Financial Liberalization and Economic Growth in the North Africa Region: Cointegration Panel Analysis by DOLS and FMOLS Models

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Abstract. This article aims at examining the impact of financial liberalization on the economic growth in the North African countries. The econometric study, which covers the period between 1995 and 2013, relies on a sample composed of four Northern African countries and referring to the database of the World Bank data (2013), Heritage Foundation (2013) and Financial Openness of (The Institute for international and development Economics, 2009). The estimate model of cointegration panel reveals that there is a long-term relationship between the variables. Moreover, the estimation of DOLS and FMOLS models shows that the latter is more adequate to explain the financial liberalization's impact on the economic growth of the North African countries.

Keywords. Financial liberalization, Economic growth, Panel cointegration, DOLS, FMOLS.

JEL. F43, O16, O47.

1. Introduction

The issue of growth determinants has become an essential element in the economic debate. The investment, according to the Liberals, is the basis of the economic growth. Thus, the economic policy should stimulate the investment and savings that are necessary for promoting the economy. The policy should aim at improving the economic environment by facilitating the access to the financial market. In the economy, where the government exercises a thorough intervention, the finance of the autonomous investment, in fact, damages the private investment and generates therefore an eviction effect[i]. An insufficient investment results in low expectations and consequently a low rate of growth; it is a vicious circle. The investment problem, according to Fitoussi (2002)[ii], occurs at the level of financial markets that are too powerful with the financial concentration. That is to say, the release of the funding will allow the investment and growth to be achieved.

Over the past three decades, the world economy has experienced many transformations; however, finance has remained the cornerstone in this connection. This has led to some upheavals that are closely associated with financial liberalization emanating from the collapse of the Bretton Woods system between 1971 (suspension of the US dollar convertibility into gold) and 1976 (adoption of floating exchange rate system). The financial liberalization has been presented,

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especially by McKinnon (1973) as an alternative to the State restrictions that reduced savings and impeded the allocation of resources.

For McKinnon (1973), the financial liberalization consists in allowing the market mechanisms to determine the financial systems operating rules so as to increase the financial savings, finance the productive and profitable investments and boost the economic growth. The author states that the development of banks and financial markets has a positive effect on the economic growth because it allows an efficient allocation of savings to be directed towards the investments. He adds that in an economy known for its financial repression, the interest rates are maintained at some levels below the real value, which leads therefore to low savings amounts.

Under the aegis of two international financial institutions (IMF and WB) and the impulse of the financial globalization, the financial liberalization has become therefore a global phenomenon of transfer, taking into account the crucial issue of financial systems in the economy.

Thus, the financial policies have secured a greater place for the market mechanisms in the industrialized countries, as is the case for the developing countries. This has pushed the developing countries forwards to adopt the policy of the economic liberalization. However, the interventionist financial policies were one of the main factors that led to the 1980s crisis from which we deduced that the liberalization might help in reestablishing the growth and stability by raising the level of savings and improving the efficiency of the economy as a whole. For this reason, the developing countries relied more on the domestic savings since the external financial flows have become increasingly rare. Moreover, the financial liberalization has increased the financial instability in many of the developing countries instead of raising the level of savings and domestic investment.

In addition, the current economic situation makes it more difficult to affirm the fact that any financial liberalization procedure is an obvious prerequisite for stimulating the economic growth of the countries because the effects of the international financial crisis overwhelm it since 2008 along with the experiences of some countries in the financial openness.

Before the 1990s, the financial system in most of the North African countries had a broken structure, with a strong intervention of the State and regulatory constraints where the capital markets showed a marginal size and a low degree of diversification of the financial instruments. These features of the financial systems at the time were insufficient to secure an adequate finance of the economy. According to Alouani (2008)[iii], Since the 1990s, some significant reforms have been carried out to overcome this problem in order to provide these countries with a modern financial system which is capable of securing an effective mobilization of the savings into the economic system and achieving a significant increase at the level of investment and growth. These countries have focused, since the 1990s, on the reform of their financial systems by taking into account its important role in enhancing the economic growth and accelerating the convergence process[iv].

The purpose behind this article is to analyze the impact of the financial liberalization on the economic growth in the North African countries. For this aim, we will first shed light on the literature review dealing with the relationship between the financial liberalization and the economic growth and second give an empirical estimation to test the consistency of the theoretical and empirical evidence for the relationship between the financial variables and the real variables of the economy. This study seeks to analyze the impact of the financial liberalization on the economic growth in the North Africa countries (Algeria, Morocco, Tunisia and Egypt) between 1995 and 2013. The motivation behind the

choice of this period for our study has been the lack of data with regard to several indicators.

In the present study, the estimation of financial liberalization impact on the economic growth has been performed by using the panel Cointegration Vector Estimation by DOLS, which is developed, by McCoskey & Kao (1998) and Kao & Chiang (2000). In addition, we are going to test the Fully Modified Ordinary Least Squares (FMOLS), which is developed in turn by McCoskey & Kao in (1998), Phillips & Moon in (1999) and Pedroni in (2000). These authors noticed that the DOLS is less biased than the OLS in panel and in estimators of small samples due to Monte Carlo simulations, and the properties of DOLS model on the samples are better than the OLS panel and the FMOLS.

2. Literature review

The relationship between finance and economic growth has been widely discussed in the economic theory. The traditional analyses of the relationship between the financial sphere and the real sphere recommend savings as a perquisite condition for a productive investment, an economic growth, and thus a sustainable development. In fact, the relationship between financial and economic development has been recognized in economic literature few decades ago since Gurley & Shaw (1960) along with Goldsmith (1969) were the pioneers who have figured out this relationship. We also find, explicitly or implicitly, among these authors and others the idea that an efficient financial system activates the economic growth by its stimulation. For those authors, the main contribution of the financial system to the economic growth lies in the fact that the latter secures the work of an effective and progressive payment system, which mobilizes savings and improves its allocation to investment thanks to real positive interest rates.

On the other hand, it is difficult to date the emergence of financial liberalization, but it is generally accepted that it first appeared in the US during the 1970s. However, its definition remains complex and differs over time according to the economies. Its beginning also differs from one country to another since it can be dictated by the market or the international financial institutions. Moreover, it appears as one of the key procedures adopted within the economic reforms and seeks to remove the regulatory control over the institutional structures and the agents' instruments and activities in different sections of the financial sector (Ghosh, 2005).

The financial liberalization has spread rapidly around the world and has played a principal role in the development of the financial system, which has contributed in its turn to the development of the economy. As a result, it leads to the capital inflows, increases investment and growth, and develops the domestic financial market (Papaioannou, 2009). Yet it has been subject to many criticisms. Thus, liberalized financial systems with a weak banking surveillance are more likely to face banking crises (Demirgüç-Kunt & Detragiache 1998). The banking crises, according to (Kaminsky & Reinhart, 1999), occur five years or less sometimes after the adoption of the financial liberalization.

On the other hand, there are four factors that cause the economies in the financially liberalized countries to become weak (Saidane, 2002): first, the lax attitude of central banks; second, the lack of adequate skills in risks management; third, the effects of the risks permeation caused by the fast rate of the economic openness and fourth, the banks' uneconomic attitude. However, the financial crises, in case there is a lack of transparency, can occur regardless of the financial liberalization. Thus, it is desirable, in countries where there are low rates of transparency, to liberalize slowly the financial system so as to enable the banks to

have more time to get information and update their credibility (Mehrez & Kaufmann 2000).

The advantages and drawbacks of the financial liberalization have given rise to another model (formulated respectively by Fry in (1997) and Stiglitz, 1998) suggesting the establishment of a system of banking and finance regulation and surveillance. According to Stiglitz (1998), the weak institutional infrastructure of the financial liberalization is the reason behind the banking crises in the emerging countries. The latter therefore become weaker against external crises, which necessitate the State's intervention in the financial sector to strengthen its regulation. Similarly, the pioneer of the financial liberalization, McKinnon & Pill (1996) highlighted the need to invest in the institutional infrastructure before initiating the financial reforms to achieve a financial liberalization.

3. Economic Landscape of the Countries of the Region of North Africa

After their independence, Algeria, Morocco, Tunisia and Egypt have adopted a centralized management model where the state imposes its complete domination. The government sought to accelerate the economic development and reduce the backlogs. Therefore, each state has carried out large-scale stimulus plans targeting mainly the industrialization. The financial systems of the four countries were strongly regulated: administered interest rates, a selective credits policy and a monopoly of public banks. Thus, the development plans adopted by these countries required considerable funds and absorbed all their resources. Thus, the essential function of the banks and other financial intermediaries was to provide liquidity in order to finance the strategic sectors. Moreover, during the 1980s, the drawbacks of this development model began to show up a result of the deterioration of the international situation. These countries suffered from a heavy external debt, a serious budget deficit and a recession in the sectors that are considered to be strategic ones.

To surmount such a difficult economic situation and the weight of foreign debts, these countries, under the auspices of the IMF, have adopted the Structural Adjustment Program (SAP) respectively in 1983, 1986 and 1994. This program required the adoption of financial liberalization policies in these countries. Thus, the financial liberalization, with its different constituents, has been suggested as a solution for the crisis, which threatened each of these countries. In this regard, the government initiated some reforms to modernize the financial systems as a whole, so as to enable them to fully perform their functions of collecting and distributing the financial resources. The next section tackles the evolution of some financial development indicators that will allow us to assess the evolution of the outcomes of the financial liberalization process adopted by these countries.

3.1. Financial development and banking intermediation

3.1.1 Financial development

Relying on the abundant theoretical works carried out on this subject, the financial development can be determined using two indicators, the ratio of money supply (M2) on the GDP, and the ratio of the Credit to private sector on GDP.

3.1.1.1. The M_2/GDP ratio

This indicator takes into consideration the methods of payment adopted in the economy; it tends to increase when the financial system develops, when the range of savings instruments widens and when the liquidity increases in the economy. Despite of that, it tends to decrease in case unplaced forms of savings in the banks increase. This variable reflects therefore the volume of financial services allocated to the economy and achieves the financial improvement. Concerning the works that have made reference to this ratio on the other hand, we can mention Gelbard &

Leite (1999) about the Sub-Saharan Africa. However, it is appropriate to draw attention to one of the drawbacks of this indicator. In fact, a high level of this ratio is supposed to represent high liquidity of the system. Otherwise, this ratio may decrease as the financial system develops. This is the case when the economic agents have other alternative long-term investment rather than short-term liquid investments.

The calculation of the first ratio leads us to conclude that all the four North African countries had a financial environment liquid enough with a ratio exceeding 60% in 2013. Thus, Morocco recorded the best results with a ratio of around 115% in 2013.
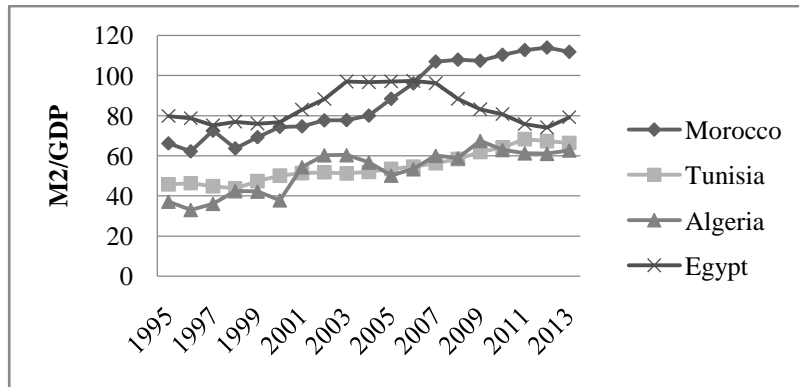

Figure 1. Evolution of the ratio M_2/PIB during the period 1995-2013

3.1.1.2. The credit to private sector/GDP Ratio

The ratio of credit granted to the private sector on GDP CSP/PIB relates to the amount and quality of the investment. It reflects the mastery of the eviction effect of the public sector compared to the private sector. Its high level reflects, to some extent, the effectiveness of the management of bank liquidity, especially in the assessment of default risk.

For our study, considering the share of the credit directed to the private sector, the financial development seems to be lower while the abstraction of the case of Tunisia and Morocco that have recorded the best results with a ratio close to 70% in 2013. This evolution has been below average in Tunisia, increasing from 70% in 1995 to 75% in 2013, while the evolution of this ratio in Morocco was very significant, increasing from 32% in 1995 to 70% in 2013. As for Egypt and Algeria, the share of credits granted to the private sector on GDP is below average which reveals the low level of the finance of economy in these countries.
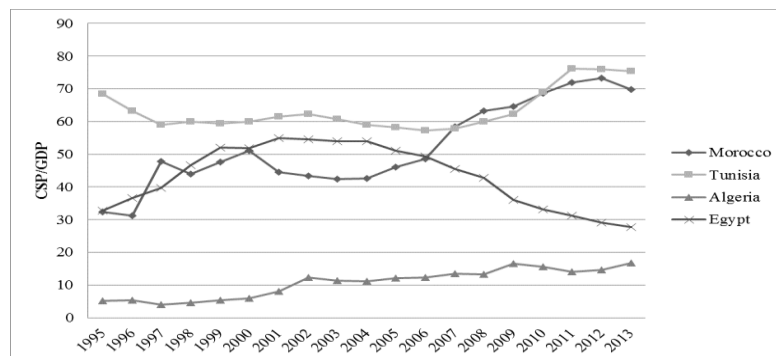

Figure 2. Evolution of the ratio CSP/PIB during the period 1995-2013

3.1.2 Bank performance
3.1.2.1. ROA[v]

If the performance of the banking sector appeared to be satisfactory for all the North African countries, then it would not be the case with Tunisia and Egypt until 2011. The results of all these countries are below global averages. The diagram below confirms this statement and traces the evolution of bank performance indexes of these countries.
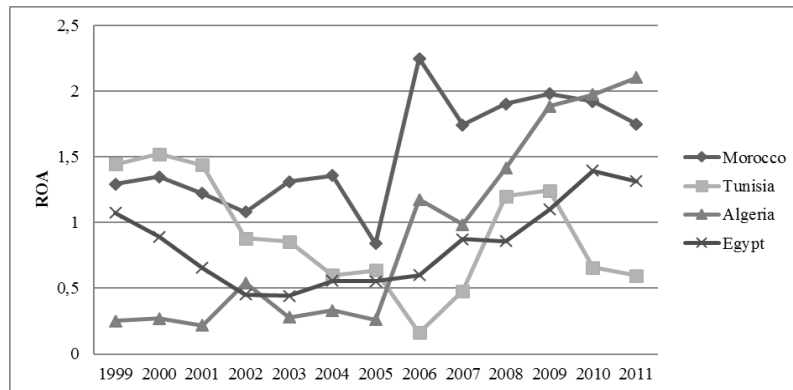

Figure 3. Evolution of the ROA indicator during the period 1999-2011

3.1.2.2. ROE[vi]

Return on equity is a ratio that measures the return of the bank's equity; in other words, it is the net result yielded in equity.
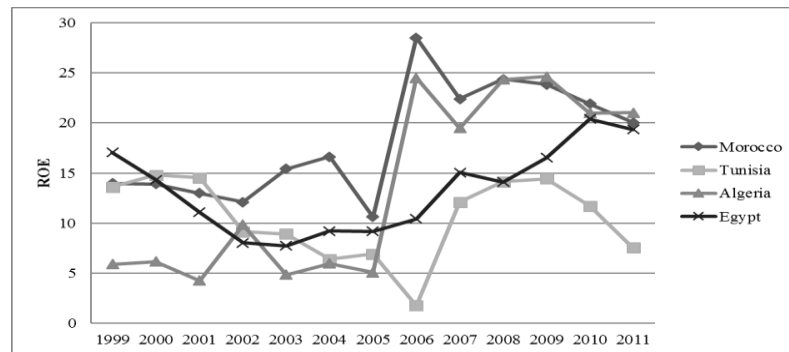
Figure 4. Evolution of the ROE indicator during the period 1999-2011

3.1.2.3. The level of intermediation margins

High intermediation margins reveal a lack of competition in the banking system. The following table shows that Morocco, Tunisia and Algeria have witnessed a gradual decline in the intermediation margin of the banks. However, the intermediation margin of the banks in Egypt has achieved a constant positive evolution since 2006, which increased from 1.5 to 2.5 in 2013.

Figure 5. Evolution of the bank margins during the period 1999-2011

3.1.3. Saving and investment
3.1.3.1 The savings attitude

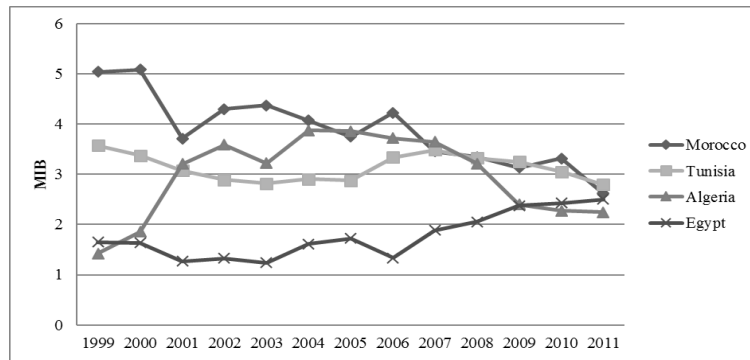In order to achieve a stable economy, the government started, during the 1980s, increasing the rates of administered interests and keeping them at high levels. Afterwards, in the early 1990s, the interest rates were liberalized. In Tunisia and Morocco, for example, the State imposed its intervention with regard to the interest rates in order to finance the budget deficit thanks to the dominance of the State over the banking sector. Thus, according to the financial liberalization theory, we consider savings as a growing function of the real interest rate because the substitution effect dominates the income effect. In fact, higher interest rates would encourage the agents to prefer savings and subsequently transfer a part of their consumption.

However, despite the increase of financial intermediation in the Mediterranean countries since the 1990s, the savings rate (defined as savings in percentage of GDP), remained stable or was in a decrease with a very large measure in Libya with a ratio which increased from 80 % in 2008 to 38 % in 2013. The following diagram illustrates this further:
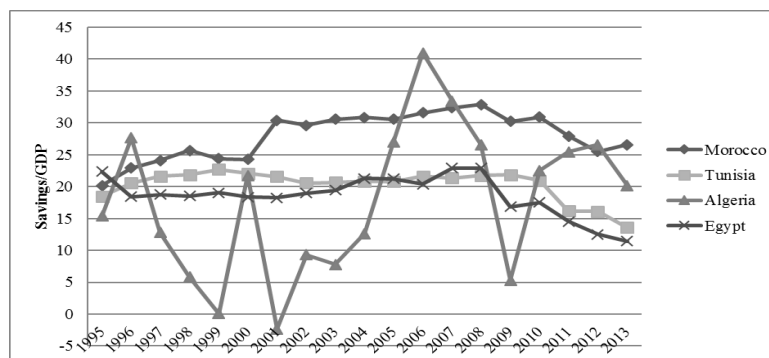
Figure 6: Evolution of savings in % of GDP during the period 1995-2013

3.1.3.2. Investment

Even though the investments reached high levels in the Mediterranean countries during the 1960s and 1970s thanks to the fact that there was full access to debts, they remained ineffective. According to the answers quoted from the studies conducted by the World Bank, the problem is the functioning of the companies themselves: the productive fabric does not work competitively; the company has no incentive to the opening of its capital. The privatization does not lead to a rapid and remarkable recovery in the activity.

As was the case in the savings attitude, Algeria and Egypt held a low rank in 2013 with a ratio of investment / GDP of about 15%, followed by Tunisia with (22%), while Morocco recorded the best results with a consistent evolution throughout the period increasing from 24% in 1995 to 35 % in 2013.

Figure 7. Evolution of investment in % of GDP during (1995-2013)

4. Methodology

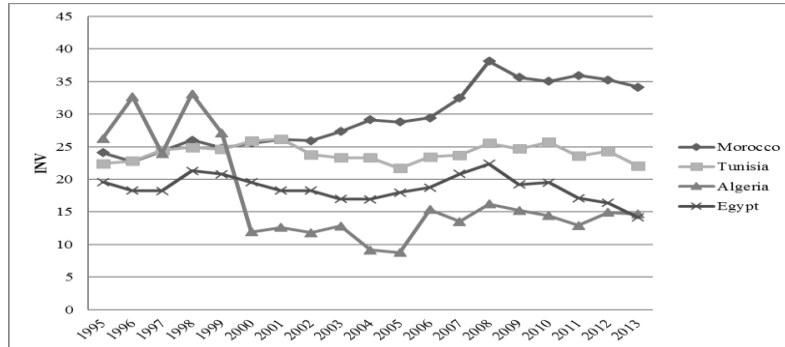The present study seeks to analyze the impact of financial liberalization on economic growth in the North African countries (Algeria, Morocco, Tunisia and Egypt) for the period 1995-2013. The reason behind choosing specifically this period was the lack of the data of some economic indicators at that time. Thus, this section will describe the econometric model that will be first used, and provide a presentation of the model variables that will be performed.

In this regard, the estimated impact of financial liberalization on economic growth will be achieved using the Estimation of Cointegration panel of DOLS model (Dynamic Panel OLS Model); developed by McCoskey & Kao (1998) and Kaoet Chiang (2000) along with FMOLS (panel fully modified OLS) developed by McCoskey & Kao (1998), Phillips & Moon (1999), and Pedroni (2000). The authors noticed that the DOLS is less biased than the OLS in panel and the estimators of small samples with reference to Monte Carlo simulations. It is also worth mentioning that the DOLS model has better properties on the samples in comparison with the OLS and FMOLS estimators.

Thus, resorting to the panel cointegration test is of great importance in this respect since it enables us to affirm whether there is a long-term equilibrium relationship between the variables, or not. If we look at this issue from the statisticians' point of view, we will find that the long-term equilibrium relationship implies that the variables move together over time. In other words, if the series contains a unit root, it will be useful to use the panel cointegration testing technique. As a result, the cointegration test panel can be used in various ways. As for our case, we apply the most popular Cointegration test of Kao (1999) who has introduced two types of cointegration tests for panel data; the *DF* and *ADF*. Thus, in order to estimate the long run co-integrating vector between the economic growth and the variables of financial liberalization, we use the estimator DOLS by Panel proposed by Kao & Chiang (2000). Afterwards, bearing in mind that the dependent variable is structurally related to the explanatory variables and knowing that a long-term equilibrium relationship "r" exists between these variables, we therefore proceed to estimate the equation below by implementing the procedure (FMOLS) which is suitable for the data in a heterogeneous co-integrated panel (Pedroni, 2000). This methodology tackles the problem of non-stationary explanatory variables as well as the bias problem.

4.1. Definition of variables

The indicator of the economic growth, which has been retained, is the logarithm of GDP per capita labeled with US dollar (Eggoh, 2010; Guillaumont & Kpodar, 2006; etc.). This indicator is scored (LOGGDP_K). It is a widely used procedure in quantitative research as one of the indicators employed to measure the economic performance of a country.

Though there are many financial development indicators (King & Levine, 1993; Verdier, 2004), we will only use some of them since the data for many of these indicators were unavailable. For this reason, we keep the three following indicators so as to measure the financial development: the logarithm of the ratio of credit to the private sector on GDP (LOG_CSP), the logarithm of the mass ratio M3 monetary GDP (LOGM3_GDP) and the logarithm of money supply M2 to GDP ratio (LOGM2_GDP).

The (LOGINF) variable represents the inflation rate measured by the consumer price index while (LOGFDE) variable represents direct investment by foreigners.

The variable (LOGGDI_GDP) represents the investment as a percentage of GDP, which influences the economic growth by referring clearly to the literature on the subject. In addition, the variables (LOGTF) and (LOGTauxOuv) represent respectively the indicator of trade liberalization in the country and the rate of commercial openness measured by the ratio between the sum of exports and imports on GDP.

On the other hand, the variables (LOGPR, LOGFF, and LOGFFC) are used to measure the level of the institutional environment in which the liberalization will be applied. This is particularly the variable of property rights, trade liberalization, indicator of freedom from corruption, and index of financial liberalization.

The (LOGKH) variable measures the enrollment rate in secondary education and therefore represents the level of human capital of the country.

Our database was mainly drawn from the database of the World Bank (WDI 2013), the Heritage Foundation (2014), the "Global development finance", and the "Financial openness".

Using the Log variables allows us to detach them from a nonlinear trend and subsequently facilitates the interpretation of results as well as proves that the above model is reliable; especially, when the variables used are from several sectors and the sample taken contains breaks trend caused by the structural and cyclical changes during the study period.

5. Statistical and econometric study results

The Analysis of descriptive statistics relies mainly on analyzing means and correlation coefficients between the variables of the model since the correlation coefficient is used to assess the degree of connection and the evolution of the variables. But as Bourbonnais said (2015) *"correlation is not causation."* That is to say, the correlation is the analysis of causality between the variables in the model that justified the use of econometric techniques.

5.1. Descriptive statistics

The table below shows that the average GDP of the sample on the studied period is 2312.07 dollars. The average minimum value of this indicator is recorded in Egypt (1269.96 dollars) while the maximum value is in Tunisia (3,157.86 dollars). As far as the money supply M2 to GDP ratio is concerned, we can notice that Morocco records the maximum value (88.09 %) while Algeria holds the lowest value (52.52 %). Moreover, the ratio of credit to the private sector in GDP shows the best results for the benefit of Tunisia (63.46 %) while Algeria has the lowest

value (10.61%). As a result, Algeria appears to be the country that holds the lower financial liberalization indicator.

Table 1. *Descriptive statistics of the model variables*

	CSP	FF	GDI	GDP	INFL	KH	M2	M3	OUV
Mean	42.39	43.15	24.79	2312	4.88	70.11	69.83	67.44	0.7294
Median	47.12	50.00	24.41	2442	3.64	73.60	66.90	69.32	0.7017
Maximum	76.26	70.00	38.23	3994	29.77	97.60	113.89	114.85	1.0300
Minimum	3.90	20.00	13.77	956.9	0.33	36.15	33.00	31.82	0.4336
Std. Dev.	21.68	12.56	5.271	888.06	4.71	16.66	20.49	22.07	0.1591
Mor mean	52,18	48,94	26,52	2003	1,98	48,32	88,09	89,93	0,6573
Alg mean	10,61	37,89	29,36	2816	6,02	72,53	52,52	41,94	0,6922
Tun mean	63,46	43,68	24,73	3157	3,76	78,53	54,51	56,73	0,9505
Egy mean	43,31	42,10	18,55	1269	7,77	81,88	84,21	81,09	0,6224
Observation	76	76	76	76	76	76	76	76	76

As for the correlation between the variables, the following observations are worth considering facts. First, there is a positive and significant correlation between the variable GDP and exogenous variables (openness rates and human capital) respectively 0.64 and 0.30, confirming to some extent the theory of endogenous growth which is based on investments in human capital, innovations, etc. On the other hand, the variables (money supply M2 and M3 as well as inflation) are negatively correlated to the GDP variable; however, we still notice that there is also a positive and significant correlation between financial development indicators M2 and M3 (0.95). Therefore, it can be argued that the results confirm partially the predictions of MacKinnon (1973) and Shaw (1973), after analyzing the correlation between the different variables.

Table 2. *Matrix of correlations*

	CSP	FF	GDI	GDP	INFL	KH	M2	M3	OUV
CSP	1.0000								
FF	0.1506	1.0000							
GDI	- 0.15***	0.0348	1.0000						
GDP	0.1039	- 0.2825*	0.6134*	1.0000					
INFL	- 0.298*	- 0.0425	-0.181**	- 0.183**	1.0000				
KH	0.0760	- 0.4715*	- 0.1232	0.3051*	0.1503	1.0000			
M2	0.428*	- 0.0542	- 0.0749	- 0.3133*	- 0.1154	- 0.0334	1.0000		
M3	0.576*	0.0790	- 0.16***	- 0.3240*	- 0.1196	- 0.1210	0.954*	1.000	
T.OUV	0.350*	- 0.0362	0.2080*	0.6484*	0.0387	0.250**	- 0.32*	- 0.218	1.0000

5.2. Unit root test

Before embarking upon the task of identifying a long-term relationship between the variables, it is necessary to check that all variables are integrated in order 1, since many unit root tests exist. For this reason, we opted in this study for the tests (a) *ADF file chi square*, (b) *Levin, Lin and Chu Version* (LLC), (c) *Im, Pesaran and Shin* (1997 IPS) and (d) *PP- chi Fisher square*. These tests are based on the procedure *Dickey -Fuller*. Although the test *Levin*, *Lin* and *Chu* (LLC) has a limit of homogeneity, the test of *Im*, *Shin* and *Pesaran* (IPS) solves this problem by assuming that the heterogeneity between units in a data frame of dynamic panel. That is why afterwards, we present the unit root test *ADF Fisher Chi -square*, since other tests are available in the appendix.

Table 3. *Unit root test*

Variables	ADF- Ficher Chi-square				Decision
	At level		At first difference		
	statistic	Prob	statistic	Prob	
LOGGDP_K	5,3006	0,7250 (1)	27,0971	0,0007 * (2)	LOGGDP_K is I(1)
LOGGDI_GDP	6,7339	0,5656 (1)	35,3318	0,0000 * (1)	LOGGDI_GDP is I(1)
LOGINF	14,3734	0,0725 (2)	64,0304	0,0000 * (2)	LOGINF is I(1)
LOGKH	11,1455	0,1936 (1)	29,0693	0,0003 * (3)	LOGKH is I(1)
LOGM2_GDP	7,8820	0,4451 (3)	38,8048	0,0000 * (0)	LOGM2_GDP is I(1)
LOGM3_GDP	3,2109	0,9204 (0)	32,1922	0,0001 * (0)	LOGM3_GDP is I(1)
LOGPR	8,7316	0,1892 (0)	41,0203	0,0000 * (0)	LOGPR is est I(1)
LOGTauxOuv	13,7601	0,0882 (3)	47,2095	0,0000 * (3)	LOGTauxOuv is I(1)
LOGTF	11,1560	0,1930 (1)	36,8233	0,0000 * (1)	LOGTF is I(1)
LOGCSP_GDP	4,6898	0,7902 (3)	18,1475	0,0201 * (3)	LOGCSP_GDP is I(1)
LOGFDE	15,3239	0,0531 (1)	65,9032	0,0000 * (1)	LOGFDE is I(1)
LOGFF	5,2406	0,7316 (0)	44,1567	0,0000 * (0)	LOGFF is I(1)
LOGFFC	7,1925	0,5160 (0)	46,1103	0,0000 * (1)	LOGFFC is I(1)

(*) Significant at 5%. I (1): indicates that the variables are not stationary at level. (1): Optimal lag lengths are provided between the parentheses.

5.3. Panel cointegration Test

As it has been mentioned so far, the Cointegration Test in panel is mainly used to confirm if there is a long-term equilibrium relationship between two or more variables. From a statistical point of view, the long term equilibrium relationship means that variables move together over time. If the series contain a unit root, then we use the panel cointegration testing technique. Indeed, the cointegration test panel may be used in various ways; Here, we apply the most popular test Cointegration of Kao (1999) who introduced two types of panel data cointegration tests, the DF and ADF.

After applying the Cointegration test introduced by Kao (1999), we reject the null hypothesis, which is without cointegration since our probability is less than 5%.

The DF test is calculated from the estimated residues following:

$$\hat{e}_{it} = \rho\hat{e}_{it} + v_{it} \tag{1}$$

By considering the following fallacious regression model:

$$y_{it} = x'_{it}\beta + z - it'\gamma + e_{it} \tag{2}$$

For all "I" using panel data with:

$$x_{it} = x_{it-1} + \varepsilon_{it} \tag{3}$$

And

$$\hat{e}_{it} = \hat{y}_{it} - \hat{x}'_{it}\hat{\beta} \tag{4}$$

We have:
The null hypothesis of no cointegration is represented as: H0: $\rho = 1$
The estimation by ordinary least squares (OLS) of ρ and of the t-statistic is given by:

$$\hat{\rho} = \frac{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{e}_{it} \hat{e}_{it-1}}{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{e}_{it-1}^{2}} \tag{5}$$

and

$$t_{\hat{\rho}} = (\hat{\rho} - 1)\sqrt{\frac{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{e}_{it-1}^{2}}{S_{e}}} \tag{6}$$

$$S_{e}^{2} = \frac{\sum_{i=1}^{N} \sum_{t=1}^{T} (\hat{e}_{it} - \hat{\rho}\hat{e}_{it-1})^{2}}{TN} \tag{7}$$

Hence our DF statistic is written:

$$DF_{t} = \sqrt{1.25}t\hat{\rho} + \sqrt{1.875N} \tag{8}$$

For the ADF test we consider the following regression:

$$\hat{e}_{it} = \rho\hat{e}_{it} + \sum_{j=1}^{p} \varphi_{j}\Delta\hat{e}_{it-j} + v_{it} \tag{9}$$

With the null hypothesis of no cointegration, the ADF test uses the same t-statistic of

Table 4. *Panel cointegration test*

Kao Residual Cointegration Test				
Automatic lag length selection based on SIC with a max lag of 3				
Newey-West automatic bandwidth selection and Bartlett kernel				
			t-Statistic	Prob.
ADF			-6.278329	0.0000*
Residual variance			0.008016	
HAC variance			0.005389	
Augmented Dickey-Fuller Test Equation				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID (-1)	-0.758617	0.108994	-6.960143	0.0000*
R-squared	0.412022	Mean dependent var		-0.003371
Adjusted R-squared	0.412022	S.D. dependent var		0.121070
S.E. of regression	0.092836	Akaike info criterion		-1.901786
Sum squared resid	0.594676	Schwarz criterion		-1.869665
Log likelihood	67.56251	Hannan-Quinn criter.		-1.889027
Durbin-Watson stat	1.812007			

(*) Significant at 5%. After applying the test Cointegration introduced by Kao (1999), we reject the null hypothesis of no cointegration for our probability is less than 5%.

5.4. Estimation of panel Cointegration

After establishing the cointegration panel, the long-term Cointegration vector could be tested by means of many methods. For example, the Ordinary Least Square estimator (OLS) completely changed the Fully Modified Ordinary Least Squares (FMOLS) developed by McCoskey and Kao (1998), Phillips and Moon (1999) and Pedroni (2000) as well as the Dynamic Ordinary Least Squares (DOLS) developed by McCoskey and Kao (1998) and Kao and Chiang (2000).

5.5. DOLS model

For the purpose of estimating the long-term cointegration vector between economic growth and the variables of financial liberalization, we resort to using the method "DOLS" proposed by Kao and Chiang (2000). Since the significant variables in this model are LOG (GDI_GDP) and LOGKH, the DOLS estimator is given therefore by the following equation:

$$y_{it} = \alpha_i + x_{it}\beta + \sum_{j=q1}^{q2} c_{ij}\Delta x_{it+j} + v_{it} \qquad (10)$$

With:

i= 1,...,n for each country in the panel, t=1,...,t is the period, q1 represents the maximum delays, q2 represents the maximum conduction.

v_{it} represents the Gaussian error vector.

y_{it} is the vector $LOG(GDP\%K)$ for all i and j (dependent variable).

- x_{it} is the vector of explanatory variables:
(LOGCSP%GDP, LOGFDE, LOGFFC, LOGINF, LOGKH, LOGM2%GDP, LOGM3%GDP, LOGGPR, LOGTAUXOUV, LOGTF, LOGFF, LOGGDI%GDP).

Table 5. *DOLS estimation*

Dependent Variable: LOGGDP_K
Method: Panel Dynamic Least Squares (DOLS)
individual coefficient covariances

Variable	Coefficient	Std. Error	t-Statistic	Prob
LOGCSP_GDP	-0.115686	0.151793	-0.762132	0.4488
LOGFDE	-0.021799	0.056184	-0.387985	0.6993
LOGFF	-0.001822	0.116614	-0.015628	0.9876
LOGFFC	-0.012530	0.134094	-0.093443	0.9258
LOGGDI_GDP	0.504187	0.178922	2.817907	0.0064*
LOGINFL	-0.004228	0.027712	-0.152583	0.8792
LOGKH	0.593282	0.142818	4.154110	0.0001*
LOGM2_GDP	0.957427	0.543270	1.762341	0.0829
LOGM3_GDP	-0.333471	0.647686	-0.514865	0.6084
LOGPR	0.261760	0.202855	1.290382	0.2016
LOGTAUXOUV	-0.637913	0.796676	-0.800719	0.4263
LOGTF	0.108956	0.185768	0.586515	0.5596
R-squared	-1.045288	Mean dependent var		7.667243
Adjusted R-squared	-1.402402	S.D. dependent var		0.425469
S.E. of regression	0.659464	Sum squared resid		27.39822
Durbin-Watson stat	0.148501	Long-run variance		0.005696

(*) significant at 5%. The significant variables in this model are LOG (GDI_GDP) and LOGKH. If the GDI_GDP increases in a unit, the GDP_K will increase to reach 0.50, and if the KH increases in a unit, the GDP_K will increase by 0.59. However, the rest of the variables are not significant for the explanation of economic growth.

5.6. FMOLS model

Having found that the dependent variable is structurally related to the explanatory variables, and taking into account that there is a long-term equilibrium relationship "r" between these variables, we proceed therefore to estimate the equation below using the procedure "fully modified OLS" which is suitable for the

data in heterogeneous cointegrated panel (Pedroni, 2000). This methodology handles the problem of non-stationary explanatory variables and the bias problem.

The estimator OLS (Ordinary Least Squares Estimator) is known for its biased results because the explanatory variables are, in general, determined endogenously in case we have our integrated variables in order 1.

We consider the Cointegration system for panel data:

$$y_{it} = \alpha_i + x_{it}'\beta + e_{it} \qquad (11)$$

And

$$x_{it} = x_{it-1} + \varepsilon_{it} \qquad (12)$$

With: the same definitions of variables as the DOLS.

Table 6. *FMOLS estimation*

Dependent Variable: LOGGDP_K				
Method: Panel Fully Modified Least Squares (FMOLS)				
Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)				
Variable	Coefficient	Std. Error	t-Statistic	Prob
LOGFDE	-0.040721	0.021691	-1.877310	0.0654
LOGFF	0.101102	0.049614	2.037751	0.0461*
LOGFFC	0.022208	0.052867	0.420077	0.6760
LOGGDI_GDP	0.397526	0.075601	5.258230	0.0000*
LOGINFL	0.013330	0.016873	0.789998	0.4327
LOGKH	0.719475	0.092467	7.780886	0.0000*
LOGM2_GDP	0.971203	0.257065	3.778040	0.0004*
LOGM3_GDP	-0.420795	0.312821	-1.345161	0.1837
LOGPR	0.069925	0.108343	0.645400	0.5212
LOGTAUXOUV	-0.695919	0.333889	-2.084282	0.0415*
LOGTF	0.053554	0.083347	0.642546	0.5230
R-squared	-0.950346	Mean dependent var		7.689505
Adjusted R-squared	-1.280913	S.D. dependent var		0.422070
S.E. of regression	0.637439	Sum squared resid		23.97339
Durbin-Watson stat	0.047921	Long-run variance		0.001311

The results of this estimation allow us to note in the second model FMOLS that most of the variables are significant. That is to say:

- If the LOGFF increases, the GDP_K will increase significantly by 0.10 units.
- If the LOGTAUXOUV increases, the GDP_K will drop significantly by 0.69.
- If the LOGGDI_GDP increases, the GDP_K increase significantly by 0.39.
- If the LOGKH increases, the GDP_K increase significantly by 0.71 units.
- If the LOGM2 increases, the GDP_K increase significantly by 0.97.
- Indeed, according to these results, we can say that the estimation method of FMOLS is more appropriate than the DOLS in this study.

6. Conclusion

On the whole, this study was undertaken so as to analyze the impact of financial liberalization on the economic growth in the North African countries for the period 1995-2013. By the end of this study, we have figured out that the Cointegration test in panel introduced by Kao (1999), confirms the existence of a long-term cointegration relationship between variables. Furthermore, the use of DOLS and

FMOLS models suggest to us that the FMOLS model is more appropriate in this study. In the first model, only the variables of gross domestic investment (GDI) and human capital (KH) are significant, whereas in the model FMOLS, three other variables have the upper hand in the economic growth. These variables have included the FF (Financial freedom), the M2 (monetary mass M2) and the rate of opening (R. opening).

Finally, with reference to successful experiences, we recommend that the financial liberalization in these countries requires a number of prerequisites; for this reason, they should implement the following procedures:

- Ensuring a gradual and thoughtful liberalization of the capital account. In other words, the progressive dismantling of controls on capital movements and the control of exchange, with a maintenance of backup devices appropriate prudential, will result in the intensification of competition and the opportunity for investors as well as businesses to benefit from the international capital market.

- Consolidating the macroeconomic stability because it has the ability to absorb exogenous shocks by foreign economies.

- Reducing risks for financial stability by making the regulatory framework more robust and prudential along with enacting policies compatible with the supervision of the financial system.

- Improving payment systems and their convergence in relation to international standards on the subject, in order to be able to have the services and the payment circuits that meet the expectations of economic agents.

-Making the risk assessment more visible by harmonizing the financial information and the financial contracts through having access to international standards of financial information (IFRS) and accounting (IAS).

Appendix

Variables	Levine, Lin & Chu t (LLC)				Im, Pesaran and Shin W-stat (IPS)				PP - Fisher Chi - square			
	At Level		At first différence		At level		At first différence		At level		At first différence	
	statistic	Prob	statistic	Prob	statistic	Prob	statistic	Prob	statistic	Prob	statistic	Prob
LOGGDP_K	-2,5297	0,0057 (1)	-4,4658	0,0000 * (2)	0,5769	0,7180	-3,6458	0,0001 *	5,0600	0,7511	24,6379	0,0018 *
LOGGDI_GDP	-0,5834	0,2798 (1)	-5,5773	0,0000 * (1)	0,0756	0,5301	-4,7284	0,0000 *	6,3890	0,6037	36,9404	0,0000 *
LOGINF	-0,6264	0,2655 (2)	-9,2753	0,0000 * (2)	-1,3620	0,0866	-8,2357	0,0000 *	31,4800	0,0001	92,9296	0,0000 *
LOGKH	-2,1264	0,0167 (1)	-0,5225	0,3007 * (3)	-1,0296	0,1516	-2,8469	0,0022 *	11,0346	0,1997	38,1545	0,0000 *
LOGM2_GDP	-0,4253	0,3353 (3)	-5,9156	0,0000 * (0)	0,3554	0,6389	-5,1854	0,0000 *	2,5227	0,9607	38,8865	0,0000 *
LOGM3_GDP	0,6021	0,7264 (0)	-5,3652	0,0000 * (0)	1,5608	0,9407	-4,3628	0,0000 *	3,0433	0,9316	33,8894	0,0000 *
LOGPR	-1,2869	0,0991 (0)	-8,9032	0,0000 * (0)	-1,0041	0,1577	-7,4545	0,0000 *	9,3850	0,1531	57,9206	0,0000 *
LOGTauxOuv	-0,9656	0,1671 (3)	-5,7029	0,0000 * (3)	-1,3854	0,0830	-6,2316	0,0000 *	23,7380	0,0025	310,2720	0,0000 *
LOGTF	-2,3169	0,0103 (1)	-5,5607	0,0000 * (1)	-1,1422	0,1267	-4,9231	0,0000 *	10,9421	0,2050	90,9198	0,0000 *
LOGCSP_GDP	0,1964	0,5778 (3)	-2,6462	0,0041* (3)	0,2595	0,6024	-2,1420	0,0161 *	2,7984	0,9464	27,1200	0,0007 *
LOGFDE	-0,8853	0,1880 (1)	-8,7652	0,0000 * (1)	-1,4818	0,0692	-8,7957	0,0000 *	16,5037	0,0357	69,2621	0,0000 *
LOGFF	-0,2103	0,4167 (0)	-7,3287	0,0000 * (0)	0,2125	0,5841	-5,9973	0,0000 *	5,3231	0,7225	47,6837	0,0000 *
LOGFFC	-0,5125	0,3041 (0)	-7,2301	0,0000 * (1)	0,5154	0,6969	-6,1971	0,0000 *	7,0296	0,5334	50,2835	0,0000 *

(*) : Significat at 5%.

Notes

[i] When the function of debtor (State) increases to the point that he excludes the other debtors due to the law amount of savings that remains available and/or due to the increase of the rates of in interests accumulated.

[ii] J.P FITOUSSI : « Fondements de la politique économique et mondialisation »

[iii] Alouani (2008), « les réformes financières dans la région MENA, une approche comparative : cas de la Tunisie, l'Algérie, le Maroc et l'Egypte », panoeconomicus,3, str.369-381.pp

[iv] The convergence criteria allow the States members line up with their financial systems so as to achieve the economic and regional integration. Thus, in addition to some criteria of the financial sector, the criteria of the macro-economic convergence include among others: the rate of inflation, the budget balance, the public debt, the balance of payments, the ratios of savings and investment.

[v] Return on assets.

[vi] Return on Equity

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