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Financial Development, New Information Technology, and Economic Growth: An Empirical Validation Test via a Dynamic Panel Data Model

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Abstract

The article aims to analyze and empirically verify what is analyzed in detail in the theoretical part. Our work will aim to empirically validate the effect of the interaction between the two variables (ICT and financial development), and quantify their effects on economic growth for the MENA region.

Introduction

The literature agrees on the fact that financial development and information and communication technologies have a considerable effect on the economic sphere.

Day after day, this relationship becomes one of the main concerns of major economist researchers, but also in the same vein it cannot be denied that in the empirical literature these studies are rare.

Shamim (2007) empirically proves that the financial sector component developed with better telecommunication infrastructure is positively related to long-term economic growth. a generalized moment method (GMM) to obtain dynamic panel data for a sample of 61 countries. He also noted that telephone subscribers and Internet users had a positive impact on the growth of financial depth for all countries. Their findings support the conclusions of Claessens, Djankov, Fan and Lang (2002) that developing countries should support the ICT sector and take advantage of the opportunities offered even when the financial system is weak.

Andrianaivo and Kpodar (2011) recently examined whether financial participation is one of the channels through which ICT diffusion affects economic growth. The conclusions using the GMM estimator in a panel of a sample of 44 African countries between 1988 and 2007 confirm the positive impact of ICT on growth and show that the development of mobile telephones influences growth. They further conclude that when mobile phone penetration rates in developed countries are high, they grow faster as a positive and significant interaction coefficient between mobile phone penetration rate and financial participation.

To answer our problem, we will use the modeling of dynamic panel data for the case of the MENA region, taking into account the possible non-linear relationship between the diffusion of ICT, financial development and economic growth. To provide more efficient estimators than the usual ones (ordinary least squares: Within). The estimate will be made by the method of generalized moments GMM in system.

Our empirical research begins with the creation of a database allowing to make good forecasts from a database encompassing 19 countries (MENA). This sample was chosen according to the availability of the data necessary for this study. for the period 1960-2017.

The main sources of data are, WDI (World Development Indicator), Omar et al (2014), and the World Bank.

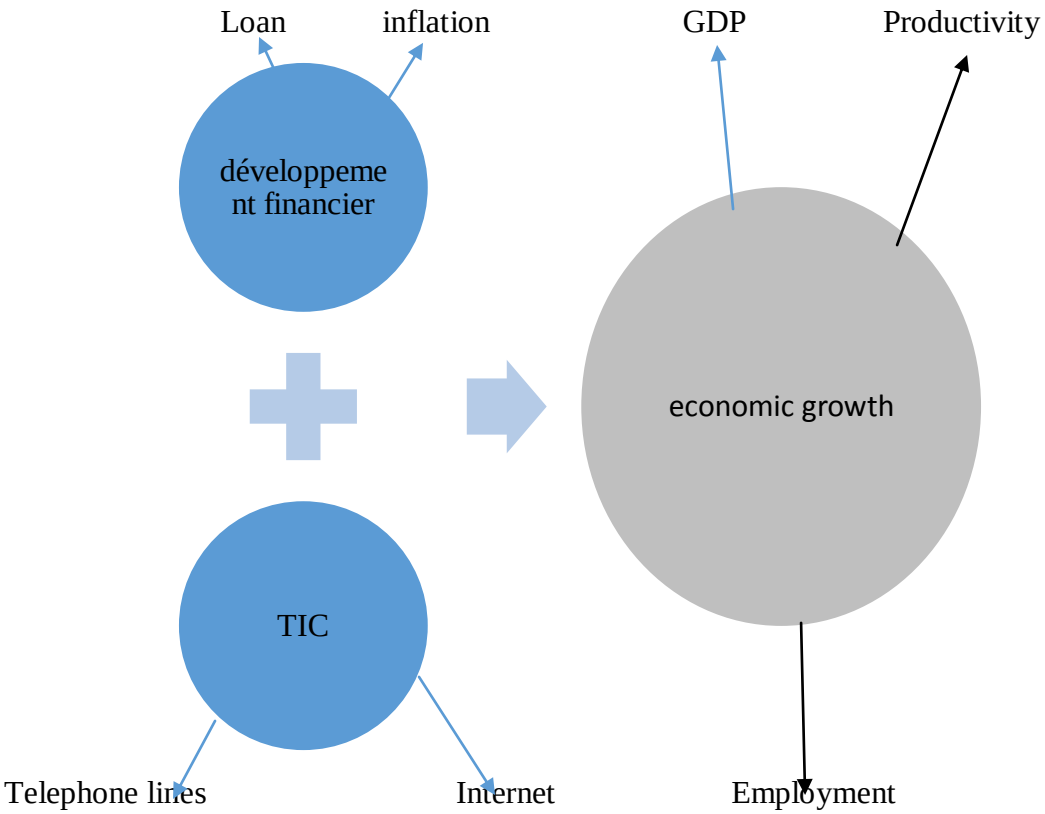


Figure 1: conceptual model of research

Dependent variable economic growth

Dependent variable ICT and development

Research indicators

Other search indicators

This model is an inspiration for the research proposals. Based on this figure, we show that financial and ICT sector indicators have a real impact on economic growth indicators. This will be checked below.

The article will be organized as follows:

In the first we will carry out graphical analyzes and descriptive statistics.

In the second , we will study the interaction between financial development and ICT in determining economic growth.

I Empirical analysis of the relationship between financial development and information technology and its impact on economic growth:

This part describes the different variables in our model to briefly explain the interaction between the development of a financial sector and information and communication technologies (ICT) in determining economic growth.

1. Theoretical framework and presentation of the variables and the model:

So that, in this work, the model of economic growth is adopted by Baroo (1998) while including the following variables: growth rate of real GDP per capita, initial level of delayed GDP per capita, financial development of banks (credit to the private sector) and ICT, which includes variables that measure investment in ICT (internet, telephone, mobile and ICT imports).

Then, according to Vu (2011), we combined the second-order terms of each ICT variable to capture the potential nonlinear relationship between ICT and growth.

Finally, according to S. Sassi and M. Goaied (2013), we demonstrate a concept of interaction between financial development and ICT variables to verify whether the relationship between financial development and growth depends on the level of development of the ICT sector.

Indeed, economic growth is estimated based on GDP, the level of development of the financial sector and ICT. The different variables used in our model are as follows:

- Economic growth which is estimated according to GDP per capita lagged
- The initial level of GDP per capita (to take convergence into account)
- The ratio of private sector lending to location of financial development
- Input from Internet users
- Number of telephone lines per 100 inhabitants
- Finally, the ratio of ICT imports to total imports of services

Probably, economic growth is estimated based on GDP, inflation rate (INF) and GDP export plus import ratios. This information is renewed in logarithmic form except for the inflation variable.

Through the review of the previous empirical literature, our reference model is modeled as follows:

$$y_{it} = \alpha_i + \lambda y_{i,t-1} + \beta_1 TIC_{i,t} + \beta_2 FD_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t}$$

Or the dependent variable "$Y_{i,t}$» denotes the real growth rate of GDP per capita of country « i » in period « t ».

The explanatory variables of growth suggested by our model are the following variables:

- " $FD_{i,t}$": the level of financial development measured by credit granted to the private sector in relation to GDP.
- "$ICT_{i,t}$": designates the measurements of new information technologies: Internet users (INTER), telephone (TELE) and mobile (MOB) subscribers (WDI.

- *"$X_{i,t}$"* :the vector of macroeconomic control variables (WDI World development indicator).
- *"Inf"*: denotes the rate of inflation.
- "OPEN": refers to the measure of openness proportions which relates to commercialization
- "GOV": measures government final consumption expenditure relative to GDP
- "α_i» : Associates the variables of the model
- "$\varepsilon_{i,t}$»is an error term.

2. Correlation matrix

The table above presents the results of the correlation matrix. The results show that the economic growth rate is poorly correlated.

In the same context, with the exception of the ICT variables, it can be seen that the risk of multicollinearity is very low due to a weak correlation between the descriptive variables.

Table1: Correlation matrix

	CREDIT	GDP_GROWTH	GOV	INFL	INTERNET	MOBILE	OPEN	TV
CREDIT	1,000	-0.161	0.133	-0.324	0.574	0.419	0.456	0.413
GDP_GROWTH		1,000	-0.021	0.057	-0.229	-0.191	-0.065	-0.134
GOV			1,000	-0.353	-0.031	0.035	0.251	-0.169
INFL				1,000	-0.205	-0.200	-0.350	-0.184
INTERNET					1,000	0.879	0.437	0.342
MOBILE						1,000	0.470	0.275
OPEN							1,000	0.342
TV								1,000

3. Descriptive statistics

Table 2: Descriptive statistics

	Mean	Maximum	Minimum	Standard. Dev.	Likelihood
CREDIT	31,980	105,475	1,267	23,804	0.000
GDP_GROWTH	1,706	122,968	-64.996	10,062	0.000
GOV	18,353	76,222	2,332	7,515	0.000
INFL	9.921	448,500	-27.523	25,569	0.000
INTERNET	20.325	98,000	0.000	25,745	0.000
MOBILE	31,315	214,735	0.000	50,319	0.000
OPEN	76.128	251,139	0.021	37,190	0.000
TV	9,234	38,453	0.032	8,398	0.000

Examination of the descriptive statistics table reveals:

- The average growth rate of the sample is 1.7% while the average opening rate is 76.12%. The average share of loans in the GDP is 31.9%.
- According to this table, we notice that the most volatile variable is the "Mobile" variable, since it displays the highest standard deviation (+50.31). On the other hand, the "GOV" and "TELE" variables are the least volatile, posting the lowest standard deviation (+7.51 and 8.39 respectively).

4. Graphical analysis

The graphs above retrace the analysis of the correlation between the rate of economic growth and its determinants.

Figure 1.1: Interaction between growth rate and credit

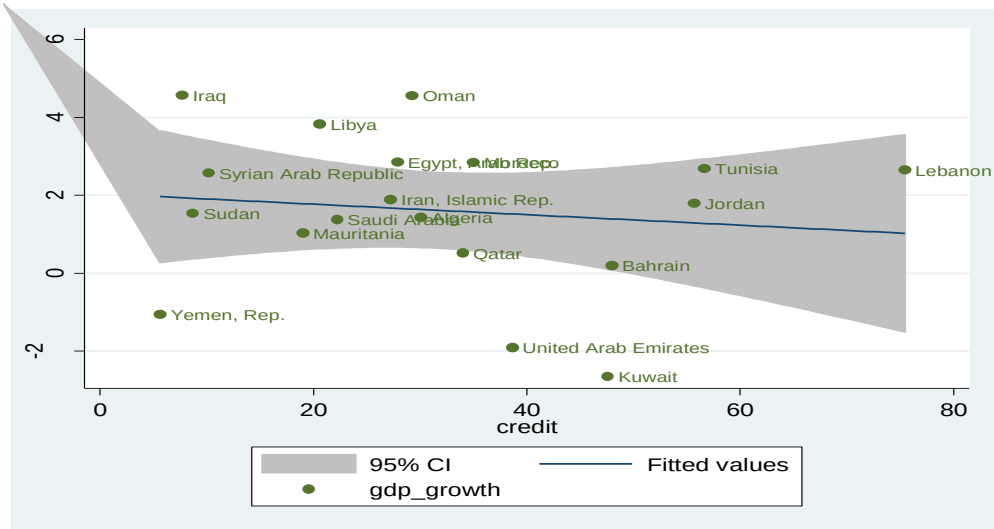


Figure1.2: Interaction between growth rate and internet

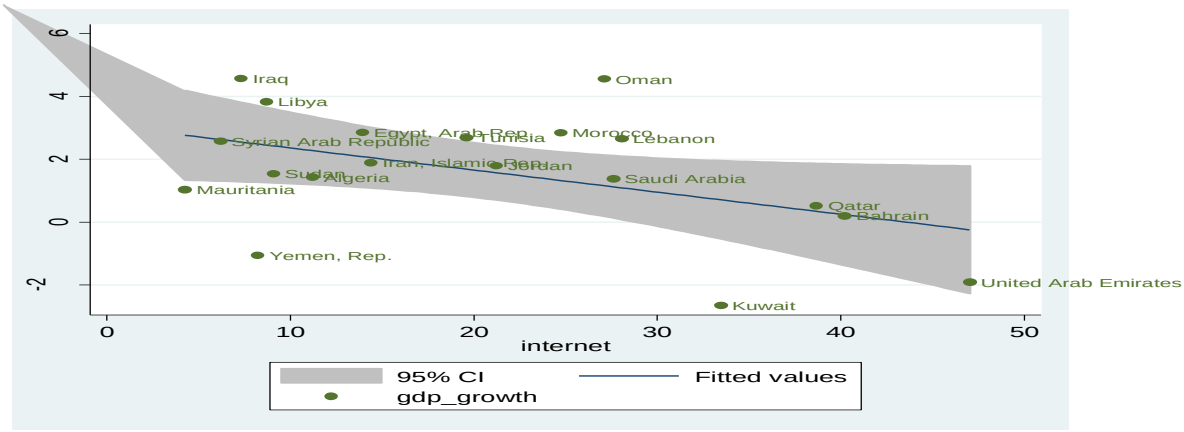


Figure 1.3: Interaction between growth rate and telephony

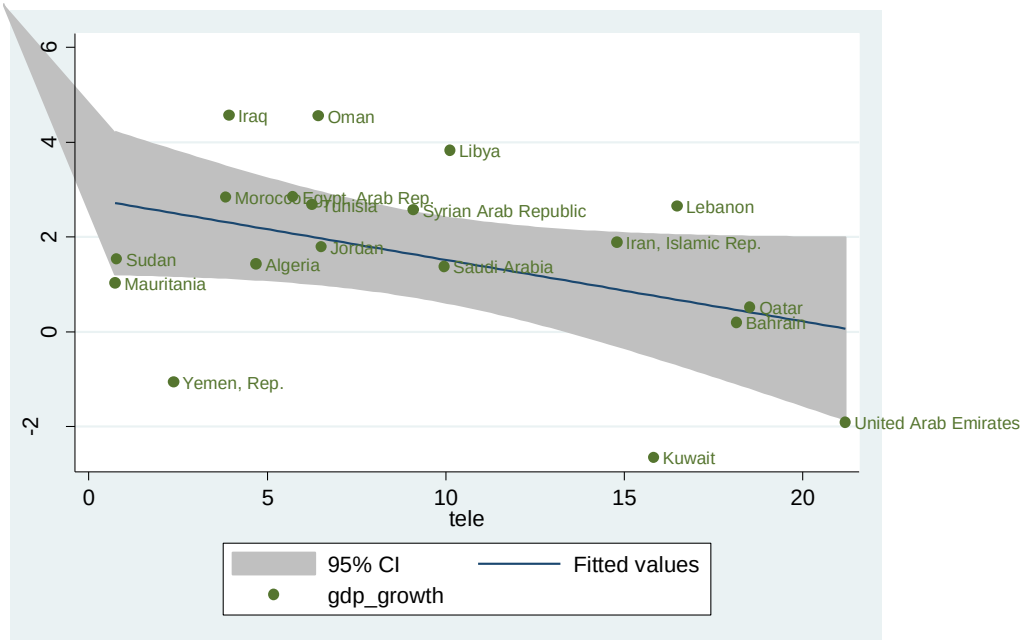
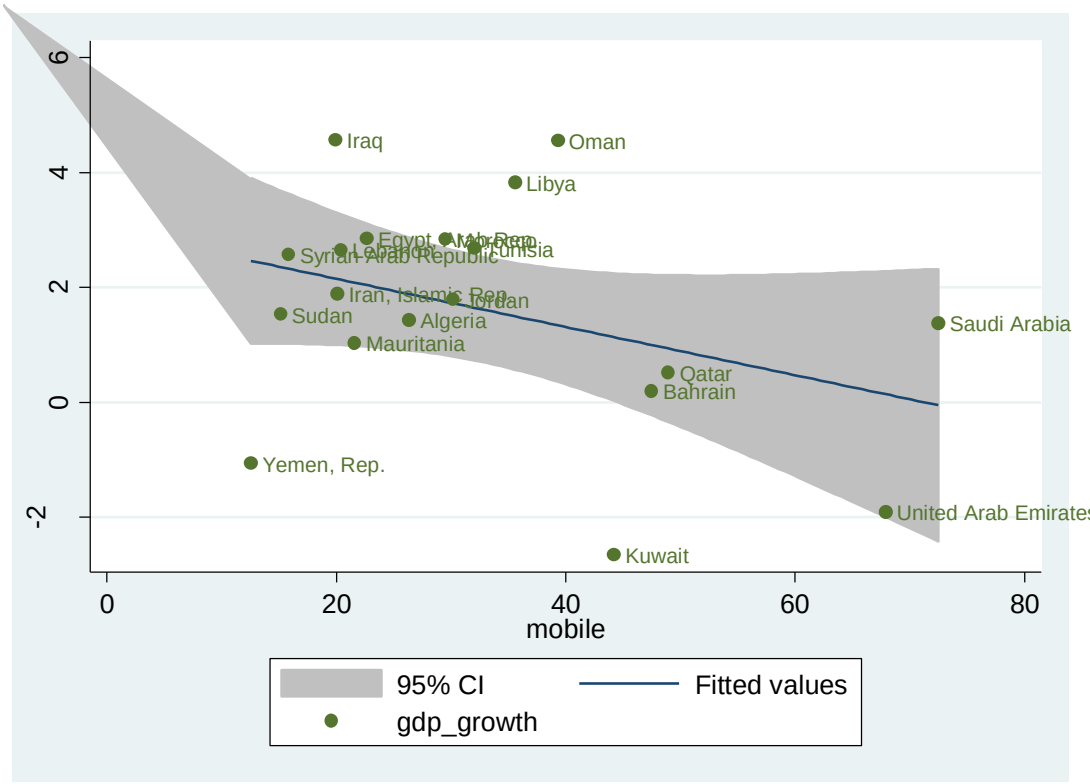


Figure 1.4: Interaction between growth rate and mobile



According to these four graphs represented above, we notice that the relationship between the two variables "growth rate" - "credit" remains rather vague and ambiguous:

- First, the existence of countries that show a low credit rate in return for a significant and high growth rate such as Iraq. Conversely for the case of Kuwait which is characterized by a more or less significant credit rate and a very low growth rate. On the other hand, Lebanon is the country which has a high level of growth which is accompanied by a high credit rate.

- The same goes for the two variables “growth rate” and “ICT”: countries such as Iran; Yemen, Syria and Sudan have low ICT levels and relatively higher growth rates than the sample average. On the other hand, Saudi Arabia is characterized by a high level of technology associated with significant growth rates.

II Model estimation results and interpretation

The results of the cross-sectional model estimates are shown in the table below using the dynamic model GMM technique:

Table 3.1: results of estimations by the system GMM method			
	(1)	(2)	(3)
VARIABLES	gdp_growth	gdp_growth	gdp_growth

Credit	-0.0309**	-0.117	-0.0489***
	(0.0152)	(0.0922)	(0.0135)
Internet	0.0149**		
	(0.00667)		
Open	0.0350*	0.341*	0.0350
	(0.0204)	(0.194)	(0.0258)
Infl	-0.0620***	-0.0387	-0.0957***
	(0.0136)	(0.0875)	(0.0329)
govt	-0.306***	-0.905*	-0.202**
	(0.0792)	(0.464)	(0.101)
gdp_capita	-0.000151***	-0.00193**	-0.000166**
	(2.73e-05)	(0.000836)	(6.95e-05)
TV		2.212***	
		(0.760)	
Mobile			0.00629
			(0.0117)
Constant	6.723***	-4.557	6.688***
	(0.735)	(4.965)	(1.321)
Sargan test	12.46(0.189)	8.76(0.36)	3.54(0.47)
M2 statistics	0.79(0.43)	-1.03(0.36)	-0.75(0.451)

(***), (**) and (*) correspond respectively to the statistical significance at 1%, 5% and 10%. Standard deviation in brackets. m1 and m2 designate respectively the tests of serial correlations of order 1 and 2 between the residuals. Hansen's test refers to the instrument validity test (p-value).

According to the estimation results of this relationship by applying the GMM method, it can be seen that all the models are well defined. In fact, the values of the second-order correlation test show no evidence of model misspecification, accepting the null hypothesis of serial correlation in the first-difference errors at order 2 between residuals at a threshold of significance of 5% (p-value greater than 10%). Similarly, the results show that the instruments are valid.

In fact, the Sargan test provides information on the good features of models that use the lagged variables of the IDE as instruments (p-value greater than 5%).

The results show the positive and statistically significant effects of ICT variables on economic growth in the MENA region, excluding the mobile variable.

This result is in line with the conclusions of Hasan (2005) and Sassi and Goaied (2013), emphasizing that ICTs are necessary for economic growth in the MENA region. The effect of entering the "TELE" variable is greater to that of the other variables. The same result is found by Sassi and Goaied (2013).

When we speak in terms of macroeconomic variables, we notice that the rate of openness to foreign trade has a positive and we can consider it as a promoter of economic growth. Through this finding, it is asserted that countries that practice a more open trade regime and a less harmful trade policy have a higher growth rate vis-à-vis those who practice hedging measures against risks.

In fact, imports of capital goods and raw materials are essential to the production process. Furthermore, export-oriented development strategies in developing countries reduce the trade deficit, contribute to export financing and reduce external debt.

They encourage local businesses to improve their competitiveness and better control technology to be able to adapt to their position in the global market. Modern technology can also include non-exporting firms in order to increase their overall productivity.

This result is identical to that of J (1973), Krueger (1978), Feder (1983) and Kao, Chiang and Chen (1999).

Indeed, excess demand for export products stimulates export specialization, economies of scale and the allocation of personalized resources to less productive sectors on the export sector side.

In addition, increased exports improve the quality of labor, learning, applied management and management techniques (David and Lowey 1998, Lal and Rajapatriana 1987).

The effect of the inflation rate is negative and statistically significant. This result clearly shows that inflation not only affected the high inflation rates but also had a negative impact on the economic growth of those countries where they experienced extreme inflationary pressures after the political transitions of the 1980s and early of the 1990s.

Based on these findings, we can extract the economic guidelines to emerge from these countries, clearly defined by a noble unemployment rate, which denotes that macroeconomic development has been weaker since the 80s and the beginning of the 90s, and so that results in a high poverty rate. Moreover, these negative effects last after the economies of these countries have stabilized.

Public spending accounts for 1% of negative and significant economic growth. This confirms the conclusions of Barro, Mankiw and Sala-I-Martin (1995), who argued that political corruption could be the reason for the inefficiency of this expenditure and therefore the slowdown in economic growth.

The financial development variable has a negative effect. It should be noted that these countries intervene too much in their financial systems and contribute to the low capital accumulation of the financial sector. Similarly, these countries have implemented a policy of financial liberalization without any positive impact on growth. This discussion was supported by Paolo Mauro (1996), who showed that corruption was the main cause of failure in most investment projects and that these inefficient projects were financed by the banking sector which controls most financial systems. in developing countries.

We present the square of the ICT variables, taking into account the possible nonlinearity between the ICT variables and economic growth. The model looks like this:

$$y_{it} = \alpha_i + \beta_1 TIC_{i,t-1} + \beta_2 (TIC_{i,t-1})^2 + \beta_3 FD_{i,t} + \beta_4 X_{i,t} + \varepsilon_{i,t}$$

The results of the estimates are summarized in the following table:

Table 3.2: results of estimations by the system GMM method

	(1)	(2)	(3)
Credit	-0.0525***	-0.0903***	-0.0356***
	(0.0104)	(0.0307)	(0.0122)
Mobile	-0.0221*		
	(0.0113)		
(Mobile)2	0.000136*		
	(7.05e-05)		
Open	0.0314***	0.0955*	0.0373**
	(0.0112)	(0.0498)	(0.0168)
Infl	-0.0893***	-0.0974***	-0.0337
	(0.0195)	(0.0223)	(0.0223)
govt	-0.164***	-0.388***	-0.208**
	(0.0507)	(0.134)	(0.0856)
gdp_capita	-8.58e-05***	-0.000560*	-0.000107*
	(3.29e-05)	(0.000315)	(5.85e-05)

(TV)2		0.00120	
		(0.00332)	
TV		0.540	
		(0.426)	
(Internet)2			0.000792**
			(0.000382)
Internet			-0.0656**
			(0.0256)
Constant	6.214***	5.786***	5.712***
	(0.940)	(1.306)	(1.296)
m2 statistics	-0.75(0.453)	-1.31(0.192)	0.83(0.405)
Sargan test	7.42(0.28)	8.840.183)	9.10(0.168)

(***), (**) and (*) correspond respectively to the statistical significance at 1%, 5% and 10%. Standard deviation in brackets. m1 and m2 designate respectively the tests of serial correlations of order 1 and 2 between the residuals. Hansen's test refers to the instrument validity test (p-value).

The results show that the correlation between the ICT variables and the economic growth rate is not linear.

In fact, the square of the TIC variables is based on the assumption that the effect of growth-related variables changes sign after an inflection point. The optimal point TIC*corresponds to the level d which maximizes growth. $d(GROWTH)/d(TIC)=0 \Rightarrow 2\beta_2 * TIC+\beta_1=0$ This implies that the optimal threshold of the variables relating to ICT: $TIC^{*}=-\hat{\beta}_1/2\hat{\beta}_2$.

They show the optimal thresholds are as follows: 41.32% for the Internet and 81.25% for the mobile.

And finally to take into account a possible interaction between the financial development variables and the ICT variables, we will try to estimate the following model:

$$y_{it}=\alpha_i+\beta_1 TIC_{i,t}+\beta_2 * FD_{i,t} * TIC_{i,t}+\beta_3 FD_{i,t}+\beta_4 X_{i,t}+\varepsilon_{i,t}$$

The results of the estimates are summarized in the following table:

Table 3.3: results of estimations by the system GMM method			
	(1)	(2)	(3)
Credit	-0.0921***	-0.0771***	-0.286**
	(0.0291)	(0.0182)	(0.116)
credit_internet	0.00388***		
	(0.00114)		
Internet	-0.282***		
	(0.0903)		
Open	-0.00235	0.0312**	0.184**
	(0.0163)	(0.0138)	(0.0727)
Infl	-0.0479***	-0.0880***	-0.135***
	(0.0121)	(0.0181)	(0.0325)
govt	-0.134	-0.155***	-0.585***
	(0.0862)	(0.0542)	(0.177)
gdp_capita	4.87e-05	-8.00e-05**	-0.00108**
	(4.61e-05)	(3.63e-05)	(0.000440)
credit_mobile		0.000421**	
		(0.000182)	
Mobile		-0.0238***	
		(0.00830)	
credit_tele			0.0164*
			(0.00959)
TV			0.458

			(0.396)
Constant	8.805***	6.773***	9.080***
	(1.493)	(1.096)	(2.336)
Comments	353	546	558
Number of id	17	17	17
m2 statistics	0.88(0.45)	-0.75(0.45)	-1.26(0.209)
Sargan test	7.00(0.22)	7.98(0.231)	16.50(0.057)

(***), (**) and (*) correspond respectively to the statistical significance at 1%, 5% and 10%. Standard deviation in brackets. m1 and m2 designate respectively the tests of serial correlations of order 1 and 2 between the residuals. Hansen's test refers to the instrument validity test (p-value).

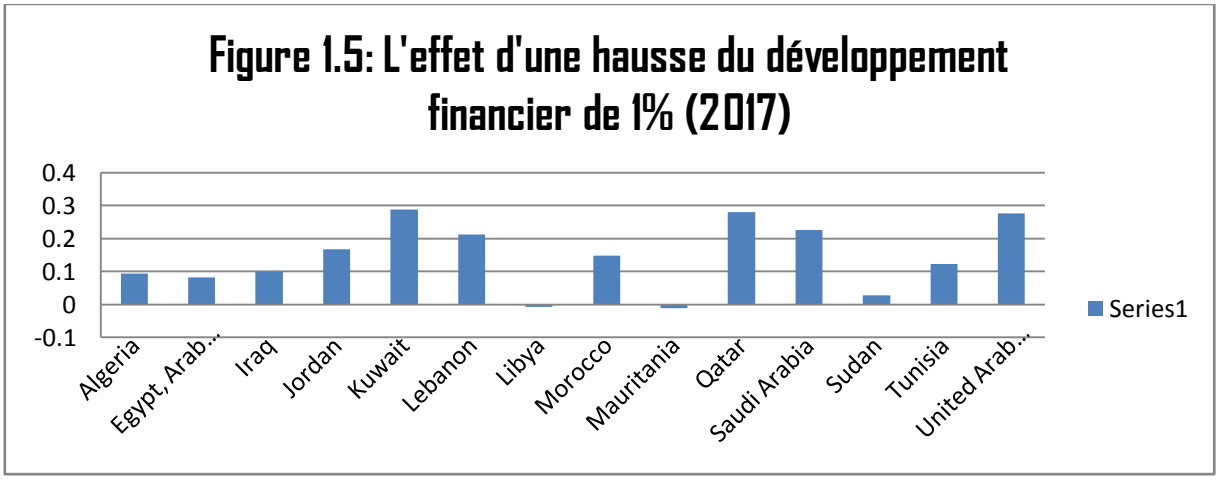
Forecasts suggest that financial performance can drive economic growth through ICT development. In fact, the incorporation variables between financial development and information and communication technologies turn out to be obvious and statistically significant. These results show that the impact of financial development depends on the levels of ICT. Beyond a certain ICT threshold, the financial sphere has had a positive impact.

The marginal impact of financial development can be calculated as follows:

$$d(GROWTH)/d(FD) = \hat{\beta}_2 + \hat{\beta}_1 * TIC$$

The ICT threshold for Internet is estimated at 23.8%. Beyond this threshold, financial progress has a positive impact on the economic growth of countries.

The graph below shows the 1% impact of increased private sector lending on economic growth for a given level of ICT.



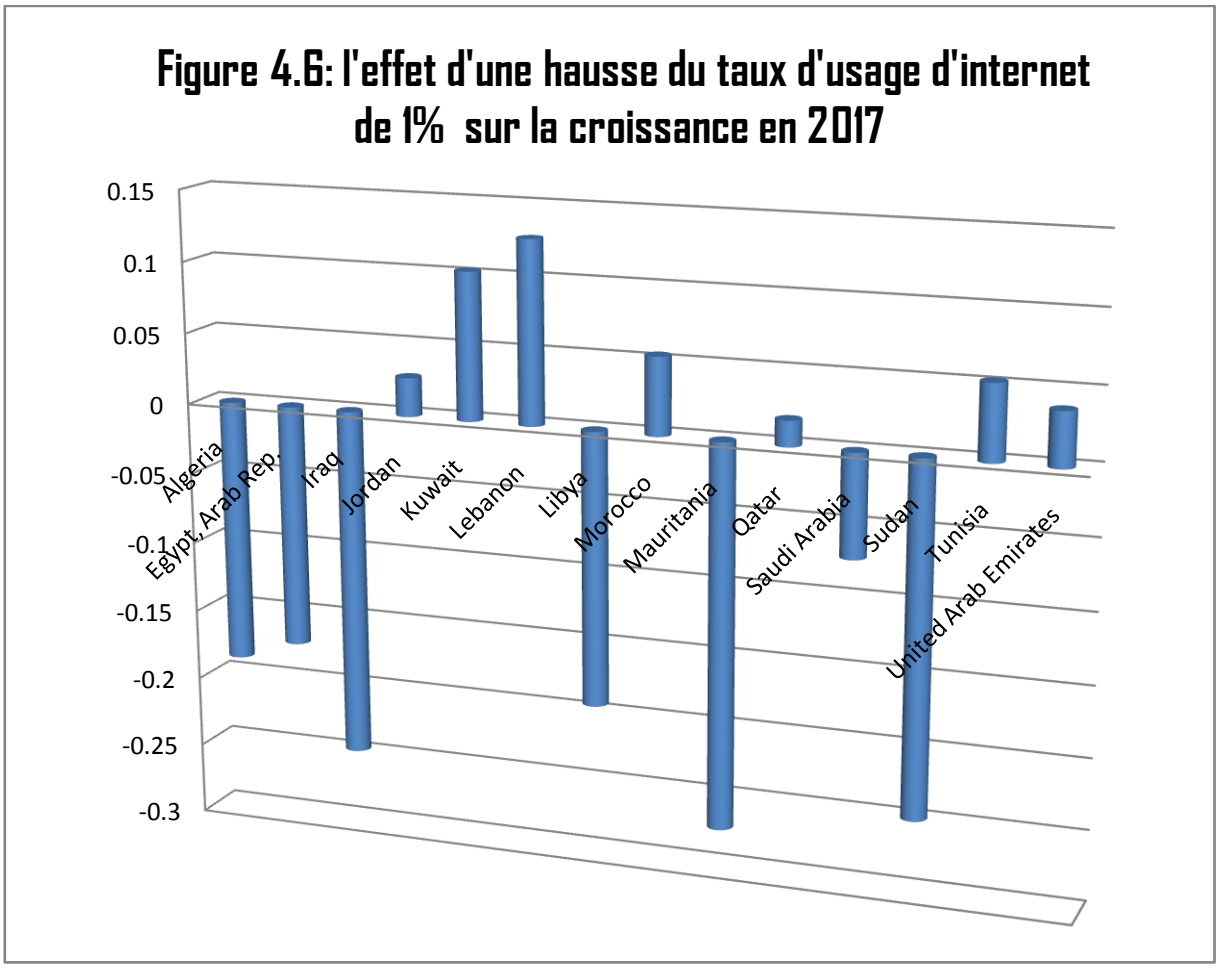
Another finding suggests that the impact of ICT on growth depends on the country's level of financial development. Indeed, the impact of ICT variables on growth remains negative after the introduction of financial development variables. This result confirms the results of Andrianaivo and Kpodar (2011) and Sassi and Gaied (2013).

In fact, we can calculate the marginalizing effect of ICT through the following formula:

$$d(GROWTH)/d(TIC) = \hat{\beta}_2 * FD + \hat{\beta}_1$$

The FD threshold for Internet is estimated at 72%. Beyond this threshold, the impact of ICT on growth will be positive.

Figure 3.6 shows the effect of a 1% increase in ICT on economic growth for a given level of DF.



Conclusion

In the light of the results discussed in the two previous parts, the objective of this article is to test empirically to what extent the interaction between financial development and ICT contributes to the strengthening of economic growth. Our approach is to apply an econometric test which studies the link between DF and ICT.

In fact, we have empirically examined the effects of this interaction on the growth of the MENA region during the period 1960-2017 by predicting the deterioration of endogeneity associated with certain

explanatory variables using the GMM method. The results show that ICTs positively influence economic activity and this depends mainly on the threshold of financial development, and that this interaction plays a key role in accelerating economic growth. In addition, according to previous empirical work, it has been noted that the impact of financial development remains negative and depends on the rate of Internet users.

This econometric study tries to empirically show the importance of the integration of ICT in financial development. In addition, we also tried to analyze the effect of the interaction between these two variables on the economic sphere.

the interaction between financial development and ICT penetration is very positive. This shows that MENA economies cannot benefit from financial development until the ICT development threshold is reached. This means that since MENA countries are part of e-commerce, they need to strengthen their ICT infrastructure. In the region.

Moreover, the diffusion of ICT has a positive impact on growth and openness. This observation suggests that promoting ICT penetration in MENA countries is important for growth as it strongly stimulates the economic activity of nations.

Not to mention, evidence of the role of the Internet in MENA countries suggests that there is a need to focus on promoting e-government and e-commerce.

Although the relationship between the factors of financial and ICT development and the economy remains ambiguous because of the measures granted to these two variables which are difficult to quantify. These factors give rise to difficulties of interpretation.

- Overall, this article shows and explains the importance of the interaction between financial development and ICT which have a direct and indirect influence on the economy. The results show that the diffusion of advanced technologies in the financial fields plays an important role in stimulating of economic growth.

References

1. Bechir, D and Marwen, M (2010). Impact of ICT in Accelerating Economic Growth [online]. Master's degree in economics: Financial and Banking Economics. Tunis: ESSEC Tunis. Available onhttps://www.memoireonline.com/11/10/4110/m_Impact-des-TIC-dans-acceleration-de-la-croissance-economique3.html.
2. Edem, A (2012). Financial development and economic growth in Franc zone countries [online]. Master's thesis in International Economics. Togo: University of Lome Togolese Republichttps://www.memoireonline.com/04/14/8821/Developpement-financier-et-croissance-economique-dans-les-pays-de-la-zone-franc.html.
3. Ghynel, NN and Souleymane, S (June 2010). Impact of information and communication technologies (ICT) on the fabric of production of goods and services in Morocco [online]. End of Study Project and Applied Economics Rabat. Available onhttps://www.memoireonline.com/10/10/4051/Impact-des-Technologies-de-l-Information-et-de-la-Communication-tissu-productif--biens-services.html.

4. Recent memoirs 'Wiki Memoirs' [online]. (February 5, 2011).http://wikimemoires.net/2011/02/croissance-economique-effet-des-tic/.
5. Mamadou, B (2012). Financial development and economic growth: theoretical studies and applications on WAEMU and ECOWAS [online]. Doctoral thesis: economics. Carnot-Pasteur doctoral schoolhttps://tel.archives-ouvertes.fr/tel-01131475/document.
6. Massinisa, H and Zoheir, O (June 2016). information and communication technologies (ICT) and organizational change within CEVITAL FOOD [online]. End of cycle dissertation: Master in Management Sciences . Bejaia: Abderrahmane Mira University of Bejaiahttp://www.univbejaia.dz/dspace/bitstream/handle/123456789/625/Les%20technologies%20de%20l%27information%20et%20de%20la%20communication%20%28TIC%29%20et%20le%20changement% 20organizational.pdf?sequence=1&isAllowed=y.
7. Adel,B and Hatem, M (2003).ITC contribution to growth; the case of Tunisia .MPRA paper No.27537,posted 25 December 2010 [online].https://mpra.ub.uni-muenchen.de/27537/3/MPRA_paper_27537.pdf.
8. Benoit, A. innovation and information and communication technologies. The Center for Productivity and Prosperity (HEC Montréal). October 2010.http://cpp.hec.ca/cms/assets/documents/recherches_publiees/CE_2011_01_FR.pdf.
9. Brou, A (2010). Financial development and economic growth in WAEMU countries: are there sectoral differences? Saving and development [online]. vol.34, no.3,2010.https://www.jstor.org/stable/i40084972?refreqid=excelsior%3Abbb9106f2b78dd9dd61f1be6105d14b8.
10. Crafts, N., 2002, "The Solow ProductivityParadox in Historical Perspective", CEPR, DiColecchia, A. and P. Schreyer, "The contribution of information and communication technologies to economic growth in nine OECD countries », OECD Economic Studies 2002-1-34, 165-186.scussion paper n° 3142, January.
11. OECD (1999) "Measuring the ICT Sector", http://www.oecd.org/dsti/sti/prod/sti wp.htm.
12. Pilat, D; Lee, and Ark,BV. Production and Use of ICT: Sectoral Perspectives on Productivity Growth in the OECD Area. OECD Economic Studies 2002/ (n°35), pages 49 to 82.http://www.oecd.org/en/economics/growth/35029248.pdf.
13. Sylviance, G and Kangni, K (2006). Financial development, financial instability and economic growth. Economics and forecasting [online]. 2006/3(n°174), pp.87-111.http://www.tpe.ac-aix-marseille.fr/methodo/outils/F07biblio.htm.
14. Thiemoko, D (2013). Financial development and economic growth does the financial structure play a role? [On line]. Masters in Economics. Quebec. University of Quebec in Montrealhttps://archipel.uqam.ca/5454/1/M12949.pdf.
15. Ugo, P (2014). Financial development and economic growth: the known knowns, the known unknowns and the unknown unknowns. Journal of Development Economics [online].2014/2,vol,22,pp.33-66https://www.cairn.info/revue-d-economie-du-developpement-2014-2-page-33.htm.

16. Seifallah.s and Mohamed.G "financialdevelopment, ITC diffusion and economicgrowth: lessons from MENA". Telecommunications policy. No. 37,203,252-261.
17. Seen, KM (2011). ICT as a source of economic growth in the information age: Empirical evidence from the 1996–2005 period. Telecommunications Policy, 35(4), 357–372.
18. Soto, M. (2009). System GMM estimate with a smallsample. Barcelona Graduate School of Economics working paper no. 395.
19. Van Nieuwerburgh, S., Buelens, F., &Cuyvers, L. (2006). Stock market development and economic growth in Belgium. Explorations in EconomicHistory, 43(1), 13–38.
20. Koutroumpis, P. (2009). The economic impact of broadband on growth: A simultaneous approach. Telecommunications Policy, 33, 471–485.