The Impact of Internet on Economic Growth: Evidence from North Africa

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Abstract

The purpose of this paper is to treat the impact of the internet on growth for a sample in the case 4 economies of the North Africa over the period 1995-2017 using various techniques such as the ARDL bounds testing approach, Panel ARDL Model, OLS Fixed Effect, OLS Random Effect, FMOLS, 2 SLS, RLS, GLM, and GMM. Indeed, for the time series results, the ARDL highlights reported the presence of a negative impact of the internet on economic growth in Algeria, Egypt, Morocco, and Tunisia. Also, the main results of the Panel data models confirm the fact that the internet exerts a significant negative impact on growth for North Africa as a whole. These economies are invited to orient the use of the internet towards productive ways in order to reap the benefits of the spread of the internet and proactively enhance the prosperity in this region as a whole.

Keywords: Internet use, economic growth, North Africa.

1. Introduction

The international organization, governments, and the United Nations have recognized the real change in the economic structure due to the potential of the internet spread. Over the past two decades, due to the phenomenal spread of the internet as a stylized fact, the emergence of the role of the internet in the social dimension and also in the economic stream through its positive externalities in terms of enhancing productivity and technological diffusion (See: Elgin (2013); Sassi and Goaied (2013)). From this perspective, the spread of the use of internet seen as a natural result of the information communication technologies (ICT) revolution with the beginning of the new millennium, which brings prosperity growth through stimulating demand, production, and reducing transaction costs of the economy (See. Roller and Waverman (2001), Pohjola (2002), Van Zon and Muysken (2005)). Indeed, the modern endogenous growth theories pointed out the fact that the internet enhances economic growth by accelerating the diffusion of innovation in the production processes (See. Lucas (1988); Romer (1986, 1990); Aghion and Howitt (1998); Barro, (1998)). In addition, Nelson and Phelps (1966) and Benhabib and Spiegel (2005), among others, pointed out that the internet boots the productivity of the economy via the diffusion and the creation of spillover, the know-how, expertise, and information dissemination which leads to facilitating the adoption of innovative technologies in the production processes, and then, economic growth promotes. In addition, the Internet accelerates the diffusion and decentralization of the data and information across the world. Furthermore, the internet facilitates the creation of a new business that strongly linked to the spread and share of information which leads to increasing the adoption of innovative techniques. Also, the internet contributes to the increase of market transparency and then intensifies the competition. Indeed, the use of the internet in the production process significantly improves productivity and then the economic growth due to IT-using firms (See. Stiroh 2002; Jorgensen et al. 2008). Recently, the results of the empirical investigations are seemed to be inconclusive, which they have failed to reach any consensus about the presence of positive or negative significant influence of the use of internet and economic growth (See. Noh and Yoo (2008); Choi and Yi (2009); Elgin (2013); Najarzadeh et al. (2014); Ishida (2015)). Indeed, Choi and Yi (2009) examined the impact of internet usage on economic growth for a sample of 207 economies over the period 1991-2000 using various econometrics methods such as pooled OLS, individual random effects, individual fixed effects, time fixed effects, individual random and time fixed model and finally panel GMM and by taking into consideration other macroeconomic aspect. Their insights recorded a

significant positive influence of the internet usage in spurring economic growth. Also, Salahuddin and Gow (2016) examined the effect of internet usage on economic growth using the ARDL bound testing for the case of the South African economy over the period 1991-2013. Their results point out a significant positive effect of the internet on economic growth. Also, their results recommended more investing in the internet infrastructure and expanding its networks and generalizing its usage. However, Ishida (2015) treated this issue for the case of Japan during the period 1980-2010. The results recorded that ICT did not support the economic growth of Japan. Maurseth (2018) treated the nexus between the internet and economic growth for a sample of 171 countries over the period 1990-2015 using several econometric techniques the pooled ordinary least squares (OLS), the individual random effects, the individual fixed effects, the time fixed effects, the individual random effects and time fixed effects, and the panel generalized method of moments (GMM). The findings recorded a significant negative impact of internet usage on economic growth in contradiction with the results of Choi and Yi (2009). Recently, Haftu (2019) examine the relationship between ICT and economic growth using the two-step system GMM for a sample of 40 Sub-Saharan Africa countries during the period of 2006–2015. The findings reveal the absence of a significant impact of the ICT on economic growth. To the best of our knowledge, there is no empirical investigation treated the impact of internet use on economic growth for the North Africa region. The motivation that hidden behind the current investigation is due to the number of the internet user in this region which is range from 44.2% in Algeria to 67.7% in Tunisia[1] in 2018, none of the previous studies investigated this controversial issue for this region. For this purpose, we attempt to treat the impact of the internet on growth for a sample of four North African economies for the individual (e.g. Time series analysis) and global scale (e.g. Panel data analysis) using different econometric methodologies over the period 1995-2017. The rest of this paper is structured as follow: Section 2 portrays the data and methodology. Section 3 outlines the results discussion. Section 4 concludes the paper.

2. Data and methodology

The data set used in this paper includes 4 countries of North Africa[2] for the period 1995 to 2017. The selection of the sample size and the period of study reckon on the faith of data. All data are obtained and calculated from the World Bank database. We take the gross domestic

[1] https://www.internetworldstats.com/stats1.htm

[2] Algeria, Egypt, Morocco and Tunisia

product as a proxy to express economic growth and individuals using the internet to express the usage of internet.

An empirical analysis of the time series and empirical analysis of the panel series are used to explain the impact of the usage of internet on economic growth and innovation.

The long-run relationship between the usage of internet and economic growth could be in view by the following model:

Time series Model

$$\mathbf{Log(Y)_t = \delta_{1t} + \beta_1 Log(I)_t + \beta_2 Log(PI)_t + \varepsilon_{1t}} \quad \mathbf{(1)}$$

Panel series Model

$$\mathbf{Log(Y)_{it} = \delta_{1it} + \beta_{1i} Log(I)_{it} + \beta_{2i} Log(PI)_{it} + \varepsilon_{1it}} \quad \mathbf{(2)}$$

Where Log (Y) is the natural logarithm of gross domestic product (2010 constant US $), Log and Log (I) is natural logarithm of Individuals using the Internet (millions of inhabitants), δ is an intercept term, β_1 and β_2 are the long run elasticity estimates, 'ε' is the term error, 'i' is the individual dimension of the panel (the country) and't' is the temporal dimension.

3. Empirical Analysis

3.1.Cross-country empirical investigation

The first step is to inspect whether the variables under consideration are stationary or not. Univariate analysis is effectuated to verify the stationary of the data.

Table 1 Unit root Test

Variables	ADF		PP	
	C	CT	C	CT
Algeria				
Log (Y)	(1.293207)	(0.897510)	(1.205734)	(1.125608)
	[3.845226]***	[3.970681]**	[3.936940]***	[4.021131]**
Log (I)	(3.550556)**	(1.521788)	(4.137904)***	(1.525095)
	[4.773210]***	[2.419783]	[3.814054]***	[5.867265]***
Egypt				
Log (Y)	(1.382575)	(3.066865)	(1.357112)	(1.560341)
	[3.133159]**	[3.452469]*	[2.199880]	[2.322009]
Log (I)	(3.845588)***	(0.858269)	(3.648804)**	(0.874229)
	[1.165353]	[2.134647]	[3.464700]**	[5.006087]***
Morocco				
Log (Y)	(2.260018)	(2.057615)	(1.054414)	(3.434053)*
	[11.48956]***	[1.049615]	[9.939555]***	[9.639378]
Log (I)	(6.542192)***	(2.957262)	(12.15522)***	(2.321767)
	[1.651698]	[0.989361]	[3.051359]**	[7.107040]***
Tunisia				
Log (Y)	(3.729592)**	(0.700369)	(3.696958)**	(0.720769)
	[3.277540]**	[4.377492]**	[3.277540]**	[4.377435]**
Log (I)	(3.958817)***	(1.886501)	(6.206270)***	(2.219423)
	[3.011322]*	[3.892749]**	[3.011322]*	[3.837368]**

Note: *, ** and * denote significances at 1% , 5% and 10% levels, respectively;**
( ) denotes stationarity in level;
[ ] denotes stationarity in first difference;
'C' denotes Constant;
'CT' denotes Constant and Trend;

The stationarity of the series was more inspected with two different unit root tests: the Augmented Dickey-Fuller (ADF) test and the Phillips Perron (PP) test. Table 2 evinces the results of these tests, both for variables in levels and in first differences.

The empirical exercise furnishes a dissimilar order of integration for the variables I (1) and I (0). This dissimilarity results in a rationale for applying the ARDL bounds testing approach to co-integration developed by Pesaran et al. (2001). The value of the F-statistics was collated with the upper or lower boundary reported by Pesaran et al. (2001). If the value of F-statistics is greater than the upper bound we reject the null hypothesis and if it is less than lower bound then we accept the null hypothesis and if the value of F-statistic falls between lower and upper bound then the test will be inconclusive.

Table 2: Cointegration analysis

ARDL Bounds Test		
Algeria		
Test Statistic	Value	k
F-statistic	7.079746	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84
Egypt		
Test Statistic	Value	k
F-statistic	5.053132	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84
Morocco		
Test Statistic	Value	k
F-statistic	63.34219	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84
Tunisia		
Test Statistic	Value	k
F-statistic	10.78717	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

As the calculated value of the F-statistics is higher than the upper bound of this critical value, Table 2 reported that there is a long-run relationship between the variables included in the model in the 4 countries.

Table 3 presents the 4 equations of long-run equilibrium for each country. In the 4 equations, the use of the internet has a negative effect on long-term economic growth. To verify the credibility of all these results, we must test the significance of these equations. If the coefficient of the error correction term is negative and has a probability of less than 5%. So in

this case, we can say that the equation of the long-term equilibrium is significant and validated (means that there is a long term relationship between variables). Indeed, the negative impact of internet usage in these countries is justified that the internet in the economic sphere is channelized away from its economic benefits towards non-productive activities (e.g. social media, wasting time, online gaming ...).

Table 3 Estimation of ARDL Models

	Long-term equilibrium relation in ARDL Models	**ECT**
Algeria	$\mathrm{LOG(Y)} = -0.0006 * \mathrm{LOG(I)} + 0.0426$	-0.916833***
Egypt	$\mathrm{LOG(Y)} = -0.0021 * \mathrm{LOG(I)} + 0.0768$	-0.712208***
Morocco	$\mathrm{LOG(Y)} = -0.0020 * \mathrm{LOG(I)} + 0.0409$	-1.537811***
Tunisia	$\mathrm{LOG(Y)} = -0.0199 * \mathrm{LOG(I)} + 0.3343$	-1.008544***
***** denote significance at 1% level**		
ECT denote Error Correction Term		

In all countries, Table 3 shows that the error correction term has a negative coefficient and a probability less than 5% in this case, we can say that the equilibrium cointegration equation is significant and that there is has a long-term relationship between the variables. So we can substantiate that in Algeria, Egypt, Morocco, and Tunisia the usage of internet has a negative effect on economic growth in the long run.

Finally, diagnostic tests (serial correlation, normality test, and heteroscedasticity test) are all derived under a sensitivity analysis to establish the authenticity of the data used for the variables involved in the four models.

Table 4 Diagnostic tests

	Algeria	**Egypt**	**Morocco**	**Tunisia**
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.1148	0.6222	0.4214	0.9584
Heteroskedasticity Test: Harvey	0.1353	0.4598	0.7716	0.0537
Heteroskedasticity Test: Glejser	0.1202	0.5515	0.6305	0.8232
Heteroskedasticity Test: ARCH	0.5624	0.9193	0.9904	0.9610
Breusch-Godfrey Serial Correlation LM Test:	0.6292	0.5535	0.2989	0.2983
Test of Normality	0.767594	0.808343	0.758210	0.181391

Therefore, Table 4 reported that the results of the diagnostic tests further validated the estimated models.

3.2.Panel Empirical Analysis

Previous to the introduction of the empirical results, there is some pre-tests of data are considered very important and very essential to lend some prerequisites about the tie of the attacked variables.

Table 4 Panel descriptive statistics

	At level		At log level	
	Y	I	LOG(Y)	LOG(I)
Mean	1.10E+11	7374472.	25.22736	13.96902
Median	1.05E+11	3526006.	25.37246	15.07566
Maximum	2.72E+11	43850341	26.32800	17.59629
Minimum	2.22E+10	511.3037	23.82192	6.236964
Std. Dev.	6.48E+10	9666051.	0.669750	2.972256
Skewness	0.554426	1.663353	-0.355344	-1.065244
Kurtosis	2.414738	5.524051	2.033272	3.202174
Jarque-Bera	6.026329	66.84495	5.518618	17.55609
Probability	0.049136	0.000000	0.063336	0.000154
Sum	1.01E+13	6.78E+08	2320.917	1285.150
Sum Sq. Dev.	3.82E+23	8.50E+15	40.81948	803.9216
Observations	92	92	92	92

Table 4 point out that all variables have a probability of refusal of less than 5%, which tick that they are all respected during the period of the study. Skewness and Kurtosis coefficients go through variables that keep a normal distribution.

The correlation matrix is reported to check for multicollinearity among variables. Table 5 indicated Positive and significant correlations exist between the internet and economic growth.

Table 5 Panel Correlation test

Panel Correlation test at level			Panel Correlation test at log level		
	Y	I		LOG(Y)	LOG(I)
Y	1		LOG(Y)	1	
I	0.7065970417191986	1	LOG(I)	0.4938056884141956	1

It is substantial to define the order of integration prior to the estimation of the panel. We utilize several panel unit root tests including Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003) and Fisher type tests using ADF and PP tests.

Table 6: Panel Unit Root Tests

Unit Root Test	Log (Y)		Log (I)	
	C	CT	C	CT
LLC	(4.40275)***	(1.16056)	(8.45672)***	(2.04117)**
	[8.09859]***	[0.63542]	[1.54874]*	[4.92064]
IPS	(1.47683)*	(0.98737)	(6.40278)***	(0.72019)
	[8.40225]***	[2.43244]***	[2.42346]***	[0.62262]
ADF	(14.4196)*	(5.40496)	(49.1323)***	(5.08343)
	[73.0055]***	[21.4723]***	[21.1473]***	[10.5543]
PP	(11.4936)	(6.05102)	(91.0938)***	(3.96407)
	[58.1606]***	[48.5296]***	[29.2883]***	[52.7812]***
Decision	I(1)		I(0)	

Note: *, ** and * denote significances at 1% , 5% and 10% levels, respectively;**
( ) denotes stationarity in level;
[ ] denotes stationarity in first difference;
'C' denotes Constant;
'CT' denotes Constant and Trend;

According to the stationary results in table 6, Log (y) is stationary at first difference and Log (I) is stationary at level. Since all variables are stationary, we can move to the next step, which consists of determinate the cointegration between variables includes in our model.

The next step is to test for the existence of a long-run cointegration between economic growth and the usage of the internet by using a panel cointegration test suggested by Kao (1999).

Table 7: Panel Cointegration Analysis

Kao Residual Cointegration Test		
	t-Statistic	Prob.
ADF	6.833671***	0.0000
Residual variance	0.000754	
HAC variance	0.000296	

Table 7 reported the results of the Kao (1990) panel cointegration test. The test results suggest a long-term relationship of cointegration between economic growth and the internet.

The results of the application of descriptive statistics, correlation tests and cointegration tests on the variables included in our investigation, allow us to apply empirical estimates on several models to confirm the robustness of our empirical results. Among these empirical models, we will use Panel ARDL Model, OLS Fixed Effect, OLS Random Effect, FMOLS, 2 SLS, RLS, GLM, and GMM.

Table 8: Panel Estimation Models

	Dependent Variable: Economic Growth			
Estimated Models	**Long run Equation ARDL Model**	**Fixed Effect**	**Random Effect**	**FMOLS**
Internet	-0.006485***	-0.002034**	-0.001560**	-0.002099**
Constant	0.125639***	0.068354***	0.061593***	
Estimated Models	**2 SLS**	**RLS**	**GLM**	**GMM**
Internet	-0.001560**	-0.001608**	-0.001560**	-0.001560**
Constant	0.061593***	0.062721***	0.061593***	0.061593***
Note: *, ** and * denote significances at 1% , 5% and 10% levels, respectively;**				
Method: Autoregressive distributed Lags (ARDL)				
Method: Panel Fully Modified Least Squares (FMOLS)				
Method: Panel Two-Stage Least Squares (2SLS)				
Method: Robust Least Squares (RLS)				
Method: Panel Generalized Linear Model (GLM)				
Method: Panel Generalized Method of Moments (GMM)				

Table 8 shows eight distinct methods of estimating the impact of the usage of internet on economic growth in this paper. The estimates obtained from the panel models show all that the usage of internet has a negative effect on economic growth.

4. Concluding remarks

Due to the increasing of the role of internet in the economic sphere, we attempt to shed the lights on the impact of the internet on economy in the case 4 economies of the North Africa over the period 1995-2017 using various techniques such as the ARDL bounds testing approach, Panel ARDL Model, OLS Fixed Effect, OLS Random Effect, FMOLS, 2 SLS, RLS, GLM, and GMM.

With respect to the individual scale analysis, the ARDL results pointed out that there is has a long-term relationship between the internet and economic growth. Also, the highlights reported the presence of a negative impact of the internet on economic growth in Algeria, Egypt, Morocco, and Tunisia. With respect to the global scale analysis, the main results of the Panel ARDL Model, OLS Fixed Effect, OLS Random Effect, FMOLS, 2 SLS, RLS, GLM, and GMM methodologies confirm the fact that the internet exerts a significant negative impact on growth for the North Africa as a whole.

From this perspective, these economies are invited to orient the use of internet towards productive ways in order to reap the benefits of the spread of internet, in terms of the diffusion and the creation of spillover, the know-how, expertise, and information dissemination which leads to facilitating the adoption of innovative technologies in the production processes, and proactively enhance the prosperity in this region as a whole.

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