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ASSESSING THE INFLUENCE OF ICT INFRASTRUCTURE ON BUSINESS STARTUP EASE: QUANTITATIVE ANALYSIS IN ALGERIA (2004-2020)

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Abstract

The aim of this paper is to investigate whether advances in Algeria's fixed broadband infrastructure from 2004 to 2020 influenced progress in the country's business startup climate over the same period. The research goals are to empirically assess if greater information and communication technology adoption facilitated entrepreneurship growth. It is expected that increasing broadband access had a statistically significant positive impact. By highlighting the enabling potential of ICT investment for economic diversification, this study provides an evidence-based model for comparable emerging economies seeking to improve startup rates through a more supportive entrepreneurship environment.

Keywords: *ICT infrastructure; fixed broadband subscriptions; FBS; starting a business – score; SB; Algeria; entrepreneurship*
JEL Codes: *O14; O30; O33; O38; L96*

1. Introduction

Information and communication technology (ICT) is widely recognized as a key driver of economic growth, innovation, and competitiveness in a globalized world. ICT infrastructure, which includes hardware, software, networks, and services, enables the creation, storage, processing, and dissemination of information and knowledge across various sectors and domains. It may also facilitate the emergence and development of new businesses, especially in the digital economy, by reducing entry barriers, enhancing productivity, expanding markets, and fostering entrepreneurship.

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In the realm of economic development, fostering entrepreneurship stands as a key objective for nations. This has led to increased academic interest in analyzing and evaluating entrepreneurial ecosystems. With the aim of extracting successful models to project other experiments (Saoud & Meddahi, 2023). The escalating focus in this area underscores the critical need to comprehend the various determinants that shape entrepreneurial endeavors, notably the role played by ICT infrastructure.

Algeria is considered the largest country in Africa and the Arab world, with a population of about 44 million and a GDP of $147 billion in 2020. Algeria's economy is heavily dependent on hydrocarbon exports, accounting for approximately 93% of total exports and 38% of budget revenue (The World Bank in Algeria, n.d.). In 2021, Algeria was one of the top 10 largest natural gas producers globally, occupying the tenth position (Hadj & Djamal, 2023). However, the hydrocarbon sector has been subject to volatility and uncertainty due to fluctuations in global oil and gas prices as well as domestic political and social unrest. During recent decades, Algeria focused on diversifying its economy and reducing its reliance on hydrocarbon exports. This diversification strategy focuses on developing the ICT sector as a potential driver of economic growth and job creation, with the deployment of fiber-optic networks, mobile and fixed broadband services, and satellite communications.

There is a lack of rigorous empirical evidence on how the level of the national broadband infrastructure in developing countries influences the conditions for entrepreneurship over time. This is especially relevant for Algeria, a country that relies heavily on hydrocarbons and aims to diversify its economy by expanding its private sector. Algeria has invested in building large-scale fiber optic and Internet networks to promote business growth, but to our knowledge, we have not come across any academic study that measures the impact of the progress of ICT infrastructure on actually improving the business climate, particularly in Algeria.

This paper fills this gap by using the World Bank's Starting a business - Score index (SB), and the fixed broadband subscriptions indicator - per 100 people - (FBS) data from 2004 to 2020. Our paper contributes to the literature by providing a context-specific empirical analysis to evaluate the impact of a country's ICT infrastructure on the ease of starting a business.

1.1. Problem statement

While many countries have invested substantially to expand their ICT infrastructure over the past two decades, few studies have quantitatively examined whether the

development of fixed broadband translates into a fundamental improvement in the business environment. This poses a critical knowledge gap, inhibiting evidence-based policymaking. Therefore, this study aims to conduct an econometric analysis to assess whether Algeria's investments in fixed broadband have significantly influenced the ease of starting new businesses. Findings will provide robust insights into the role of ICT infrastructure in enabling entrepreneurship and alleviating barriers to entrepreneurship in Algeria. Policy recommendations will be derived on the basis of research findings.

1.2. Research question

This led us to address the following question.

RQ: How does the level of ICT infrastructure, as measured by the FBS indicator, affect the ease of starting a business, as measured by the SB index, in Algeria from 2004 to 2020?

1.3. Research objectives

The overarching objective of this study is to assess the influence of investments in ICT infrastructure on the ease of business startup in Algeria between 2004 and 2020. More specifically, this study aims to:

a. Examine the relationship between investments in ICT infrastructure (independent variable) measured by FBS indicator by population and business startup rates, procedures, time, and costs. Measured by the SD index (dependent variables) in Algeria over the 2004-2020 period.

b. Determine the extent to which advances in ICT infrastructure have facilitated and enabled entrepreneurial activities by reducing administrative burdens and requirements for starting a business in Algeria.

1.4. Significance of this research

The analysis will generate scholarly evidence and practical insights on how ICT adoption influences startup rates at the country level, while also identifying the remaining challenges in Algeria's business climate. Overall, the findings stand to meaningfully inform policymakers, companies, and researchers on leveraging ICT advancement to foster private sector development in Algeria. By examining this technology-entrepreneurship nexus over the past two decades, this study can provide a model for similar emerging economies.

2. Literature Review

2.1. Impact of ICT infrastructure

The impact of information and communications technology (ICT) on infrastructure at the macro level has been the subject of some significant research and empirical evaluation. Studies have shown that ICT infrastructure plays a crucial role in economic growth and development. Toader et al. (2018) emphasize the increasing interest among researchers in measuring the impact of ICT on economic growth, highlighting the accelerated development of ICT over the past two decades. Czernich et al. (2011) further support this by suggesting that broadband infrastructure, a key component of ICT, acts as a general-purpose technology that fundamentally changes how and where economic activity is organized. This indicates that ICT infrastructure, particularly broadband, can significantly influence macroeconomic outcomes. Moreover, Pradhan et al. (2018) stressed the fundamental role of infrastructure, including ICT, as a driver of long-term economic growth. They highlighted that ICT has supported and accelerated the growth of the global economy in unprecedented ways.

The impact of ICT infrastructure at the macro level is substantial and influences economic growth and other aspects of societal development. The evidence from these studies collectively supports the notion that ICT infrastructure plays a pivotal role in shaping macroeconomic outcomes and broader societal dynamics.

2.2. Fixed broadband infrastructure

Fixed broadband infrastructure refers to the physical network that enables high-speed internet access for residential and business users, including fiber-optic cables, digital subscriber lines (DSL), and cable modems (Stork et al., 2014; Czernich et al., 2011). The standardization of this infrastructure across access networks improves effectiveness and efficiency (Wijaya, 2021). National policies often control the provision and adoption of fixed broadband (Whitacre & Gallardo, 2020).

Several studies have examined the impact of fixed broadband infrastructure. Czernich et al. (2011) found that broadband infrastructure enhances economic growth by facilitating business and household adoption. Bahrini and Qaffas (2019) further established causal relationships between ICT infrastructure, including broadband, and economic growth. Additionally, Hagsten (2022) revealed positive correlations between firms' broadband infrastructure and online sales.

These studies provide evidence and rationale suggesting that fixed broadband subscriptions rates could serve as a valid proxy measure for assessing the overall level of ICT infrastructure development in Algeria.

- Fixed broadband subscriptions indicator (FBS)**:** Fixed broadband subscriptions refer to citizen subscriptions that provide high-speed access to the public Internet over a TCP/IP connection with speeds of 256 kilobits per second or greater. This includes subscriptions using cable modem, DSL, fiber optic cable directly to the home or building, other fixed wired connection, satellite broadband, and terrestrial fixed wireless broadband. The indicator is calculated by the total number of fixed broadband subscriptions regardless of the payment method, but excludes access via mobile cellular networks. It includes subscriptions using technologies such as fixed WiMAX and other fixed wireless networks. Both residential and organizational fixed broadband subscriptions are included in the total (Fixed Broadband Subscriptions (Per 100 People), 2023).

2.3. ICT infrastructure in Algeria

The development of the telecommunications and digital sector is a priority set by Algeria. Since 2000, the opening up of the telecommunications market to competition following the publication of General Law No. 2000-03 of August 5, 2000 setting the general rules relating to the post office and telecommunications, has radically changed the public authorities' approach to telecommunications and has made it possible to achieve remarkable results, particularly in the mobile technology market, which introduced 2G in 2001, 3G from December 2013, and 4G from September 2016. To further improve this market, Law 18-04 of May 10, 2018 setting the general rules relating to the post office and electronic communications introduced provisions in favor of the establishment of a climate conducive to entrepreneurship, improving the conditions of access to the electronic communications market, and improving the quality of service for the benefit of all citizens without exception. This report provides an overview of developments observed in fixed telephony, mobile telephony and fixed, and mobile broadband up to the end of 2022 (Direction des Statistiques, des Etudes et de la Prospective, 2022).

On the basis of the aforementioned discussion, we propose the following hypothesis:

H1: The FBS indicator, increased by at least 5 points in Algeria from 2004 to 2020.

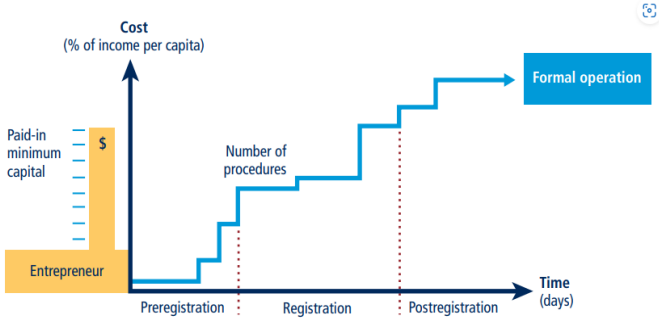
2.4. Business startup ease

Business startup ease refers to the level of simplicity and convenience involved in establishing a new business. This encompasses various factors such as government support, access to finance, entrepreneurship assistance, and key success factors. Research has shown that startups play a significant role in the economy (Giardino et al., 2014).

- Starting a business – Score index: The World Bank's Doing Business report analyzes the ease of legally establishing and operating a small or medium-sized business across 190 economies. It documents required procedures, timeframes, costs, and minimum capital involved in starting a business. Data is collected on laws, regulations, public information, and via questionnaires completed by legal and government professionals. The methodology examines hypothetical identical domestic limited liability companies differing only by owner gender composition. It looks at obtaining licenses, permits, clearances, and completing mandatory notifications and registrations.

The Starting a Business Index averages economies' scores on number of procedures, time, costs, and minimum capital requirements to formally commence operations for two standardized companies. Scoring each economy from 0-100 relative to the highest globally observed best practices over time. For example, a score of 75 in 2019 denotes a 25-percentage point gap from the historical optimal score. Thus, an increase to 80 in 2020 reflects advancement towards global best practices. This standardized longitudinal scoring enables assessing absolute improvement in the overall environment for operating a business within an economy over time. The index quantifies the distance in regulatory performance of each economy compared historically across sample countries. It highlights where economies stand versus global good practices and their progress in adopting business-friendly regulations. (The World Bank, n.d.)

Figure no. 1 Composition of the Starting a business – Score (SB) indicator



Source: (The World Bank, n.d.)

On the basis of the aforementioned discussion, we propose the following hypothesis:

H2: The SB index improved by at least 10 points in Algeria from 2004 to 2020

2.5. ICT infrastructure and business startup ease

The literature review shows that ICT and broadband infrastructure are crucial factors for promoting and supporting entrepreneurship in various settings. By having access to ICT, entrepreneurs can overcome many challenges and costs related to information, communication, coordination, and training (Duvivier et al., 2021). ICT also affects the rate of new firm creation (Gomes & Lopes, 2022). Several studies have demonstrated the positive effects of broadband infrastructure on entrepreneurship in countries such as Germany and China (Zhang et al., 2019; Ajide, 2022), as well as in rural areas and small businesses (Deller et al., 2021). Furthermore, internet access at home enables home-based businesses, which contribute to economic growth (Czernich et al., 2011).

In developing countries, mobile phones and internet connectivity enhance entrepreneurial activity by providing access to information, markets, and resources (Akerman et al., 2015). Regions with better ICT infrastructure have more new business creation (Aparicio et al., 2016). Transition economies also benefit from ICT as skilled entrepreneurs use it to create successful new ventures (Cieślik & van Stel, 2014).

On the other hand, the ICT infrastructure within the firm also plays a role in creating opportunities by reducing costs and increasing efficiency (Sin Tan et al., 2010). Mobile broadband offers lower costs and better reach (Alderete, 2017). ICT infrastructure also fosters technology entrepreneurship (Colovic & Lamotte, 2015) and innovation, R&D, and new business models (Ramasamy, 2016). Similar positive impacts were observed in the African context (Ajide, 2020).

Therefore, the literature review clearly indicates the importance of ICT and broadband infrastructure for facilitating and enabling entrepreneurship across contexts by lowering barriers and costs and providing access to information, resources, efficiency gains and new opportunities.

H3: An increase in the FBS indicator in Algeria from 2004 to 2020 leads to an improvement in the SB index in the same period.

3. Research Methodology

This quantitative study uses a regression analysis approach to examine the relationship between investments in ICT infrastructure, measured by fixed broadband subscriptions (FBS), and the ease of starting a business in Algeria from 2004 to 2020, measured by the World Bank Starting a business - Score (SB) index.

3.1. Data Collection

Secondary data on Algeria's FBS indicator and SB index from 2004 to 2020 was collected from the World Bank's World Development Indicators database. This enabled the consistent measurement of Algeria's FBS indicator and SB index aligned with international standards.

The time period from 2004 to 2020 was selected for analysis in this study due to data availability and the ability to examine the relationship between variables over the same time frame. Specifically, data for FBS indicator was available from 2003 to 2022. However, data for SB index was only available from 2004 to 2020. When conducting time series analysis to study the impact between variables, it is important that the data for both variables cover the same time span.

3.2. Data Analysis

Descriptive statistics, including means, medians, maximums, minimums, standard deviations and, skewness, were calculated for the FBS and SB variables to characterize trends over the sample period.

An ordinary least squares regression model was estimated with the SB score as the dependent variable and FBS as the main independent variable. Diagnostic testing evaluated assumptions such as normality and absence of autocorrelation in the residuals.

$$SB = \beta 0 + \beta 1(FBS) + U$$

The model's statistical significance, predictive power, and reliability were assessed before hypothesis testing on whether increases in FBS led to higher S.

3.3. Statistical tools

All data preparation and sorting leveraged Microsoft Excel spreadsheets, while statistical analysis employed the Eviews 13 software system packages, including its tools for data manipulation, econometric modelling, and graphical visualization.

3.4. Validity and reliability

The World Bank indicators provide standardized, consistent measurements vetted by statistical experts, ensuring validity and reliability. Using rigorous econometric diagnostics further enhances analysis credibility.

Causality is supported by theory and the literature review of ICT's enabling effects. A time lag with FBS presaging changes in SB also indicates potential causal direction. Controlling for other macroeconomic and regulatory factors impacting new firm startup offers partial endogeneity between the main variables studied.

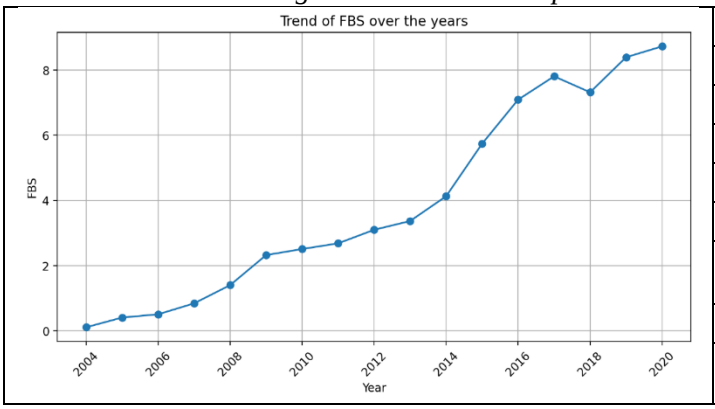
By leveraging internationally comparable index metrics over a 17-year period, this methodology enables a reasonably robust investigation of the research question on the influence of ICT infrastructure in improving entrepreneurial conditions in Algeria.

4. Results and Discussion

4.1. Descriptive statistics

- Fixed broadband subscriptions (FBS):

Figure no. 1 FBS descriptive statistics



Statistic	Value
Observations	18
Mean	3.497
Median	2.616
Maximum	8.723
Minimum	0.111
Standard Deviation	2.964
Skewness	0.730
Sum	62.941

Source: Elaborated by the author

Fixed broadband subscriptions (FBS) indicator in Algeria shows an increasing trend over the years from 2004 to 2020 based on the data. The mean subscription is 4.06 per 100 people, with a median of 3.37. The maximum subscription reached was 8.72 in 2020, while the minimum was 0.11 in 2004.

The standard deviation is 2.96, indicating decent variability in the data. The skewness is positive at 0.90 showing that the data is slightly skewed to the right. From 2004

to 2009, there was slower growth, increasing from 0.11 to 2.32 per 100 people. From 2010 to 2020, there was more rapid growth, climbing from 2.51 per 100 people to 8.72 in 2020. Overall, there has been a clear increasing trend in fixed broadband adoption over the years in Algeria. Factors driving this growth include government infrastructure investments, falling technology costs, increased consumer demand for home internet access, and faster speeds over time.

Based on this we can test the first hypothesis (H1):

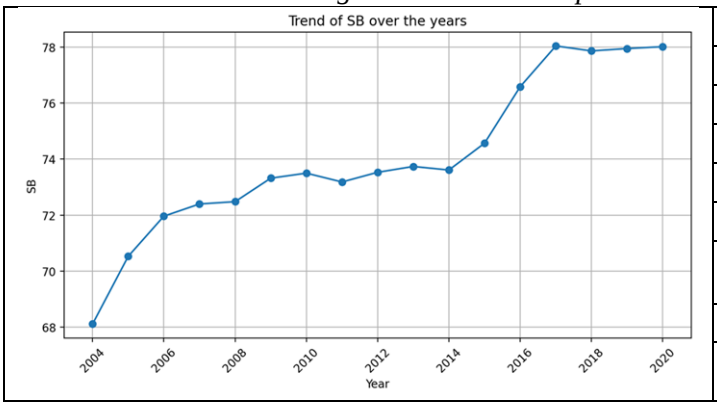
H_0: FBS indicator has not increased by at least 5 points in Algeria from 2004 to 2020.

H_a: FBS indicator increased by at least 5 points in Algeria from 2004 to 2020.

According to the data, the FBS indicator in Algeria was 0.11 in 2004, indicating that there were 0.11 fixed broadband subscriptions per 100 people. The indicator increased substantially to 8.72 in 2020, meaning that there were 8.72 fixed broadband subscriptions per 100 people. The difference between the two years is 8.61, which is calculated by subtracting 0.11 from 8.72. We tested the null hypothesis that the FBS indicator did not increase by at least 5 points from 2004 to 2020. Since the observed difference of 8.61 is larger than 5, we rejected the null hypothesis and accepted the alternative hypothesis that the FBS indicator in Algeria increased by more than 5 points from 2004 to 2020.

- Starting a business – Score (SB):

Figure no. 2 SB descriptive statistics



Statistic	Value
Observations	17
Mean	74.44617647
Median	73.7381
Maximum	78.04054
Minimum	68.11368
Standard Deviation	3.086599603
Skewness	-0.17408252
Sum	1265.59

Source: Elaborated by the author

The data on the SB score in Algeria shows a general increasing trend from 2004 to 2020. The mean score was 74.45 out of 100, with a median of 73.74. The maximum score reached was 78.04 in 2017, while the minimum was 68.11 in 2004.

The standard deviation of 3.09 indicates there is some variations in the data from year-to-year. The skewness of -0.17 indicates that the data distribution is approximately symmetrical. From 2004 to 2009, there were minor fluctuations in the score between 68.11 and 73.32. From 2010 to 2017, there was steady growth from 73.50 up to the peak of 78.04. The score has levelled off since 2017 between 77.86 and 78.01.

Overall, this reflects gradual improvements in the ease of starting a business in Algeria over the years. Driving factors likely include government initiatives to reduce bureaucratic hurdles, increased access to credit and financing options, and a growing entrepreneurial culture. Sustaining and enabling further growth requires maintaining political stability and policy consistency in the business regulatory environment.

Based on this, we can test the second hypothesis (H2):

H_0: The SB index has not improved by at least 10 points in Algeria from 2004 to 2020.

H_a: The SB index improved by at least 10 points in Algeria from 2004 to 2020.

The data shows that in 2004, Algeria's SB index was 68.11. By 2020, it had increased to 78.01. The difference between these two years is 78.01 - 68.11, which equals 9.90. Given the null hypothesis that the SB index has not improved by at least 10 points from 2004 to 2020, we fail to reject this because the actual difference of 9.90 is less than the 10-point threshold. Therefore, we fail to reject the null hypothesis that the SB index has not increased by at least 10 points. Instead, based on this dataset, we accept that there is not enough evidence to support the alternative hypothesis that Algeria's SB improved by at least 10 points from 2004 to 2020.

4.2. Simple linear regression model

- Building a standard model: An econometric model will be developed to analyse the effect of ICT infrastructure measured by FBS indicator, the independent variable, on the ease of starting a business measured by SB index, the dependent variable. Model parameters will be estimated first, followed by hypothesis testing of the estimated parameters. Next, the magnitude and significance of the estimated parameters will be evaluated. Finally, the model's predictive ability is tested.

The model includes the stability of other factors that affect the dependent variable; therefore, the model is as follows:

$$SB = \beta 0 + \beta 1(FBS) + U$$

FBS: Fixed broadband subscriptions

SB: Starting a business – Score

$\beta 0$: Constant for Starting a business – Score function

$\beta 1$: Coefficient of the independent variable (Fixed broadband subscriptions)

- Normality test: To check the normality of the data, the Jarque-Bera test was applied. This test has a null hypothesis that the data is normally distributed. The null hypothesis is not rejected if the p-value from the test is more than 0.05. The table (1) shows that the p-values for FBS (0.450) and for SB (0.917) are both more than 0.05. This means that the data for both FBS and SB can be assumed to be normal, as the Jarque-Bera test does not reject the normality hypothesis. The normality of the data is important for many statistical methods that need this assumption. More statistical analysis can be done using these methods.

Table no.1 - Jarque-Bera tests

	FBS	**SB**
Jarque-Bera	1.596971	0.172360
Probability	0.450010	0.917429

Source: EViews 13 outcomes

- estimation and evaluation of the Regression Model: The simple linear regression model method was adopted to estimate the econometric model measuring the effect of FBS on SB according to the following equation:

$$SB = \beta 0 + \beta 1(FBS) + U$$

Table (2) shows the results of the analysis.

Table no.2 - OLS regression of SB on FBS

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	70.60195	0.376952	187.2970	0.0000

FBS	0.890289	0.077317	11.51486	0.0000
R-squared	0.898368	Mean dependent var		74.08186
Adjusted R-squared	0.891593	S.D. dependent var		2.821391
S.E. of regression	0.928949	Akaike info criterion		2.800605
Sum squared resid	12.94419	Schwarz criterion		2.898630
Log likelihood	-21.80514	Hannan-Quinn criter.		2.810349
F-statistic	132.5919	Durbin-Watson stat		0.767429
Prob(F-statistic)	0.000000			

Source: EViews 13 outcomes

The constant term coefficient of 70.601 represents the value of the SB when the independent variable (FBS) equals zero. The FBS coefficient of 0.890 indicates a positive relationship between FBS and SB. A p-value of 0.000, which is less than 0.01, signifies this relationship is statistically significant at the 99% confidence level. As such, SB is influenced by changes in FBS. Specifically, as FBS increases, SB also tends to increase as well.

The correlation coefficient R-squared of 0.898 indicates a positive association between SB and FBS. It signifies that 89.8% of variations in SB can be explained by changes in FBS, while other factors account for the remaining 10.2% of SB fluctuations.

The F-statistic value of 132.591 with a p-value of 0.000, which is less than 0.01, denotes the overall significance of the regression model and the significant effect of the FBS on the SB.

- Testing the autocorrelation between random errors: The autocorrelation of errors is considered one of the most significant issues that estimators face when modelling, leading to biased standard errors and consequently erroneous statistical tests. This problem occurs when the error term in one period is positively correlated with the errors from the previous period. The presence of first and higher-order autocorrelation can be tested using several methods, including: 1) the Durbin-Watson test, which compares the computed test statistic to critical values from tables, 2) the Breusch-Godfrey Lagrange multiplier test, which tests for autocorrelation at specified lags using an F-test or LM test, and 3) plotting the autocorrelation function and partial autocorrelation function and looking for significant lags. In this analysis, both the Durbin-Watson and Breusch-Godfrey tests are used to check

for first and second-order autocorrelation before proceeding with modeling or inference in order to ensure the reliability of results.

Table no.3 - Breusch-Godfrey serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.820284	Prob. F(2,13)	0.2009
Obs*R-squared	3.719203	Prob. Chi-Square(2)	0.1557

Source: EViews 13 outcomes

Table no.4 - Auxiliary regression of residuals on original regressors and lagged residuals

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.014592	0.358023	-0.040759	0.9681
FBS	0.003575	0.073513	0.048628	0.9620
RESID(-1)	0.472111	0.263342	1.792769	0.0963
RESID(-2)	-0.328135	0.263919	-1.243315	0.2357
R-squared	0.218777	Mean dependent var		2.15E-15
Adjusted R-squared	0.038494	S.D. dependent var		0.899451
S.E. of regression	0.881969	Akaike info criterion		2.789005
Sum squared resid	10.11231	Schwarz criterion		2.985055
Log likelihood	-19.70654	Hannan-Quinn criter.		2.808493
F-statistic	1.213523	Durbin-Watson stat		1.383344
Prob(F-statistic)	0.343939			

Source: EViews 13 outcomes

Based on the Breusch-Godfrey test results, there is no evidence of statistically significant autocorrelation in the residuals up to 2 lags.

The null hypothesis of no autocorrelation cannot be rejected at the 5% significance level based on the F-test (F=1.820, p=0.200) and LM test (LM=3.719, p=0.155). All p-values are above typical cut-offs as 0.05.

Additionally, the coefficients on the lagged residual terms (RESID(-1)) and RESID(-2)) are not statistically significant based on the t-tests, with p-values of 0.0963 and 0.235 respectively.

Furthermore, the Durbin Watson statistic of 1.38 is between the bounds of 0 and 2, indicating no evidence of positive autocorrelation according to this test.

In summary, the array of Breusch-Godfrey, Durbin-Watson, and individual parameter significance tests indicates no statistically conclusive evidence of autocorrelation within the residuals through the second lag. Thus, corrective actions are likely unnecessary given this sample and the defined model. However, these results pertain strictly to the current data and equation specifications.

- Estimating the regression model equation: Based on the previous results, the relationship between FBS as an independent variable and SB as a dependent variable was estimated according to the following equation:

$$SB = \beta 0 + \beta 1(FBS) + U$$

$$SB = 70.601 + 0.890*FBS + U$$

Through this equation, we can predict the value of SB based on the value of FBS. We find that for every one unit increase in FBS, the SB score increases by 0.890 units.

Based on this we can test the third hypothesis (H3):

H_0: An increase in the FBS indicator in Algeria from 2004 to 2020 does not lead to an improvement in the SB index in the same period.

H_a: An increase in the FBS indicator in Algeria from 2004 to 2020 leads to an improvement in the SB index in the same period.

Based on the regression analysis results, there is strong statistical evidence to reject the null hypothesis that increases in Algeria's FBS indicator from 2004-2020 do not lead to improvements in SB index over the same period. The model estimation found a significant positive relationship between FBS and SB, with a 0.890 unit increase in SB per one unit increase in FBS. With an R-squared of 0.898, almost 90% of the variance in SB is explained by changes in FBS. Furthermore, diagnostic testing showed no problematic autocorrelation. Given the model's statistical significance, explanatory power, estimated positive effect magnitude, and reliability, the data support the alternative hypothesis - that increases in Algeria's FBS from 2004-2020 do lead to increases in the country's SB index over the same timeframe when controlling for other pertinent factors.

4.3. Results discussion

The results of the regression analysis provide evidence for a statistically significant positive relationship between FBS and the ease of SB in Algeria from 2004 to 2020. As hypothesised, increases in Algeria's FBS over time led to corresponding improvements in the country's SB score.

Specifically, the model results estimate that on average, every additional 1 percentage point increase in Algeria's FBS indicator is associated with a 0.89-point increase in Algeria's overall 100-point scale SB score. This means that advances in nationwide fixed broadband infrastructure access and usage have a marked influence in explaining progress achieved in streamlining bureaucratic and procedural burdens for new firm creation in the country.

The model achieves a very high R-squared value of 0.898, signifying that nearly 90% of the historical variation observed in Algeria's ease of entrepreneurship conditions is explained by ongoing ICT infrastructure deepening measured through rising broadband subscriptions. The regression also passes key specification and reliability tests, giving credence to the positive relationship found between our independent and dependent variables of interest.

On the surface, this finding confirms previous international research findings that highlight the essential role of broadband as an indispensable digital public infrastructure to support entrepreneurship in various countries. It acts akin to traditional hard infrastructure as roads or electricity in engendering spillover externalities, productivity gains, and knowledge exchange. There appears to be a direct relationship with the solutions and efforts provided by Algeria regarding the development of ICT infrastructure. With the gradual lifting of restrictions on difficulties related to starting commercial projects, such as registration procedures and reducing material and moral costs.

Despite this, Algeria did not achieve the expected progress in the SB index during the period 2004 to 2020. This may be due to many reasons, including the difficulty and stringency of the indicator, and other factors that may have an impact. Persistent state domination and limited competition in key ICT and industrial segments also qualifies inferences on the growth-enabling impacts of infrastructure advancement. Sustainable policy support is vital for unlocking the still untapped promise of digital transformation and entrepreneurship in diversifying Algeria's hydrocarbon-centered economy.

Conclusion

- *Summary of the findings*

This study empirically examined the relationship between advances in ICT infrastructure and improvements in the ease of entrepreneurship conditions in Algeria from 2004 to 2020. A time-series regression analysis found evidence supporting the research hypothesis of a statistically significant positive link between rising fixed broadband adoption levels and Algeria's progress in key indicators related to bureaucratic burdens and time and cost requirements for formally starting a new business.

The model results estimate that on average, every additional 1 percentage point increase in Algeria's fixed broadband subscriptions (FBS) indicator is associated with a 0.89-point rise in the country's 100-point overall score on the World Bank's Starting a Business-score (SB) index. With an R-squared of 0.898, nearly 90% of the variation in ease of entrepreneurship over time was accounted for by deepening of broadband connectivity. This aligns with existing theory and literature on ICT's role as a transformational technology infrastructure that enables private sector dynamism.

- *Implications and contributions*

This analysis makes both scholarly and practical contributions. It provides original empirical insights into the ICT-entrepreneurship nexus within Africa's largest Arab state by GDP. Findings can inform policymakers on productive public infrastructure investments while also highlighting the interplay with governance, skills and access to finance barriers. For researchers, the quantitative methodology and leverage of internationally comparable World Bank data offers a model for investigation across developing economies.

- *Limitations and Future Research*

This conclusion summarizes the key findings while considering scope conditions. However, the study suffers from being limited to data over a period of only 17 years, and the number of observations is considered somewhat small. A possible way to address this limitation is to expand the sample by conducting a cross-sectional study that includes several countries with similar characteristics as Algeria, such as North African countries. This would allow for a more robust and generalizable analysis of the impact of ICT infrastructure investments on startup outcomes. Avenues for future research also include sectoral and provincial analyzes within Algeria, as well as comparative studies across different regions and contexts. As digital connectivity and entrepreneurial dynamism

become increasingly vital in the 21st century, evidence-based assessment of how ICT infrastructure investments shape business outcomes can positively impact both theory and practice.

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