

Financial liberalization and bank crisis: empirical evidence from Algeria using logistic model

التحرير المالي و الأزمات البنكية : دراسة قياسية عن الجزائر باستعمال نموذج الانحدار اللوجستي

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Abstract:

This paper estimates effects of Algerian financial liberalization policy on possibility of bank crises using a logistic regression (logit) model(1970-2018). We find that financial liberalization would have no significant and immediate impact on crisis. Results show that inflation rate, exchange rate, and fuel exports have a very significant impact on occurrence of crises in Algeria. On other hand, internal liberalization by granting loans or external financial liberalization through liberalization of financial market and capital account has no impact on crisis.

Keywords:financial liberalization; bank crisis; financial crisis; logistic regression.

JELClassificationCodes: C32, F36, G01.

ملخص:

تهدف هذه الورقة الى قياس تأثير سياسة التحرير المالي الجزائري على إمكانية حدوث أزمات بنكية باستخدام نموذج الانحدار اللوجستي (logit) للفترة 1970-2018. توصلنا أن التحرير المالي لن يكون له تأثير كبير وفوري على الأزمة. حيث تظهر النتائج أن معدل التضخم، سعر الصرف وصادرات المحروقات لها تأثير كبير على حدوث الأزمات البنكية في الجزائر. من ناحية أخرى، فإن التحرير المالي الداخلي عن طريق منح القروض أو التحرير المالي الخارجي من خلال تحرير السوق المالية وحساب رأس المال ليس له أي تأثير على الأزمة.

كلمات مفتاحية: التحرير المالي، الأزمة البنكية، الأزمة المالية، الانحدار اللوجستي.

تصنيفات JEL: G01، F36، C32.

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1. INTRODUCTION

Developing countries has witnessed many bank crises in 1990s which has resulted to an increased interest in instability of these countries markets. Also, these countries experienced great fluctuations in their assets. Attractiveness of capital markets in developing countries emerged during 1980s(Joyce , 2010, pp. 875-895). This period witnessed a great influx of foreign capital into their markets. This is because most of these countries' economies are characterized by an exchange rate regime that is fixed with US dollar and higher yields resulting from offered interest rate. However, capital inflows were characterized as short-term. Speculators could withdraw them at any moment and leave these markets without funding. Subsequently, this massive inflow of capital has preceded movements of financial liberalization in these countries through elimination of barriers to financial transactions. Furthermore, it prompts foreign investors to enter strongly into these markets due to high returns resulting from offered interest rates. Also, under liberalization policy, banks have become less important in financing as they have faced several forms of competition from financial markets and foreign financial institutions(Angkinand , Swangngoenyuan , & Wihlborg , 2010, pp. 263-298).This has led to a decrease in profits of local banks on their traditional activities. They concentrate their efforts on financing real estate sector, which was considered a stable sector leading to a shortage of bank credit, high unpaid loans, and other factors due to weak regulatory and institutional frameworks that led to bank crises.

Period following adoption of financial liberalization policy in Algeria was characterized by several difficulties and crises in banking sector during nineties and beginning of millennium (Valencia & Leaven , 2012, pp. 1-33). Based on past work and events in this sector, we have examined possibility of a relationship between implementation of financial liberalization policy and occurrence of banking crises in Algeria using logistic regression model, by asking the following problem:

Is there a relationship between application of financial liberalization policy and occurrence of a banking crisis in Algeria?

Study hypothesis:

- There is a significant statistical relationship between expansion of loans granting and possibility of a crisis in Algeria.
- There is a significant statistical relationship between the drop in hydrocarbon exports index and possibility of a crisis in Algeria.

However, we divided this research into two sections; first was devoted to presenting concept of financial liberalization through theoretical literature and most important experimental works that examined relationship between financial liberalization and occurrence of bank crises. Second section presents econometric study with most important results obtained.

2. Literature review :

2.1 Financial Liberalization:

Concept of financial liberalization has been studied by several economists. This concept first appeared in works of Mac Kinnon(Mc Kinnon, 1973)and Shaw (Shaw, 1973). Authors presented financial liberalization policy as an effective and simple way to stimulate economic growth and development of financial system in developing countries.

2.1.1 McKinnon (1973):

Researcher is interested in thrift. For him, state cannot achieve economic growth without investment, and investment cannot be achieved without thrift. This led him to take an interest to individuals' savings. He concluded that they can only be motivated to save by freeing up restrictions on interest rates, combating fiscal restraint, and encouraging financial liberalization. Study of McKinnon addresses economics in which financial system is primitive. In addition, it is a macro-economic study where money is only financial asset available to savers or investors and is sole driver of growth.

According to researcher, process of accumulation of capital, through savings to direct them to investments which are effective for economic growth, can be achieved only if real interest rate is not specified by authorities. However, result shows that intervention of authorities obstruct economic growth. In fact, according to McKinnon, increase of return on

money causes a higher savings on fixed assets, which encourages formation of financial assets and accumulation of capital. With return of self-financed investment funds, traders prefer to keep funds in their investment. Financial liberalization allows removal of barriers through competition amongst financial intermediaries on a broad banking system that will revive capital movement.

2.1.2 Shaw (1973): In same year, 1973, Shaw published book “Financial Deepening in Economic Development.” For this researcher, basic property of policy of financial restraint is to determine fact that authorities’ interest rate is lesser in real market level. Difference between his work and that of Mc-Kinnon shows that for him, accumulation of capital can be done through financial intermediaries by products of loans and not only from deposits as assumed by Mc-Kinnon. In fact, Shaw assumed that self-financing is not only means of project financing. However, investors can obtain bank loans. Rates of interest paid to rely on self-financing can also lead to rationalization of loans. Thus, this rationalism in developing countries causes favoritism in granting loans and does not encourage creativity.

Researcher proves in his model how weak interest rates increase fragility of banking system. For researcher, only ways to obtain effective growth is financial liberalization and this determines market interest rate. Also, for him, this policy is appropriate for developing countries which are characterized by low savings. High interest rates through financial liberalization will cause rising of savings and thus will allow decline of capital. These studies have witnessed emergence of literature and many studies, including those supporting them and defending policy of financial liberalization and its positive effects in achievement of financial development and economic growth.

Some econometric and experimental studies also tried to prove it, while other researchers proved relationship between policy of financial liberalization and occurrence of banking and financial crises. Some of them will be reviewed.

3. Empirical Studies on Relationship between Financial Liberalization and Banking Crises

3.1. Empirical Studies on Positive Relationship between Financial Liberalization and Banking Crises

3.1.1. The Twin Crises: The Causes of Banking and Balance of Payment Problems(Kaminsky & Reinhart , 1996): In their research, they focused on analysis of indicators that allow identification of bank crises based on theory of signals. They set a threshold for each indicator used in study, such as financial liberalization, exports, real exchange rate, and cash mass on reserves. If indicator exceeded specified threshold, it is a sign of a bank crisis twenty-four months later. Study included a sample of 20 countries, including 50 developed and 15 developing countries between 1970 and 1995. Then researchers concluded that index of financial liberalization and rate of exchange is most influential in occurrence of bank crises.

3.1.2. The Determinants of Banking Crises: Evidence From Developing and Developed Countries(Demirgüç-Kunt & Detragiache , 1997, pp. 81-109): Based on macroeconomic variables and institutional variables, researchers attempted to study probability of bank crises. study of a sample of 65 developing and developed countries for period 1980-1994 used logistic regression model. Researchers found that influential variables are rate of interest, inflation rate, growth rate, and percentage of cash mass on reserves. Increasing inflation increases likelihood of crisis. Therefore, according to researchers, policies of financial restraint are more effective because it reduces rate of inflation and possibility of crisis. Moreover, other indicators include high percentage of cash mass on reserves and absence of an effective institutional framework that raises possibility of a crisis. Result of study is that pursuit of a policy of financial liberalization in an economy suffers from macroeconomic imbalances and institutions that raise incidence of bank crises. The two researchers re-studied in 1998, but they used implicit variables of financial liberalization in addition to institutional variables on model.

Study included a sample of 53 developing and developed countries for period of 1980-1995. Using logistic regression model, researchers found that financial liberalization played a major role in occurrence of bank crises, particularly in countries that suffer from legal and institutional deficiencies. They re-examined their previous studies in 2000, adding deposit variable as an additional explanatory variable. study included 61 developing and developed countries between 1980 and 1997. Using logistic regression model, researchers concluded that in addition to financial liberalization, deposit insurance system increases probability of bank crises, especially in developing countries. In 2005, Demirguc-kunt and Detragaiche conducted a study where they updated data. Period used was from 1980 to 2002 with study of 94 countries. Using regression model, researchers found that financial liberalization and budget deficits increase probability of bank crises, and probability of occurrence of model exceeds 70%.

3.1.3. Is there a correlation that exists Between Financial Liberalization and Banking Crises in Emerging Countries(Chebbi, 2005): study was conducted on a sample of 17 developing countries from Latin America, South-East Asia, Mediterranean countries and Africa, covering period 1980-2001. Logistic regression model was used. libfin5 measure of financial liberalization takes value of 01 if a bank crisis occurs after 05 years of financial liberalization, and 0 if it does not occur. This is performed based on dates of financial liberalization in study of Williamson and Mahar (1998). Researcher concluded that implementation of policy of financial liberalization positively affects occurrence of bank crises after three years of financial liberalization and not from first year.

3.1.4. Financial Globalization and Banking Crises In Emerging Markets(Joyce , 2010, pp. 875-895): study examined effect of financial liberalization on occurrence of bank crises. Study included 20 developing countries for period of 1976-2002 using logistic regression model. Researcher concluded that external financial liberalization by liberating capital account has a positive relation on crises. A binary indicator (1.0) was used to measure banking crisis.

3.1.5. Measuring The Severity of A Banking Crisis and Finding Its Associated Factors: How Are The Factors Different for Simple and Severe Banking Crisis?(Khan & Dewan, 2014, pp. 857-866): This study was conducted with data for a sample of 109 developed and developing countries for period of 1980-2003. Study was carried out based on logistic regression model and ratio of loans granted to private sector to measure financial liberalization. Researchers concluded that there was a delay for a period of four years between economic boom resulting from financial liberalization and occurrence of a severe banking crisis. This therefore means that crisis occur in a significant time difference before that announcement.

3.2. Experimental Studies on Negative Relationship between Financial Liberalization Policy and Banking Crises

3.2.1. When Does Capital Account Liberalization Help More than It Hurts(Arteta, Eichengreen, & Wyplosz, 2001, pp. 01-39): This study included a sample of 59 developing and developed countries between 1973 and 1992. Using least squares method and Quinn index to measure degree of capital account liberalization, researchers found that financial liberalization has a positive impact on economic growth in developing and developed countries. Additionally, it has macroeconomic stability which is required especially in developing countries.

3.2.2. Capital Controls, Sudden Stops and Current Account Reversals(Edwards, 2007, pp. 73-120): researcher focused on studying impact of external financial liberalization through liberalization of capital account based on occurrence of banking crises. Study included a sample of 163 developing and developed countries between 1970 and 2000. It uses two methods. first is analysis of non-scientific tests and frequency tables to analyze cases and main characteristics of both sudden stop and current account deficit in countries studied, with different degrees of restrictions on capital account. In second method, researcher used multiple regression models to study relationship between low capital flow and crisis. Researcher concluded that there is no relationship between external

financial liberalization and occurrence of bank crises, but occurrence here refers to other factors than liberalization of capital account.

3.2.3. Financial Liberalization and Banking Crises(Shehzad & de Haan, 2009, pp. 1-40):researchers studied effect of financial liberalization in its internal and external aspects on probability of a bank crisis. Study included a sample of 91 countries between 1973 and 2002 by using a probability regression model to analyze a data and a binary measure of crisis. Indicator of financial liberalizationis based on a variable derived from study of Abiad& al(Abiad, Detragiache, & Tressel, 2008, pp. 2-26). This variable consists of 07 indicators: loan restrictions, interest rate constraints, deregulation, privatization, control, and foreign capital flows. Authors concluded that there is no relationship between financial liberalization and possibility of bank crises. Effective bank controls with regular and systematic financial liberalization increase development of banking system and reduce probability of crises.

3.2.4. Financial Liberalization and Banking Crises: A Cross-Country Analysis(Angkinand , Swangngoenyung , & Wihlborg , 2010, pp. 263-298): researchers used a set of data for 48 countries in period of 1973 to 2005 to study possible relationship between policy of financial liberalization and occurrence of bank crises in studied countries. Based on a dynamic model of a basket of data, a binary variable for measuring crisis, interest rate index, ratio of loans granted and barrier cancellation index, privatization index and foreign capital flow index taken from database by Abiad (2008),which were adopted to measure degree of financial liberalization in studied countries, researchers found a negative correlation between financial liberalization and occurrence of bank crises.

4 . Empirical Study

To study effect of Algerian financial liberalization policy on possibility of bank crises, we have relied on model of logistic regression used by researcherChebbi(Chebbi, 2005). Also we applied it to case study in Algeria, through an econometric study from 1970 to 2018. This was done based on indicators of financial liberalization, macroeconomic indicators, and indicators of banking system.

4.1 Empirical Study Methodology

Model to be evaluated for relationship of financial liberalization to banking crises in Algeria is written as follows:

$$P(y = 1) = F(B_0 + B_1Kaopen + B_2Inf + B_3Croiss + B_4Export + B_5Liquid + B_6Termch + B_7Txch + B_8Tcb + B_9M2resrv)$$

Here,

Y: Is indicator of banking crisis $\begin{matrix} \longrightarrow & y = 0 & \text{in absence of a} \\ & & \text{bank crisis} \\ \longrightarrow & y = 1 & \text{existence of a banking} \\ & & \text{crisis} \end{matrix}$

Kaopen: index is based on Chinn & Ito's work(Chinn & Ito, 2019, pp. 1-14), which determines degree and intensity of restrictions on transactions related to capital account. Database created by these researchers includes 182 countries for period of 1970 to 2018, including Algeria. A higher value of this index indicates a more liberal economy, and this is what we used in our study to measure external financial liberalization.

Inf: It is inflation index which measures degree of economic stability in Algeria.

Croiss: It represents growth rate of economy (GDP growth).

Export: It includes exports from oil sector (Exportation).

Liquid: It is an indicator of liquidity of economy, which is for GDP (Liquidity).

Termch: Terms of trade adjustment.

Txch: Official exchange rate.

Tcb: Domestic credit provided by banking sector.

M2reser: Money and quasi money (M2) to total reserve ratio.

2.2 Empirical results

Through use of SPSS software, following results were obtained:

- Table 1 shows data entered in analysis and number of views considered at 100%. Here, we have no missing views.

Table 1 :Summary of treatment of observations

Unweighted observations		N	Percentage
Selected Observations	Included in analysis	48	100,0
	Missing Observations	0	,0
	Total	48	100,0
Excluded Observations		0	,0
Total		48	100,0

Source: by authors, adapted from SPSS.

Table 2 shows all results of primitive model containing constant only. If these results show discontinuation at fourth stage, highest probability (-2log likelihood) estimate of 44,584 equals previous stage.

Table 2 : History of iterations

Iteration		-2log likelihood	Coefficients
			Constant
Step 0	1	44,815	-1,182
	2	44,585	-1,350
	3	44,584	-1,358
	4	44,584	-1,358

Source: by authors, adapted from SPSS.

Table 3 shows constant value of this primitive model estimated ($b = -1,358$) as Wald statistic shows for this constant (13,205), while value of statistical level of this statistic ($\text{sig} = 0,000$) is less than moral level specified by researcher ($\text{Sig} = 0,10$). So we reject hypothesis of nothingness and accept alternative hypothesis. Furthermore, we accept moral of this constant and logarithm of argument is $[0,163 = (B) \text{EXp}]$.

Table 3 : Variables in equation

		A	E.S.	Wald	ddl	Sig.	Exp(B)
Step 0	Constant	-1,358	,374	13,205	1	,000	,257

Source: by authors, adapted from SPSS.

Table 4 shows number of repetitive cycles of maximum function at lowest value (-2log likelihood = 25,926). We stopped at this session

because change in coefficients (p1, p2pt) is less than 0.001. In fact, change in parameters has become very slow after fifth cycle, as we can observe from Table 4. So it can be said that parameters in courses 6, 7, 8, and 9 are similar with very simple differences.

Best results can be obtained because logarithmic weakness of greatest possible function is at its lower end at this cycle. As same table shows quality statistics of standard model, we found that negative value of logarithm is maximum possible function of current model (-2LL = 25,926), which is less than negative of Lg. maximum possible function of model containing constant only (=44,584) indicates quality of model containing all variables.

Table 4 :Iterations history

Iteration	-2log likelihood	Coefficients										
		Constant	Kaopen	Inf	Croiss	export	liquid	Termch	txch	Tcb	m2rerv	
Etape 1	1	32,189	-3,448	-,699	,075	-,022	-,111	,048	,000	,038	-,007	,041
	2	27,588	-6,178	-1,571	,130	-,047	-,196	,087	,000	,072	-,018	,056
	3	26,252	-8,557	-2,243	,172	-,082	-,250	,116	,000	,099	-,028	,094
	4	25,986	-9,910	-2,541	,194	-,106	-,273	,131	,000	,114	-,033	,119
	5	25,942	-10,182	-2,590	,199	-,110	-,278	,134	,000	,117	-,034	,123
	6	25,929	-10,186	-2,591	,199	-,110	-,279	,134	,000	,117	-,034	,123
	7	25,926	-10,182	-2,591	,199	-,110	-,279	,134	,000	,117	-,034	,123
	8	25,926	-10,179	-2,590	,199	-,110	-,279	,134	,000	,117	-,034	,123
	9	25,926	-10,178	-2,590	,199	-,110	-,279	,134	,000	,117	-,034	,123

Source: by authors, adapted from SPSS.

Model Quality Tests: Table 5 shows that value of $X^2 = 18,659$, which is significant at level of α , is less than 0.05 and 0.10 where (sig = 0,028). This confirms significance of whole model for DDL = 9 which is number of variables explained for model.

Table 5 :Model specification tests

		Khi- two	ddl	Sig.
Step 1	Step	18,659	9	,028
	Bloc	18,659	9	,028
	Model	18,659	9	,028

Source: by authors, adapted from SPSS.

Testing Explanatory Power of Model:

In logistic model, Nagelkerke statistic and Cox & Snell statistic are used to test explanatory power of model. Cox & Snell statistic is a measure of improvement in geometrical mean square for each view. Given its value in current model, it represents 0.543. Also, response was explained by explanatory variables in logistic regression model as shown in Table 6.

Table 6 : Summary of models.

Step	-2log likelihood	R-two of Cox & Snell	R-two of Nagelkerke
1	25,926	,346	,543

Source: by authors, adapted from SPSS.

Table 7 summarizes parameters of optimal model obtained in ninth cycle of Table 4. Here, column A contains attached model parameters in log-adds.

Table 7 :Variables in equation

		A	E.S.	Wald	ddl	Sig.	Exp(B)
Step 1	Kaopen	-2,590	3,183	,662	1	,416	,075
	Inf	,199	,092	4,653	1	,031	1,220
	Croiss	-,110	,185	,353	1	,552	,896
	export	-,279	,169	2,735	1	,098	,756
	Liquid	,134	,090	2,210	1	,137	1,144
	termch	,000	,000	,147	1	,701	1,000
	Txch	,117	,059	3,969	1	,046	1,124
	Tcb	-,034	,061	,319	1	,572	,966
	m2rerv	,123	,359	,118	1	,731	1,131
Constant		-10,178	8,169	1,552	1	,213	,000

Source: by authors, adapted from SPSS

Thus, regression equation for this model is written as follows:

$$\log\left(\frac{p^{\wedge}}{1 - P^{\wedge}}\right) = -10,178 - 2,590Kaopen + 0,199Inf - 0,110Croiss - 0,279Export + 0,134Liquid + 0,000termch + 0,117Txch - 0,034Tcb + 0,123M2resrv$$

From Table 7, we note that estimated value of Kaopen variable, which represents external financial liberalization, is negative (-2,590). Also, index of its wald (0.662) is at a significant level equal to (sig = 0,146). This is greater than specified level as opined by researcher, making index of external financial liberalization insignificant. Consequently, this can be explained by fact that some of literature stated that external financial liberalization has nothing to do with banking crisis, especially since Algeria has not only managed internal financial liberalization through enactment of appropriate laws and liberalization of loans, but absence of liberalization of capital account and lack of activity in financial market. There are other reasons that could lead to banking crisis. For variable Inf, which represents inflation, we noted that it came first in terms of level of morale (sig = 0,031) and index of wald (equal to 4,653) indicates high morale of estimated parameter. This indicator indicates that inflation is a very influential factor in banking crisis. Furthermore, increase in independent variable inf in one unit will increase logarithm of weighting coefficient by having dependent variable equal (y = 1) by (0,199) once in logarithm of dependent variable with stability of effect of other variables according to .(McKinnon & Pill, 1998, pp. 1267-1282), (Sundarajan, V, 1996, pp. 1-36), and(Galbis, V., 1994, pp. 1-27)).

variable, Txch, which represents rate of exchange rate, ranked second in terms of level of significance (sin = 0.046). Thus, this variable has a strong impact on crisis, and this is logical because economies, especially those that rely heavily on imports such as Algeria are affected by exchange rate fluctuations. As for export index, it is significant at 10% where (sig = 0.098) at a census of 2,735. However, this means that a decrease in value of exports by (-0.279) will increase logarithm of weighting factor for bank to

experience crisis. ratio of exp (b) to parameter means that if independent variable falls, rate of change in probability of a bank crisis is 0.756. This explains that Algerian economy is very dependent on hydrocarbon revenues as a resource for economy. Therefore, any drop in prices will result inevitably to a decline in imports of foreign currency, which will lead to total instability and destabilization of banking system.

Although value of parameter for variable *croiss* is small, relative level of wald is insignificant (sig = 0,552), i.e., growth variable has no significant effect on model. Same for liquidity variable where (sig=0,137) is higher than level specified by researcher. Also, *termch* is purchasing power of imported goods and services which is not significant in our model (sig = 0.701). This can be explained by fact that except for inflation, macroeconomic variables do not directly affect occurrence of banking crisis in Algeria. However, drain results from excess of export revenues of fuel. For bank variables, also variable *tcb*, total loans to private sector, which measures degree of internal financial liberalization, is treated as negative. This is illogical because increase in granting of loans will pay to high risk and thus increases risk of non-payment which results to crisis. At same time, there was no significant statistical difference (sig = 0,572). This can be explained by lack of loans for effective projects size and creative value added to economy.

In addition to focus on granting consumer loans and private loans subsidized by state in framework of special programs, latest internal financial liberalization has no influence on occurrence of banking crisis in Algeria. *M2 / reserve* variable, which is sum of money and quasi-money on bank reserves, is positive and insignificant (sig = 0.739). In theory, increase in this index leads to fragility of banking system and its high impact on external shocks. Nevertheless, excess of liquidity that characterizes Algerian banks enables them to face shocks.

Conclusion :

With regards to possibility of a banking crisis in Algeria, we have found through logistic regression model (1970-2018) ,that inflation rate, exchange rate, and fuel exports have a very significant impact on occurrence of crises in Algeria. On other hand, internal liberalization by granting loans or external financial liberalization through liberalization of financial market and capital account has no impact on crisis. Consequently, this corresponds to some of theoretical and empirical studies mentioned above which shows some set of specific conditions for developing countries to achieve an effective financial liberalization policy (Angkinand , Swangngoenyuan , & Wihlborg , 2010, pp. 263-298), like a macroeconomic stability and favorable legal framework. Countries with high inflation and interest rates reduce investment opportunities. Loans are directed towards unproductive and non-value added investments that negatively affect banking system, and that also increases probability of a banking crisis.

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