Addressing the reality of e-governance implementation and economic diversification in Algeria.
- Measuring the impact of e-governance determinants on economic diversification determinants in Algeria during the period (2005-2023).
- Evaluating the role of e-governance in supporting emerging productive sectors and contributing to reducing dependence on the hydrocarbon sector.

1.6 Study Methodology:

The study requirements necessitated reliance on the descriptive approach in reviewing the basic concepts related to the topic of e-governance and economic diversification, as well as the comparative analytical approach to shed light on the extent of adopting this project in Algeria compared to other countries and analyzing the problem of economic diversification in Algeria. The study also relied on the **Stepwise** statistical model to determine the nature of the impact under study, based on survey indicators and data issued by the United Nations Department of Economic and Social Affairs for 2023, as well as data from the Ministry of Commerce and Export Promotion, in addition to reviewing all finance laws during the period between 2005-2023.

2. E-Governance and Economic Diversification: A Conceptual Reading:

The topic of e-governance constitutes one of the most prominent institutional transformations imposed by the digital revolution on modern economies, while economic diversification is considered a strategic goal for achieving sustainability and reducing dependence on rentier resources. Consequently, linking the two concepts allows for an in-depth reading of the relationship between digital transformation as a regulatory mechanism and the restructuring of the productive base as a developmental choice.

2.1 The Conception of E-Governance:

The concept of e-governance builds on the broader idea of governance, which emerged as a legal term in 1979 and gained prominence in the late 1980s through international organizations like the IMF, UN, and World Bank. Governance is broadly defined as the management of economic and social resources to achieve development, guided by rules that ensure transparency, accountability, participation, and the rule of law, while promoting effective public administration and democratic principles (UNDESA, 2014, p. 02).

E-governance evolved alongside technological advances, particularly the global expansion of information and communication technology, offering a modern approach to improving government management. It involves using digital tools to facilitate interaction between governments, citizens, and businesses, modernize internal administrative processes, enhance efficiency, promote democratic performance, and boost economic dynamism. Organizations like the World Bank and UNESCO emphasize that e-governance increases transparency, improves service delivery, and strengthens citizen participation and institutional accountability (Backus, 2001, p. 2).

Based on these approaches, it can be said that e-governance is not limited to supporting traditional good governance principles, but rather extends beyond that toward building a new interactive model based on leveraging digital technology to

enhance the relationship between governments and stakeholders, whether they are citizens, the private sector, employees, or governmental and non-governmental organizations. It provides innovative mechanisms for human resource participation and sector managers' involvement in a digital manner through electronic platforms, thereby expanding the circle of public discourse and facilitating the expression of opinions in a more transparent and effective manner.

2.2 Opportunities and Requirements of E-Governance:

E-governance has become a core element in discussions on good governance and public administration reform, serving as a strategic framework rather than just a technical option. It offers opportunities to improve public service quality, streamline administrative processes, and reduce bureaucracy. However, realizing these benefits depends on governments establishing the essential foundational requirements for effective implementation.

❖ Opportunities Offered by E-Governance:

The adoption of e-governance as a public policy in the context of managing developmental affairs in most countries aimed to seize numerous opportunities, the most important of which include the following:

- **Enhancing Transparency and Accountability:** E-governance enables the reduction of bureaucratic procedures through digitizing administrative transactions, which allows for real-time tracking of operations and enhances the trust of citizens and investors by ensuring integrity in public management.
- **Participation in Decision-Making:** E-governance represents a tool for expanding interaction channels between government and citizens, where individuals and institutions can submit proposals or observations through digital platforms, thereby enhancing participatory democracy and contributing to formulating policies that are more responsive to actual needs (ADNANE & Lahouari, 2022, p. 439).
- **Developing Public Policies:** Through exploiting and analyzing big data, e-governance enables public authorities to formulate more accurate and effective economic and social policies capable of accommodating global transformations and economic diversification requirements.
- **Attracting Foreign Investment:** Improving the business climate by electronically facilitating administrative and financial procedures reduces bureaucratic obstacles, thereby enhancing foreign investors' confidence and making the Algerian economy more attractive.
- **Rationalizing Public Expenditure:** Reliance on digital systems reduces operational costs and limits financial waste by improving oversight mechanisms and directing resources toward high value-added sectors.

- **Improving Public Administration Efficiency:** Service automation works to simplify procedures and accelerate transactions, which raises the quality of public services and increases the productivity of economic institutions.
- **Supporting the Digital Economy:** Adopting e-governance forms a foundation for expanding the use of modern technology in various sectors, thereby opening opportunities for the emergence of new activities based on innovation and knowledge (Samiha, 2025, p. 158).

❖ **Requirements for Activating E-Governance in Developing Countries:**

- Developed countries moved toward activating e-governance at a very advanced stage compared to the efforts of developing countries in this field. This is due to the nature of the environment in which this strategic tool will be localized, which is related to the nature of countries' government performance and the extent of its awareness and vigilance toward digitalization and its functional applications. The following presents the most important requirements that facilitate the process of activating e-governance in developing countries:
- **Advanced Digital Infrastructure:** Providing highly efficient communication networks and comprehensively and equitably expanding Internet services (Ben Nadir & Guerdi, 2013, p. 47).
- **Appropriate Legal and Regulatory Framework:** Enacting modern legislation to protect electronic transactions and ensure cybersecurity.
- **Developing Human Competencies:** Qualifying human resources capable of efficiently dealing with and managing digital systems.
- **Changing Organizational Culture:** Promoting values of openness and transparency within public and private institutions (Lounes, 2018, p. 499).
- **Sustainable Financing for Digital Projects:** Through partnerships between the public and private sectors, ensuring the continuity of technological initiatives.

2.3 The Conception of Economic Diversification:

Albert O. Hirschman sees economic diversification as a key tool for development and reducing economic vulnerability. He argues that overreliance on a single sector or resource exposes economies to external shocks. His theory emphasizes expanding the productive structure by developing new sectors and broadening the export base, while stimulating backward and forward linkages between sectors helps advance stagnant industries. This process facilitates the shift from unbalanced to balanced growth, forming the foundation of diversification in developing countries (Matallah, 2020, p. 102).

Economic diversification is defined as a process aimed at reshaping the productive structure of the economy through integrating new sectors capable of generating income, thereby reducing excessive dependence on the dominant sector. The purpose of this is to open high value-added investment fields that provide more

efficient employment opportunities for the national workforce and contribute to driving economic growth in the long term (BAILICHE & ALMI, 2024, p. 336).

Economic diversification is considered one of the strategic pathways that allows for the distribution of investments across different economic sectors in order to reduce the risks of over-reliance on a single sector or a small number, which makes the economy characterized by mono-production and mono-export.

2.4 Justifications and Motivations for Economic Diversification in Developing Countries:

Numerous economic studies have explored economic diversification as an effective solution to the "**resource curse**" in developing countries. Heavy reliance on a few exports—mainly oil and minerals—makes these economies vulnerable to global fluctuations, despite the high profits these resources generate compared to other commodities like agriculture.

The Resource Curse Hypothesis suggests that resource-rich countries do not necessarily achieve higher growth rates and may even experience slower development. Researchers such as **Auty (2001), Ross (1995), and Sachs & Warner (2004)** identified three main aspects of this phenomenon:

- ❖ **Economic Volatility:** Countries depending on a single export face cyclical shocks from global markets due to high demand elasticity and unstable prices (Dhaif & Azouzi, 2018, p. 132).
- ❖ **Dutch Disease:** Resource booms lead to currency appreciation, unequal competition for labor and resources, and the decline of other productive sectors like manufacturing and agriculture.
- ❖ **Institutional Effects:** Overreliance on rent income fosters rent-seeking behaviors that weaken political and economic institutions (Bennin & Benini, 2016, p. 254).

However, the debate continues over whether natural resources are truly a curse. Recent research by **Rudiger (2006), Maxwell (2004), Davis & Tilton (2005), and Sachs (2007)** argues that mineral and oil resources can become a strategic opportunity for development if their revenues are invested in productive **sectors** and used to promote structural transformation and diversification within the economy.

3. The State of E-Governance and Economic Diversification in Algeria:

Following its independence, Algeria adopted an unbalanced growth model that prioritized strategic sectors where the country had a relative abundance of resources. The government relied on this model to foster socially cohesive, socialist-oriented development among its population. Within this framework, the industrial and agricultural sectors were identified as key pillars of national development strategies, with implementation beginning in 1963.

The nationalization of hydrocarbons in 1971, coupled with the subsequent rise in global energy prices, revealed the sector's substantial contribution to Algeria's GDP—exceeding 38% in 1974. This figure highlighted a concerning imbalance despite the financial allocations made during the first four-year development plan, the industrial sector's share of GDP did not surpass 6.2%, while agriculture accounted for only 9.9%. These figures exposed the growing fragility of the national economy and its increasing dependence on the booming hydrocarbons sector.

This dependency persisted into the early 1990s, despite the government's adoption of significant structural reforms aligned with principles of liberalism and market economy. The economy remained vulnerable, with hydrocarbon revenues accounting for over 45% of GDP (Araar, 2021, p. 1180). This situation underscored the strategic necessity of pursuing economic diversification. In response, the government launched a structural adjustment program between 1995 and 1998 aimed at revitalizing stagnant sectors and enhancing the contribution of agriculture and industry to GDP. These efforts were part of a broader strategy to diversify and promote non-hydrocarbon exports.

3.1 Algeria's Pursuit of Economic Diversification and the Emergence of E-Governance:

At the dawn of the 21st century, the Algerian government intensified its commitment to economic diversification. Various programs aimed at supporting and revitalizing economic growth were introduced, serving as key drivers to stimulate the national economy. These efforts focused on enhancing the competitiveness of the domestic institutional fabric and gradually replacing oil exports with industrial and agricultural exports. Although some progress was made—reflected in relatively acceptable levels of non-hydrocarbon exports—these gains did not fully reflect the country's potential in terms of resource availability or its competitive production factors, especially labor costs.

This disparity prompted the government to conduct a thorough assessment of the local business environment, including a critical review of investment climate regulations. The findings emphasized the need to reform the performance mechanisms of public administrations, which serve as the operational backbone for all wealth-generating sectors. This reform process included strengthening transparency, expediting administrative procedures, and investing in human capital capable of operating within a modern digital and electronic governance framework. These steps were seen as essential to improving the investment environment and enabling the practical realization of economic diversification.

In line with this vision, Algeria began implementing an e-governance strategy in 2005, coinciding with its hosting of the Arab League Summit. The government

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launched national e-service platforms and digital administrative portals as part of its efforts to modernize public administration and simplify procedures. As these initiatives advanced, Algeria recorded notable improvements in its e-Government Development Index (EGDI), positioning the country within the group of nations showing relatively high levels of digital government development. Recent United Nations reports ranked Algeria among the leading African countries, with a global ranking close to 112.

3.2 Limitations of E-Governance Impact on Economic Diversification in Algeria:

Despite the institutional progress achieved the impact of e-governance on diversifying Algeria's productive base remains limited. This is largely due to the continued dominance of the hydrocarbon sector within the national economic structure. Between 2005 and 2023, hydrocarbons consistently accounted for a substantial share of both GDP and public financing mechanisms. During this period, the sector contributed approximately 43% to the gross domestic product, over 89% of total exports, and nearly half of the state's budget revenues. Such dependency highlights the structural confinement of the economy, suggesting that digital and administrative reforms—while necessary—are insufficient on their own without supportive industrial, agricultural, and trade policies (Noui, 2018, p. 187).

One of the key indicators used to assess Algeria's implementation of e-governance within its broader development strategy is the Transparency Index, particularly with regard to the transparency of government sector performance. The use of digital tools and online platforms plays a significant role in combating fraud, negligence, and administrative corruption. Another critical measure is the E-Participation Index, which reflects the readiness and capacity of a country's human resources to interact with public administrative services through digital means. This includes the ability of citizens to request and access public services online, ultimately contributing to more inclusive and responsive decision-making.

Additionally, the Infrastructure Index for E-Governance Implementation serves as a key metric, capturing the availability and quality of physical and technological assets necessary for a fully functional digital government. Meanwhile, economic diversification has remained a top government priority since independence. To evaluate the actual progress of diversification, this analysis relies primarily on the Export Diversification to Import Diversification Ratio, which provides insight into the structural transformation of Algeria's trade composition. The following table presents the evolution of all aforementioned indicators over the selected time period.

Table N°1: Evolution of the Economic Diversification Index in Algeria Compared to E-Governance Indicators (2005–2023).

Year	Economic	Telecommunication	Human	Online
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	Diversification Index (Y)	Infrastructure Index (X1)	Capital Index (X2)	Service Index (X3)
2005	0.6988	0.1134	0.5114	0.1846
2006	0.7510	0.1169	0.6215	0.0687
2007	0.8291	0.1197	0.6410	0.0731
2008	0.9539	0.1230	0.7114	0.2241
2009	1.1580	0.1264	0.7290	0.0779
2010	1.2451	0.1238	0.7377	0.0984
2011	1.5200	0.1599	0.8120	0.1697
2012	1.8940	0.1861	0.8249	0.2549
2013	2.2041	0.1856	0.8369	0.2953
2014	2.6404	0.1989	0.8412	0.3094
2015	2.9717	0.1967	0.8570	0.0787
2016	3.0648	0.1934	0.8710	0.0820
2017	3.4353	0.2220	0.8810	0.0954
2018	3.9380	0.2478	0.8921	0.2153
2019	3.9910	0.2387	0.8995	0.2569
2020	3.7935	0.2748	0.8745	0.2387
2021	4.0893	0.2894	0.8456	0.3267
2022	3.5109	0.3478	0.8964	0.3540
2023	3.5953	0.3889	0.9847	0.3987

Source: Compiled by the authors based on data from the National Office of Statistics (Algeria) and retrieved from the United Nations E-Government Knowledgebase: <https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/3-Algeria> (Accessed on 01-07-2025).

4. Measuring the Impact of E-Governance on Economic Diversification in Algeria:

Most empirical studies addressing the impact of e-governance on economic diversification in developing countries indicate the existence of a positive relationship between these two variables. Building upon this literature, the present study aims to assess the potential influence of e-governance on economic diversification in one of North Africa's leading emerging economies—Algeria.

This analysis employs time series data spanning the period from 2005 to 2023, using a set of e-governance indicators as explanatory (independent) variables, while the Economic Diversification Index—measured through the export-to-import diversification ratio—serves as the dependent variable. The econometric model is built upon a technical measurement approach and seeks to determine the strength and direction of this relationship.

The following table provides a detailed description of the variables used in the empirical model:

Table N°2: Description of Variables Used in the Econometric Model.

Symbol	Indicator	Description
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Dependent Variable.		
y_t	Economic Diversification Index.	This index represents the average value and volume of exports across various Algerian sectors compared to the average value and volume of imports across the same sectors, on an annual basis. It serves as a robust proxy for the contribution of productive sectors to the national GDP, measured through the commodity concentration of exports and imports.
Independent (Explanatory) Variables.		
x_1	Telecommunication Infrastructure Index (TII)	Represents the availability of digital infrastructure, technical facilities, and foundational systems that enable the digitization of communication and public services. This includes the deployment of online platforms, activation of smart databases, and modern communication channels both within government entities and between the government and the public.
x_2	E-Participation / Human Capital Index (HCI)	Reflects the capacity of human resources to manage ICT infrastructure and to facilitate the delivery of digital public services. It also captures the degree of public responsiveness to digital government initiatives.
x_3	Online Service Transparency Index (E-SI)	Measures the transparency of e-services offered by public authorities, emphasizing the degree to which such services operate free from corruption, bribery, and bureaucratic inefficiencies. It is considered a key indicator of integrity in digital public service delivery.

Source: Prepared by the authors.

4.1 Econometric Model Specification:

This study aims to estimate the nature and magnitude of the impact that key e-governance indicators exert on a primary proxy of economic diversification in Algeria. The dependent variable is defined as the export-to-import diversification ratio, capturing the relative contribution of various productive sectors to national exports in contrast to the sectors' dependence on imports.

Given the limited time span (2005–2023) and the relatively small number of statistical observations, a Stepwise Regression Approach is employed to identify the optimal model specification. This modern estimation technique systematically eliminates explanatory variables that lack statistical significance or exhibit weak explanatory power—as indicated by a low coefficient of determination (R^2).

The stepwise procedure ensures that only independent variables demonstrating strong statistical significance and a high explanatory capacity are retained. The goal is to maximize model reliability by including only those variables that meaningfully

contribute to explaining variations in the dependent variable. In this context, the model prioritizes:

- High R^2 values, reflecting the strength of association between independent and dependent variables.
- Statistically significant coefficients (typically based on p-values within a defined confidence level).
- Minimization of multicollinearity and overfitting, which is critical given the small sample size

This approach allows the model to focus on the **most** influential dimensions of e-governance in shaping Algeria's economic diversification dynamics.

Table N°3: Excluded Explanatory Variables in the Estimation of E-Governance Impact on Economic Diversification.

		Excluded Variables ^a				Collinearity
Model		Beta In	t	Sig.	Partial Correlation	Statistics Tolerance
1	x1	.237 ^b	1.593	.131	.370	.346
	x3	.046 ^b	.425	.676	.106	.748

a. Dependent Variable: **y**

b. Predictors in the Model: (Constant), **x2**

Source: Generated by the authors using EVIEWS 12 software.

As shown in Table 03, the Stepwise Regression approach led to the exclusion of two explanatory variables— x_1 (Telecommunication Infrastructure Index) and x_3 (Online Service Transparency Index)—from the final model due to their lack of statistical significance. Their p-values (Sig.) exceeded the 5% threshold, indicating weak explanatory power with respect to the dependent variable (y).

In contrast, the variable x_2 (E-Participation / Human Capital Index) was retained in the final model due to its strong statistical significance and high explanatory power. Specifically:

- The variable x_2 yielded an R^2 value of 0.92, meaning it explains 92% of the variation in Algeria's economic diversification index over the period 2005–2023.
- The variable was significant at the 5% level, confirming its strong influence on the dependent variable.
- This finding underscores the critical role of human capital and public engagement with digital platforms in shaping the effectiveness of e-governance initiatives aimed at economic diversification.

The statistical strength of x_2 suggests that technological infrastructure and service transparency, while important, may not yield measurable impact without active human participation and capacity-building in digital governance systems.

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Table N°4: Model Summary Indicating the Strength of the Relationship for the Most Influential Independent Variable.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.926 ^a	.858	.850	.245075318789035

a. Predictors: (Constant), x2

Source: Prepared by the authors based on output from EViews 12 software.

Assuming a linear relationship between the model variables, the econometric model can be expressed as:

$$y_t = \beta_0 + \alpha_1 X_1 + \alpha_2 X_2 + \varepsilon_t$$

However, based on the stepwise regression results, the optimal model retains only the explanatory variable X_2 to estimate its effect on the dependent variable y_t .

The chosen model was validated through the F-test, which indicated a high level of statistical significance at the 5% significance level, confirming the overall goodness of fit and explanatory power of the model.

The following table presents the detailed results of the F-test.

Table N°5: ANOVA Results – Significance of the Independent Explanatory Variable X_2 .

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.180	1	6.180	102.894	.000 ^b
	Residual	1.021	17	.060		
	Total	7.201	18			

a. Dependent Variable: y

b. Predictors: (Constant), x2

Source: Prepared by the authors based on output from EViews 12 software.

The ANOVA table demonstrates the overall significance of the regression model in explaining the variations in economic diversification in Algeria.

- The F-statistic value of 102.894 is substantially high, and the associated p-value (Sig.) is 0.000, which is far below the 5% significance level.
- This result strongly rejects the null hypothesis that the independent variable x_2 has no effect on the dependent variable y_t .
- Thus, the model confirms that the E-Participation / Human Capital Index (x_2) is a highly significant explanatory variable for Algeria's economic diversification between 2005 and 2023.

4.2 Model Estimation:

Based on the annual time-series data for the explanatory variables included in the model after the exclusion stage (as previously described), and using EViews 12 software, the following long-run estimation results were obtained for the impact of

the independent explanatory variable X_2 on the dependent variable Y_t over the period 2005–2023.

Table N°6: Long-Run Estimation Results of the Effect of X_2 on Y_t .

		Coefficients ^a				
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	17.413	.402		43.336	.000
	x2	5.022	.495	.926	10.144	.000

a. Dependent Variable: y

Source: Prepared by the authors based on output from EViews 12 software.

Based on the results of the previous table, which specifies the estimated regression equation in this model, it can be written as follows:

$$y_t = \beta + \alpha X_2 + \varepsilon_t$$

- Y_t is the dependent variable representing the economic diversification index in Algeria during the period 2005–2023.
- β is the intercept (constant) term.
- α is the coefficient measuring the significance and effect of the explanatory independent variable X_2 .
- ε_t represents the error term (residuals).

Using the estimated coefficients from Table 06, the model can be written as:

$$y_t = 17.413 + 5.022X_2$$

The estimation results indicate a statistically significant long-run relationship between the independent explanatory variable, represented by the E-Participation / Human Capital Index X_2 and the dependent variable, the economic diversification index Y_t in Algeria over the period 2005–2023. Specifically, a one-unit increase in the independent variable X_2 leads to an increase of approximately **5.022** units in the dependent variable Y_t , reflecting a positive and significant impact in the context of this study.

4.3 Statistical Quality Testing of the Estimated Model:

Before interpreting the economic significance of the impact of the independent explanatory variable X_2 , On the dependent variable Y_t , it is essential to verify that the estimated model is free from common statistical problems. These include:

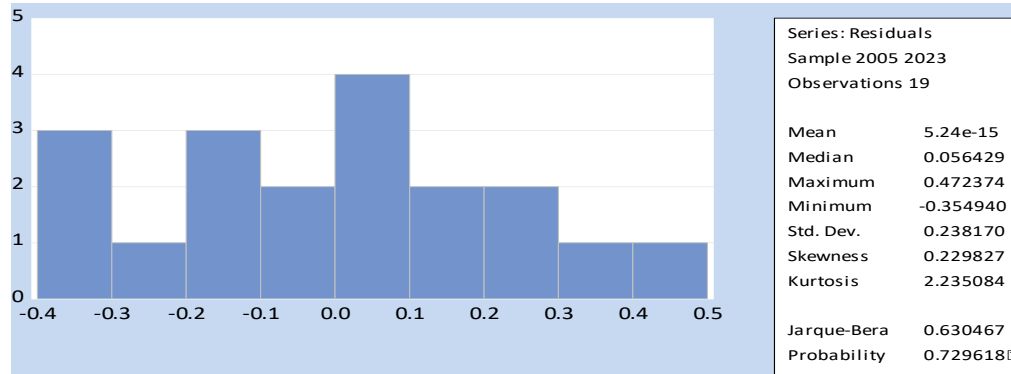
- **Autocorrelation of residuals** (serial correlation).
- **Normality of residuals.**
- **Heteroscedasticity** (non-constant variance of errors), among other potential issues.

Ensuring the absence of such problems is crucial to enhance the reliability and credibility of the estimation results, both from a statistical and economic perspective.

❖ **Test of Normality for Estimation Residuals:**

The Jarque-Bera test was employed to assess the normality of the residuals from the estimated model. The null hypothesis of this test states that the residuals follow a normal distribution. The test results are illustrated in the following figure:

Fig N° 1: Jarque-Bera Test Results for Estimation Residuals.



Source: Prepared by the authors based on outputs from EViews 12 software.

From Figure N° 01, it is clear that the histogram bars of the estimation residuals resemble the bell-shaped curve characteristic of a normal distribution. Moreover, the p-value of the Jarque-Bera test (0.729618) is greater than 5%, leading us to accept the null hypothesis of normality.

❖ **Test for Autocorrelation of Residuals:**

The Breusch-Godfrey test is considered one of the most effective methods for detecting autocorrelation in residuals. The results of this test are summarized in the following table:

Table N° 7: Results of the Breusch-Godfrey Test for Autocorrelation of Residuals.

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	2.950589	Prob. F(2,15)	0.0831
Obs*R-squared	5.364404	Prob. Chi-Square(2)	0.0684

Source: Prepared by the authors based on outputs from EViews 12.

According to the results in the table, the calculated F-statistic (0.0831) is less than the critical value at the 5% significance level. Therefore, we accept the null hypothesis, indicating no presence of autocorrelation in the residuals.

❖ **Test of the Homoscedasticity Hypothesis:**

To verify the validity of the assumption of constant variance of the error term (homoscedasticity), the Breusch-Pagan-Godfrey test is used, as shown in Table N° 08.

Table N° 8: Breusch-Pagan-Godfrey Test Results.

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.159565	Prob. F(1,17)	0.6945
Obs*R-squared	0.176679	Prob. Chi-Square(1)	0.6742
Scaled explained SS	0.087346	Prob. Chi-Square(1)	0.7676

Source: Prepared by the authors based on outputs from EViews 12.

Since the calculated F-statistic is less than the critical value at the 5% significance level, we accept the null hypothesis, which indicates the constancy (homoscedasticity) of the error term variance in the estimated model.

❖ Ramsey RESET Test:

This test is used to assess the functional form adequacy of the model in representing the relationship between economic variables. The results of this test are as follows:

Table N° 9: Results of the Ramsey RESET Test.

Ramsey RESET Test			
Equation: UNTITLED			
Omitted Variables: Squares of fitted values			
Specification: Y X2 C			
	Value	df	Probability
t-statistic	1.098688	16	0.2882
F-statistic	1.207116	(1, 16)	0.2882
Likelihood ratio	1.381952	1	0.2398
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.071629	1	0.071629
Restricted SSR	1.021053	17	0.060062
Unrestricted SSR	0.949423	16	0.059339

Source: Prepared by the authors based on outputs from EViews 12.

Since the p-value of the F-test is greater than the 5% significance level, the proposed functional form of the model expressing the relationship between the studied economic variables is accepted.

Accordingly, the estimated model is written as follows:

$$y_t = \beta + \alpha X_2 + \varepsilon_t \qquad y_t = 17.413 + 5.022X_2$$

4.4 Economic Analysis of the Estimation Results:

The estimation results indicate that the signs of the coefficients in the estimated model support its economic validity. Most theoretical frameworks confirm a positive effect between economic diversification on one hand, and indicators such as communication infrastructure, electronic participation of human capital, and transparency of electronic services on the other. This aligns with the model estimated in our study.

The results reveal that the explanatory independent variable X_2 , representing the electronic participation index of human capital, is the most influential factor affecting the level of economic diversification in Algeria during the period 2005-2023. This finding is consistent with economic theories that emphasize the critical role of active and constructive electronic engagement of human capital in e-governance projects, as they are the primary drivers and supervisors of the digital transformation process in its broad and precise sense.

The estimation indicates that a one-unit increase in the electronic participation index of human capital in Algeria's e-governance project leads to a 5.022% increase in economic diversification. This positive effect highlights the importance of

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investing in the capabilities and potential of human resources involved in e-governance initiatives.

Recent scholarly contributions emphasize the necessity of investing more in human capital, which is considered the engine of sustainable economic diversification with high efficiency and effectiveness. Despite the availability of digital platforms and infrastructure across public services and various productive sectors, the delivery of electronic services fundamentally depends on the skills, knowledge, and performance efficiency of the active human resources in production sectors. These capabilities are key to increasing exports across all sectors and diversifying imports, as highlighted by researchers such as Jonathan Eaton and Harvey S. Rosen.

Moreover, electronic participation of human capital in implementing e-governance projects is a cornerstone for supporting local investment by improving the investment climate through enhanced transparency and eliminating bureaucratic obstacles that hinder the growth of emerging industries, which are essential for economic diversification. Additionally, this participation reflects the ability of many young entrepreneurs in facilitating procedures for establishing their small enterprises, thus attracting foreign direct investment—one of the pillars of economic diversification and its effectiveness. It also involves setting standards for monitoring and evaluating the performance of electronic service delivery. Contributions by Duncan Bentley affirm that economic diversification relies directly on the flexibility of knowledge acquired by human resources in various production sectors, which makes increasing productivity and improving output quality feasible.

Since 2005, Algeria has focused on developing qualified human capital within its e-governance project to activate development across various fields, with economic diversification being a major goal to reduce excessive dependence on the hydrocarbon sector and to safeguard against financial shocks caused by price volatility in this dominant sector. After the 2014 oil price shock and following notable progress in localizing digital platforms and e-governance, Algeria shifted towards a balanced growth model that revitalizes dormant sectors such as agriculture, industry, and tourism—areas in which the country holds relative abundance. By 2023, Algeria succeeded in establishing a diverse institutional fabric capable of penetrating external markets, particularly in the manufacturing industry (iron, steel, cement), as well as agricultural and food products.

5. Conclusion:

This study shows that e-governance represents a fundamental pillar for enhancing economic diversification in Algeria, by modernizing public administration, reducing bureaucracy, and increasing transparency, as well as improving the business climate and attracting investments through simplified procedures and an efficient institutional environment. The success of this role depends on the readiness of digital infrastructure, the competence of human resources, and the engagement of economic actors.

Economic diversification cannot be achieved merely by expanding productive sectors; it requires modern governance that integrates digital technologies into

decision-making and implementation. It is therefore essential for the Algerian government to accelerate the digitization of public services, invest in developing digital skills, update supportive legislation, establish monitoring and evaluation mechanisms, and ensure the participation of the private sector and civil society. Economic diversification will only be successful if it relies on effective e-governance capable of delivering efficiency, transparency, and sustainability.

The key findings of this study can be summarized as follows:

- The empirical analysis confirmed that the electronic participation index of human capital (X_2) is the most influential factor driving economic diversification in Algeria between 2005 and 2023, aligning with theoretical perspectives highlighting the central role of human capital in successful e-governance initiatives.
- The results show that a 1% increase in the electronic participation index of human capital corresponds to a 5.022% rise in economic diversification, highlighting the importance of investing in digitally skilled human resources.
- Theoretical analyses suggest that e-governance acts as a crucial lever for economic diversification by modernizing public administration, reducing bureaucracy, and increasing transparency in managing national resources.
- The study confirmed that employing e-government technologies enhances the business environment and attracts foreign investments through streamlined procedures and an institutional framework characterized by efficiency and transparency.
- Achieving economic diversification requires not only the expansion of productive sectors but also a modern governance system based on digital technologies that encompasses decision-making, implementation, and monitoring phases.
- Comparative international experiences show that countries successfully integrating e-governance have built more flexible economies able to cope with global market volatility, providing valuable lessons for Algeria.
- Accelerating the digitisation of public services and implementing a thorough sectoral integration strategy are critical requirements for e-governance to effectively support economic diversification.
- Economic diversification in Algeria will only be effective through sound e-governance capable of ensuring efficiency, transparency, and addressing challenges related to rentier economies and energy market fluctuations.

Based on these insights, the following recommendations emerge:

- Expedite the completion of the national digitization project by establishing a robust, secure digital infrastructure capable of supporting diverse e-governance services.
- Prioritize the development of digital human capital through specialized training programs in information and communication technologies, while enhancing public sector employees' skills to ensure the success of digital transformation.
- Establish appropriate legislative and regulatory frameworks that keep pace with e-governance requirements, ensuring cybersecurity, data protection, and facilitating digital transactions.

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- Activate continuous monitoring and evaluation mechanisms for e-governance programs using quantitative and qualitative indicators to measure their impact on economic diversification.
- Strengthen public-private partnerships in digitization initiatives by encouraging investment in technological solutions and advancing digital services.
- Engage civil society and economic stakeholders in designing and implementing e-governance strategies to guarantee inclusiveness and effectiveness of adopted policies.
- Expand the scope of public electronic services to cover as many sectors as possible, especially those related to investment, trade, business creation, and small and medium-sized enterprises.

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