The Determinants of Commercial Banks' Liquidity in Algeria: A Panel Data Analysis 2010-2020

محددات السيولة على مستوى البنوك التجارية في الجزائر: تحليل بيانات بانل 2010–2020

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Abstract:

This paper aims to identify the determinants of liquidity of Algerian banks. By means of a panel data analysis, we used data from all commercial banks operating in Algeria (20 banks: 6 public and 14 private) during the period 2010-2020. We tested the impact of some internal characteristics of these banks and some macroeconomic indicators on the liquidity of Algerian banks, we used as a proxy of liquidity the ratio: liquid assets/total assets. The results of this study indicate that capital adequacy, deposits, GDP growth rate and lending rate affect positively and significantly the liquidity of Algerian banks, while credits, size, asset quality and operational efficiency influence negatively Banks' liquidity. For ownership bank, the results show that private banks have higher liquidity ratios than public banks. Regarding the oil shock and the profitability of the bank, they have insignificant impact on the liquidity.

Key words: *Liquidity, Algerian commercial banks, internal factors, external factors, Panel data.*

ملخص:

تهدف هذه الورقة إلى التعرف على محددات السيولة على مستوى البنوك التجارية في الجزائر و ذلك بالاعتماد على تحليل بيانات بانل المتعلقة بجميع البنوك التجارية العاملة في الجزائر (20 بنكًا: 6 عموميا و 14 خاصًا) خلال الفترة 2010-2020. اختبرنا تأثير بعض الخصائص الداخلية لهذه البنوك و كذا بعض مؤشرات الاقتصاد الكلي على سيولة البنوك التجارية الجزائرية ، حيث استخدمنا كمقياس للسيولة نسبة: الأصول السائلة إلى إجمالي الاصول. تشير نتائج هذه الدراسة إلى أن كفاية رأس المال، الودائع، معدل الإقراض و معدل نمو الناتج المحلي الإجمالي تؤثر بشكل إيجابي و ذو معنوية على سيولة البنوك الجزائرية ، بينما تؤثر الائتمانات الممنوحة، حجم البنك ، جودة الأصول و الكفاءة التشغيلية سلباً على سيولة البنوك. أما بالنسبة لملكية البنك ، فقد بينت النتائج ان معدلات سيولة البنوك الخاصة اعلى من البنوك العمومية. أما فيما يخص الصدمة النفطية و ربحية البنك ، فإن ليس لهما تأثير ذو معنوية على السيولة.

الكلمات المفتاحية: سيولة ، بنوك تجارية ، عوامل داخلية ، عوامل خارجية، بيانات بانل.

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1. INTRODUCTION

Banks have become one of the most vital components of any financial system. In Algeria, the banking sector is the main financing source of financing for the national economy due to the narrowness of the financial market. In such a situation, the presence of an efficient banking system : healthy, solid, dynamic, open and stable, is considered as a determining factor to favour the success of any development strategy.

The issue of banking sector stability has acquired considerable importance, as it is an objective of the financial authorities in all countries of the world. This stability in itself is a function of several parameters of the individual banks' health. One of the main reasons of why banks may not be healthy is the liquidity risk.

Liquidity is defined as the ability of commercial banks to fund increases in assets and meet their obligations as they come due without incurring unwanted losses Vodova (2013). The liquidity risk arises from the fundamental role of banks in transforming short-term resources into long-term credit that takes place in an environment of incomplete markets and asymmetric information.

Many works have shown the negative effects of liquidity risk. The Basel Committee (2009) explained that the viability of commercial banks depends on the liquidity position of the bank. Liquidity risk can negatively affect the performance and capital of banks (Drehmann & Nikolaou, 2009) . Under critical conditions, the lack of sufficient liquidity even leads to bank's bankruptcy. (Diamond & Dybvig, 1983) provide evidence of the importance of the bank's role in creating liquidity. They how that the optimal level of liquidity is strongly related to effective banking operations and that the poor liquidity management can lead to insolvency (in case of low liquidity) and low profitability (in case of high liquidity) and, ultimately, destroy shareholder value.

These negative effects have led us to investigate the main determinants of liquidity risk in order to mitigate its perverse effects. The identification of the major determinants of this financial risk has been the subject of several studies, which have not led to the same explanatory factors. These studies have assumed that bank liquidity depends on several bank-specific factors (such as the size of the bank, the level of profitability, the level of asset liquidity and the level of capitalization [CAR]...) as well as macro external factors (such as economic growth, interest rates, exchange rate volatility, monetary policy, inflation and unemployment rate....).

Regarding the Algerian context, the deficit of saving compared to investment has become structural since the oil shock of 2014. This situation has contributed to limit the role of banking intermediation in Algeria. Nevertheless, Algerian banks continue to give primacy to the granting of credit, despite the exhaustion of the key factors that have supported this traditional activity for a long time. In 2020, total loans represent on average almost 70% of total bank assets. This strong growth in loans, not followed by a proportional evolution of deposits, has generated, in recent years, the decline in the rate of coverage of loans by deposits, from 123% in 2013 to 104% in 2020.

Given the importance of liquidity in the functioning and survival of banks and the lack of consensus on the determinants of liquidity risk, the main objective of this research paper is to

identify the key determinants of Algerian banks' liquidity so that they can manage liquidity risk properly and avoid liquidity depletion and bankruptcy.

To achieve this objective, we used annual data for twenty banks representing the entire Algerian banking sector, observed over the period from 2010 to 2020, and we opted for a panel data analysis.

The rest of the paper is organized as follows. Section 2 presents a review of the literature on the determinants of bank liquidity and develops the research hypotheses. Section 3 presents some elements of the methodology used. The results obtained are presented and discussed in section 4 and are followed by a conclusion.

2. LITERATURE REVIEW

Several theoretical and empirical researches have been interested in identifying the determinants of bank liquidity. In this framework, two different determinants categories of bank liquidity have been observed: internal determinants (bank-specific factors) related to management decisions and financial statement ratios, and external determinants (macroeconomic factors) related to economic conditions.

2.1. Internal determinants of bank liquidity

According to the literature, several bank-specific determinants can be highlighted to explain liquidity in banks. However, their relationship with bank liquidity differs according to empirical studies. These determinants are mainly related to the financial behavior and structure of banks such as size, share of loans and deposits in total assets, asset quality, level of capital adequacy, profitability and operational efficiency.

2.1.1. Bank size

The relationship between bank size and liquidity has been hotly debated among researchers. According to the "too big to fail" hypothesis, the size of a bank can have a negative impact on its liquidity. (Lucchetta, 2007) indicates that banks that define themselves as "too big to fail" are therefore less motivated to hold higher liquidity ratios. Based on the same assumption (Choon, Hooi, Murthi, Yi, & Shven, 2013) consider that large banks profit to engage in high-risk activities. This made liquidity creation different from one bank to another and that depends on their size, which indeed results in both positive and negative relationship between bank size and bank liquidity. This is confirmed by (Deléchat, Henao, Muthoora, & Vtyurina, 2012)who found that liquidity increases with the size of the bank but there is a point at which the size of the bank starts to show a decreasing effect on liquidity.

In other cases, some large banks do not work to increase their liquidity level because they guarantee several types of financial assistance in case of financial difficulties. They consider themselves too big and they know that the government must protect them from a default that would negatively affect the economic and financial situation of the whole country (El-Chaarani, 2019) . This reasoning may explain the liquidity behavior of some large Algerian public banks.

Empirically, this negative impact of bank size on liquidity levels has been examined by many researchers. The study of (El-Chaarani, 2019) found that the size of banks, in the Middle East region, has a negative and significant impact on the level of liquidity because small banks have a liquid assets reserve while large banks rely on the interbank market and credit instruments. In addition, large banks have a professional business capacity to attract more customers and provide additional loans that reduce the liquidity level. Similarly, (Aldeen, Siswahto, Herianingrum, & Al Agawany, 2020), confirmed that there is a negative and significant impact between the bank size and its liquidity both in conventional banks and in Islamic banks in Syria. (Ben Moussa, 2015) studied the liquidity determinants of 18 banks in Tunisia, He also showed the existence of a negative and insignificant relationship between bank size and its liquidity.

Other researchers found that the size of the bank positively affects its liquidity level. . (Nguyen & Vo, 2021) examined the liquidity determinants of 17 commercial banks quoted on Vietnamese stock exchanges. They found that bank size has a positive impact on bank liquidity. They justified this relationship by the fact that commercial banks with large total assets will have the opportunity to diversify their investments, without focusing on credit. In this framework, commercial banks can invest in government bonds and derivative contracts on the stock market to increase convertibility and increase liquidity. In addition, quoted commercial banks have the advantage of having large-scale assets, for attracting a large number of customers to deposit or borrow money. From there, these commercial banks have the ability to select customers for loans to limit credit risk and increase bank liquidity.

(El Khoury, 2015) studied the determinants of liquidity of commercial banks in Lebanon. The results show that bank liquidity is positively related to bank size. This positive and statistically significant impact is consistent with the hypothesis that small banks focus more on traditional activities such as deposit to loan transformation (tend to hold few investment securities).

(Vodová, 2011) studied the factors affecting liquidity of 22 banks in the Czech Republic. According to this study, the relationship between bank size and its liquidity is ambiguous. This study recommends dividing banks into groups according to their size and estimating the determinants of liquidity separately for small, medium and large banks. This finding also confirmed by (Valla, Saes-Escorbiac, & Tiesset.M, 2006) their study examined liquidity within the French banking system; they found no clear relationship between bank size and its liquidity.

H1: The size of the bank has a negative impact on the bank's liquidity.

2.1.2. Capital adequacy

The capital adequacy ratio is an indicator of the level of capital in the banking sector. According to the risk absorption theory proposed by the research of (Diamond & Dybvig, 1983), (Allen & Gale, 2004) and (Repullo, 2004) a higher capital ratio will improve the ability of banks to absorb the risks associated with the creation of liquidity and thus increasing the ability of the bank to create more liquidity. On the other hand, a high level of capital improves the ability of banks to create liquidity. When a bank needs more liquidity, it usually results in a higher loss due to the disposal of illiquid assets. However, this can be avoided if the bank has a high level of capital to

provide the necessary liquidity

The positive impact of capital adequacy on liquidity was also confirmed by (Bonfim & Kim, 2012). For their part, (Berger & Bouwman, 2009)consider that the capital increase improves the bank's ability to create liquidity.

On the other hand, the financial fragility hypothesis predicts that capital increase reduces liquidity creation, according to (Diamond & Rajan, 2001)banks are forced to create liquidity by fragility, allowing depositors to withdraw when needed, while shielding borrowers from depositors' liquidity needs but stabilization policies, such as capital requirements can reduce liquidity creation. Similarly, (Heuvel, 2008) Confirms that the amount of assets a bank can hold by issuing deposits are constrained by higher capital requirements. Therefore, stricter regulations on capital requirements can be extremely costly for banks.

H2: Capital adequacy has a positive impact on bank's liquidity.

2.1.3. Deposits

Deposits are the main source of funding for a bank and the most important part of its liabilities. The results of the study of (Al□Homaidi E. A., Tabash, H. Farhan, & Almaqtari, 2019) showed the existence of a positive and significant impact of deposits on bank's liquidity. These results are consistent with the findings of (Singh & Sharma, 2016). While (Ben Moussa, 2015) revealed that there is a positive but insignificant effect of deposits on bank liquidity. (Diamond & Dybvig, 1983) postulate that the maturity transformation of short-term deposits into long-term loans makes banks inherently vulnerable to liquidity risk. Thus, the mismatch exposes and makes banks vulnerable to depositor confidence.

H3: Deposits have a positive impact on bank's liquidity.

2.1.4. Loans

This ratio indicates the share of loans in the bank's assets. The higher this ratio is, the worse the bank's liquidity is, because the bank is more vulnerable to liquidity risk (Vodová, 2011). Results from the work of (Tran, Nguyen, & Nguyen, 2019) and (Vu, 2012) indicate that the total loan to total capital ratio is inversely related to bank liquidity. Indeed, (Pilbeam, 2005) predicts that an increase in loan demand will lead to a decrease in liquid assets, resulting in a negative relationship between loan growth and bank's liquidity.

H4: Loans have a negative impact on bank's liquidity.

2.1.5. Asset quality

Asset quality is mainly the quality of granted loans. (Bloem & Gorter, 2001) consider that the increase in the level of non-performing loans[2] relative to total loans (asset quality ratio) will

[2]Regulation No. 14-03 of February 16, 2014 on the classification and provisioning of receivables and commitments by signature of banks and financial institutions considers classified receivables (non-performing) as receivables that present a probable risk of total or partial non-recovery, and / or receivables observing unpaid for more than three (03)

decrease depositors' confidence which will lead to large withdrawals and increase the liquidity problem. The study of (El-Chaarani, 2019) reveals that the accumulation of many bad loans decreases the value of assets, increases liquidity risks, and makes banks unable to meet their financial obligations. (Growe, De Bruine, Lee, & Maldonado, 2014)showed that a poor loan quality leads to a poor asset quality, and a poor asset quality leads to a low liquidity level.

Regarding empirical studies, (Tran, Nguyen, & Nguyen, 2019) found that the loan loss provision/total loans ratio is negatively related to the liquidity position of banks. This is similar to the results of the studies of (Valla, Saes-Escorbiac, & Tiesset.M, 2006), (Bunda & Desquilbet, 2008) and (Vodová, 2011)that they found that the ratio of provision for credit losses/total loans has a negative correlation with the liquidity status of the bank. . (Lucchetta, 2007) also found that non-performing loans as a proportion of gross loans have a negative impact on bank's liquidity.

H5: Asset quality has a negative impact on bank's liquidity.

2.1.6. Profitability

This is a general measure of the overall financial health of an institution over a given period of time. The results of the work of (Demirgüç-Kunt, Laeven, & Levine, 2003)showed that high liquid assets are related to lower net interest margins they also argued that highly liquid securities may receive lower interest income and thus there is a negative relationship with bank profitability. According to (Owolabi, Obiakor, & Okwu, 2011), (Valla, Saes-Escorbiac, & Tiesset.M, 2006) and (Rauch, Steffen, Hackethal, & Tyrrel, 2010) liquidity is negatively related to bank's profitability, meaning that more liquidity implies less profitability.

In contrast (Aspachs, Nier, & Tiesset, 2005) and (Vodová, 2011)found that profitability does not have a significant impact on liquidity. Furthermore (Bordeleau & Graham, 2010)suggest that profitability is improved for banks that hold liquid assets, however, there is a point at which holding additional liquid assets decreases a bank's profitability. Furthermore, this relationship varies depending on a bank's model and the state of the economy. They recommend that there is a trade-off between resilience to liquidity shocks and the cost of holding low-yielding liquid assets, as the latter can impact banks' ability to generate income, increase capital, and extend credit.

H6: Profitability has a negative impact on bank's liquidity.

2.1.7. Operational efficiency

In principle, operational efficiency can be defined as the ratio of total expenses to run a business operation to the total revenue earned by the firm. This ratio indicates how effectively a company can use its assets and revenues. For banks, this ratio is defined in terms of operating expenses and operating income. Operating efficiency measures the proportion of costs incurred during an economic or financial activity, a lower efficiency ratio means that a bank is operating better (Curaka & Poposk, 2012) (Rashid & Jabeen, 2016)reported that there is a negative

months. These receivables are classified according to their level of risk in three (03) categories: receivables with potential problems; very risky receivables; compromised receivables.

relationship between this ratio and banking performance. Regarding the impact of this ratio on bank liquidity (Ben Moussa, 2015) and (Al□Homaidi E. A., Tabash, H. Farhan, & Almaqtari, 2019)showed the existence of a negative and significant impact.

H7: Operational efficiency has a negative impact on the bank's liquidity

2.1.8. Ownership bank

Studies examining the relationship between ownership and liquidity risk are scant and the results found are mixed. Examining the lending behavior of public and private banks, (Brei & Schclarek, 2015) find that private banks' lending reduce to a greater extent than that of public banks because public banks have more access to additional funding and generally do not experience deposit withdrawal. (De Haas, Korniyenko, Pivovarsky, & Loukoianova, 2012) and (Cull & Peria, 2013) reach to the same conclusion. Distinguishing between foreign and local ownership, (Vazquez & Federico, 2015) indicate that small local banks are comparatively more exposed to liquidity risk during the financial crisis, than large foreign institutes that have better access to domestic capital markets and stable funding bases. (Duqi & Al-Tamimi, 2018) examined the impact of ownership nature on regulatory capital ratios and liquidity risk, the results imply that foreign and private ownership show a strong inclination for high capital levels, while the role of government investors in liquidity risk remains undecided.

H8: Ownership has an impact on the bank's liquidity.

2.2. External determinants of bank liquidity

In addition to the internal determinants of bank liquidity, this research also considers the external determinants of bank's liquidity, including macroeconomic factors. These determinants are mainly related to economic growth, the lending rate, and the 2014 oil shock.

2.2.1. Economic growth

Economic growth measures the ability of an economy to produce goods and services in each country and is considered one of the most important factors that can influence bank's liquidity. During economic growth, business activities expand and therefore the demand for loans increases. As a result, banks will have more opportunities to provide loans when they decrease their liquid assets. This can lead to a negative association between economic growth and liquidity (El-Chaarani, 2019)

According to (El Khoury, 2015), the business cycle affects banks' activities; the demand for loans is higher during expansion and lower during downturn. Therefore, in expansion, the number of profitable investments is higher, which encourages banks to lend more, resulting in fewer liquid assets. In this regard (Aspachs, Nier, & Tiesset, 2005) found that liquidity is negatively related to real GDP growth. (Valla, Saes-Escorbiac, & Tiesset.M, 2006) also revealed that liquidity is negatively related to the business cycle as measured by GDP.

H9: GDP growth has a negative impact on bank's liquidity.

2.2.2. The interest rate

Theoretically, higher lending rates encourage banks to lend more and hold fewer liquid assets. Therefore, the interest rate on loans has a negative relationship with liquidity. This relationship has been validated empirically by (Al□Homaidi E. A., Tabash, Farhan, H., & Almaqtari, 2019). However, the positive relationship is also confirmed in the presence of credit crunch and credit rationing, which is consistent with the results of (Bunda & Desquilbet, 2008) and (Vodová, 2011). (Tran, Nguyen, & Nguyen, 2019) pointed out that the higher the interest rate on long-term loans, the higher the bank's capacity against liquidity risk.

H10: The interest rate on loans has a negative impact on the bank's liquidity.

2.2.3. The oil shock

Many works have highlighted the impact of financial crises on bank's liquidity ((El Khoury, 2015) (Bunda & Desquilbet, 2008) (Vodová, 2011) (Choon, Hooi, Murthi, Yi, & Shven, 2013). However, there is a little work on the impact of non-financial shocks, particularly oil shocks, on bank's liquidity. Financial crises usually lead to poor bank liquidity because it affects banks in two different ways. First, the volatility of important macroeconomic variables adversely affects the business environment of banks. Second, the instability worsens the business environment of borrowers; this can worsen their ability to repay loans, which can lead to a decline in bank's liquidity (Vodová, 2011).

Regarding non-financial shocks, (Al-Khazali & Mirzaei, 2017) test the impact of oil shocks on non-performing loans (NPLs) of banks in oil exporting countries and, if so, whether the effect is homogeneous among banks. They find that negative oil price movements have a significant negative impact. Banks located in financially less developed countries and/or in debt economies are more vulnerable to oil shocks. Similarly, small banks seem to benefit more from positive shocks and large banks seem to lose more from negative shocks. These effects will certainly impact bank's liquidity.

The 2014 oil shock significantly influenced banking activity in Algeria. For all banks, the average annual growth rate of credits (deposits) of 22.74% (12.69%) during the period 2010-2014 decreased to 10.73% (5.20%) during the period 2015-20. Thus, we believe that oil shocks could have an impact on the liquidity of Algerian banks.

H11: Oil shocks have a negative impact on bank liquidity

3. METHODOLOGICAL APPROACH:

3.1 Sample and data collection:

Our study is based on a sample composed of all banks operating in Algeria (20 banks: 6 public and 14 private). In order to carry out this study, we used the financial statements (balance sheets and income statements) of these banks during the period 2010- 2020. These documents are collected from the National Center of the Trade Register (CNRC) and the banks' websites. Regarding the macroeconomic data, they are collected from the official website of the World Bank.

3.2 Measures of variables:

Before specifying our model, we will describe all the variables retained for the econometric analysis and indicate the studies that used the measures we retained.

3.2.1 The dependent variable:

Several proxies have been used to measure the liquidity of a bank. In this study, we chose the ratio of liquid assets to total assets. The higher this ratio, the better the bank's liquidity, as it means that banks hold more liquid assets relative to total assets. This measure has been used by (Munteanu, 2012) , (Horváth, Seidler, & Weill, 2014), (Cucinelli, 2014), (Ben Moussa, 2015), (Singh & Sharma, 2016), (Ghenimi, Chaibi, Omri, & B, 2017), (Tabash, 2018).

3.2.2 Explanatory variables:

The measures of the explanatory variables selected for the multivariate analysis and their sources are presented in the following table:

Table 1. Description of internal explanatory variables and data sources

Variables	Notation	Measure	Source
Capital adequacy	CAD	$\frac{\text{Equity capital}}{\text{Total assets}}$	(Munteanu, 2012), (Roman & Camelia, 2015), (Singh & Sharma, 2016),
Deposits	DEP	$\frac{\text{Deposits}}{\text{Total assets}}$	(Singh & Sharma, 2016), (Ben Moussa, 2015), (Rashid & Jabeen, 2016),
Loans	LOANS	$\frac{\text{Loans}}{\text{Total assets}}$	(Tran, Nguyen, & Nguyen, 2019) , (Vu, 2012)
Asset quality	AQ	$\frac{\text{Non performing loans}}{\text{Total loans}}$	(Tran, Nguyen, & Nguyen, 2019) (Valla, Saes-Escorbiac, & Tiesset.M, 2006)
Profitability	ROA	$\frac{\text{Net income}}{\text{Total assets}}$	(Vodová, 2011) (El Khoury, 2015) (Ben Moussa, 2015).
Size	Size	Ln (Total assets)	(Vodová, 2011) (El Khoury, 2015) (Ben Moussa, 2015).
Operational efficiency	OPEF	$\frac{\text{General operating expenses}}{\text{Total assets}}$	(Rashid & Jabeen, 2016)
Ownership	OWN	A dichotomous variable that takes the value 1 if the bank is private and 0 if the bank is public.	(Duqi & Al-Tamimi, 2018) (Vazquez & Federico, 2015)

Source: Developed by authors.

Table 2. Description of macroeconomic variables and data sources

Variables	Notation	Measure	Source
Economic growth	GDP	The real annual growth rate of GDP	(Bordeleau & Graham, 2010), (Vodová, 2011), (El Khoury, 2015)
Interest rate	INTRT	The real lending rate	(Ongore & Kusa, 2013) (2013), (Perera & Wickramanayake, 2016)
Oilshock	OIL	A dichotomous variable that takes the value 1 for years in the period after the 2014 oil shock and 0 for the period before.	Proposed by the authors on the basis of studies on financial crises

Source: Developed by authors.

3.3 Model specification:

In order to test the hypotheses of our research and identify the factors that can explain the liquidity of Algerian banks, we opted for the panel data regression method. Our panel is composed of 200 bank-year observations. The model to be estimated is specified as follows:

$$LIQ_{it} = \beta_0 + \beta_1 CAD_{it} + \beta_2 DEP_{it} + \beta_3 Loans_{it} + \beta_4 AQ_{it} + \beta_5 PROF_{it} + \beta_6 SIZE_{it} + \beta_7 OPEF_{it} + \beta_8 OWN_{it} + \beta_9 GDP_{it} + \beta_{10} INTRT_{it} + \beta_{11} OIL_{it} + \epsilon_{it}$$

3.4. Descriptive statistics

In this section, we will first present some descriptive statistics related to the variable to be explained and the internal explanatory variables, making a distinction between public and private banks.

Table 3. Descriptive statistics of the variable to be explained and the internal explanatory variables

		LIQ	CAD	DEP	LOANS	AQ	ROA	SIZE	OPEF
Public banks	**MIN**	0,0405953	0,0492323	0,6285576	0,1835629	0,068253	0,0002189	26,64418	0,0039485
	MAX	0,2399561	0,1984247	0,9279415	0,7803558	0,34051	0,0232842	28,88149	0,0175566
	MEAN	0,1340826	0,10492	0,8161111	0,5474012	0,1647237	0,0097422	28,04391	0,0099883
	SD	0,0478897	0,0337454	0,0801565	0,1376835	0,0621585	0,0061848	0,532388	0,0038754
Private banks	**MIN**	0,0717539	0,0956621	0,1102862	0,012563	0	-0,0082509	23,2324	-0,0126506
	MAX	0,9248755	0,8544943	0,8320801	0,786916	0,447949	0,0658311	26,70476	0,0520356
	MEAN	0,2947485	0,260097	0,6234478	0,509951	0,0619	0,0234467	25,17445	0,021218
	SD	0,1611636	0,1477195	0,1482855	0,1338612	0,0705798	0,0105156	0,8349932	0,0077979
All banks	**MIN**	0,0405953	0,0492323	0,1102862	0,012563	0	-0,0082509	23,2324	-0,0126506
	MAX	0,9248755	0,8544943	0,9279415	0,786916	0,447949	0,0658311	28,88149	0,0520356
	MEAN	0,2465487	0,2133313	0,6812468	0,5211861	0,0927471	0,0193354	26,03529	0,0178491
	SD	0,1557957	0,143692	0,1584282	0,1357974	0,0828094	0,0113237	1,519281	0,0085757

Source: Based on statistical processing by the STATA 11 software.

The table above indicates that the liquidity of Algerian banks varies around an average of 24.65%, with a relatively high level of dispersion (15.57%). By introducing the distinction according to the nature of ownership of the bank, we find that the average liquidity of private banks (29.47%) is significantly higher than that of public banks (13.40%). The t-test indicates that this difference is significant ($p = 0.0000 < 5\%$). The standard deviations recorded for the LIQ variable for the two subgroups are different; 4.78% for public banks versus 16.11% for private banks; this means that there is more dispersion in liquidity within private banks than public banks.

Regarding the independent variables, the table above shows that the variables: capital adequacy, deposits, credits, asset quality and size show high dispersion while the variable operational efficiency and profitability show relatively close values. The table above also shows that the characteristics of public banks differ significantly from those of private banks. On average, public banks are much larger[3], they have larger shares of loans and deposits in total assets, they have also lower capital adequacy ratios, and they have bad assets quality. The t-statistics show significant differences in means in favor of public banks for the variables: Size, Asset Quality, Deposits and Loans, while they show significant differences in means in favor of private banks for the variables: Capital Adequacy, Profitability and Operational Efficiency. The standard deviations recorded for all explanatory variables for private banks are higher compared to those of public banks except for the variable asset quality.

The following table summarizes the descriptive statistics of the external explanatory variables retained for the entire sample:

Table 4. Descriptive statistics of external explanatory variables

	Min	Max	Mean	SD
GDP	-5,1%	3,80%	1,97%	2,45%
INTRT	-8,65%	15,45%	4,40%	7,43%

Source: Based on statistical processing by the STATA 11 software.

These statistics indicate that the average real GDP growth rate in Algeria is 1.97% during the period 2010-2020. Since the oil shock of 2014, GDP growth in Algeria has slowed significantly from 3.8% in 2014 to -5,1% in 2020. This situation confirms once again the increased dependence of the Algerian economy on hydrocarbons and the absence of a serious alternative that could reduce the loss in terms of growth. As for the real interest rate, it recorded an average rate of 4.40% during the period in question with a relatively high level of dispersion.

In order to examine the relationship between the selected variables and to test the existence of the multicollinearity problem, we calculated the correlation coefficients:

[3] The average size of public banks is more than 17 times the average size of private banks.

Table 5. The correlation matrix

	LIQ	CAD	DEP	LOANS	AQ	ROA	OPEF	SIZE	OWN	GDP	INTRT	OIL
LIQ	1.0000											
CAD	0.3557*	1.0000										
DEP	-0.3570*	-0.7692*	1.0000									
LOANS	-0.4516*	-0.2135*	0.1769*	1.0000								
AQ	-0.3933*	-0.3996*	0.4436*	0.1314	1.0000							
ROA	0.2049*	0.4392*	-0.4886*	-0.0287	-0.3665*	1.0000						
OPEF	0.0957	0.4945*	-0.4772*	0.1552*	-0.3566*	0.2325*	1.0000					
SIZE	-0.4606*	-0.7776*	0.7782*	0.2141*	0.5610*	-0.5597*	-0.6591*	1.0000				
OWN	0.4737*	0.4967*	-0.5586*	-0.1267	-0.5703*	0.5559*	0.6015*	-0.8675*	1.0000			
GDP	0.0704	0.0531	-0.0871	-0.2025*	-0.1044	0.1625*	0.0537	-0.1168	0.0000	1.0000		
INTRT	0.0209	-0.0969	0.1504*	0.2340*	0.0432	-0.1768*	-0.0893	0.1260	-0.0000	-0.3678*	1.0000	
OIL	-0.0843	-0.0961	0.1511*	0.4064*	0.1035	-0.2940*	-0.0385	0.1532*	0.0000	-0.4937*	0.5109*	1.0000

(*): Refers to the 5% level of significance.

Source: Based on statistical processing by the STATA 11 software.

The correlation matrix above indicates that liquidity is negatively and significantly correlated with deposits, loans, asset quality and size and it is positively and significantly correlated with bank profitability measured by ROA and capital adequacy, it also indicates that there are significant correlations, positive or negative, between some explanatory variables. The highest correlation coefficients are those linking ownership with size (-86,75%). In order to ensure the absence of the multicollinearity problem, an additional examination of the VIF coefficients and tolerance was performed[4].

Table 6. Results of the VIF test

Variable	VIF	1/VIF
SIZE	14.94	0.066918
OWN	9.20	0.108663
CAD	7.04	0.142119
DEP	4.83	0.207209
OPEF	2.58	0.386864
ROA	2.26	0.442012
CHOC	2.24	0.446943
LOANS	1.84	0.544920
AQ	1.56	0.640704
INTRT	1.44	0.696116
GDP	1.40	0.716361
Mean VIF	4.48	

Source: Based on statistical processing by the STATA 11 software.

[4]According to (Evrard, Pras, & Roux 2003), a VIF lower than 10 and a tolerance higher than 0.1 allow to conclude that there is no multicollinearity.

The table above shows that the VIF of the variable SIZE is above 10, which shows that multicollinearity is a serious problem in this model. This is due to the strong correlation between size and ownership. This collinearity can cause concern in the interpretation of the regression coefficients of independent variables. In such a situation, the most generally adopted solution consists in deleting all the explanatory variables responsible for the multicollinearity or else having them introduced one by one to avoid this kind of problem. In this study, the solution adopted consists in introducing the explanatory variables responsible for multicollinearity (size and ownership) separately in two models to avoid this kind of problem.[5]

4. RESULTS AND DISCUSSION:

In panel data regressions, it is necessary to follow certain econometric steps. The first step is to check the homogeneous or heterogeneous specification of the data generating process (Doucouré 2008). The Fisher test is used to verify the overall homogeneity of the model. The results of this test indicate that the probability of the calculated Fisher statistic is less than 1% (Prob> F = 0.0000) for both models. Therefore, the H0 hypothesis will be rejected[6], and the specific effect model (fixed or random) is more appropriate. In order to distinguish between the fixed and random effect model, we used the Hausman specification test. The results of this test indicate that the Chi2 probability is greater than 5% (Prob>chi2 = 0.1118), which confirms the existence of a random individual effect for both models. We also performed the Breusch-Pagan Lagrangian Multiplier test for random effects to confirm this result. The results of this test indicate the existence of individual effects (Prob>chi2=0.000), so we retain the random effects model for the estimation of our models.

Then, in order to test the presence of autocorrelation of errors, we proceeded with the autocorrelation test of (Wooldridge 2002) whose null hypothesis is the absence of autocorrelation of errors. The results of this test indicate the existence of serial autocorrelation (Prob> F = 0.0008 less than 5%) for both models . Finally, we tested for the presence of heteroscedasticity by following the necessary steps using the STATA software. In the context of a heteroscedasticity test, the null hypothesis is homoscedasticity. The results of this test confirm the presence of heteroscedasticity (Prob> chi2 is less than 5%) for both models. Therefore, we used the PCSE (Panel-Corrected Standard Errors) method to estimate our model. This method takes into account the presence of these two statistical problems and allows for correction. It provides unbiased coefficients especially for the micro-panels (Beck & Katz 1996)[7]. The regression results after correction for both models are presented in the following table:

[5] We will use the letters A and B to distinguish between models.
[6] The null hypothesis of this test is that the coefficients of the variables are not different from zero.
[7]The estimation of the same model with the FGLS (FeasibleGeneralized Least Squares) method gives the same results with the exception of the variables: GDP growth and lending rate which lose their significance.

Table 7. Regression results

Variables	Notation	Model A Coef.	Model B Coef.	Expected sign
Capital adequacy	CAD	0.2460365 0.000***	0.1371933 0.016*	+
Deposits	DEP	0.1737368 0.004***	0.1660873 0.008***	+
Loans	Loans	-0.7934187 0.000***	-0. 8222583 0.000***	-
Asset quality	AQ	-0.34106 0.000***	-0.3961101 0.000***	-
Profitability	ROA	- 0.6237092 0.230	0,1305144 0.816	-
Operational efficiency	OPEF	- 2.353648 0.001***	-1.661783 0.015**	-
Ownership	OWN	0.0840211 0.001***		+/-
Size	SIZE		-0.0211738 0.002***	+
Economic growth	GDP	0.2694897 0.012**	0.1796784 0.129	-
Lending rates	INTRT	0.0909222 0.013**	0.1107135 0.005***	-
Oil shock	OIL	-0.0091543 0.197	0.0017967 0.802	-
	_cons	0.5961885 0.000***	1.225775 0.000***	

*** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level

Source: from statistical processing by STATA 11 software.

The results of the Wald Chi2 test of overall significance indicate that the explanatory power of both models is satisfactory (Prob> chi2 = 0.0000).

The results indicate that capital adequacy has a positive and significant impact on the liquidity of Algerian banks, this confirms hypothesis (2) which states that a higher capital ratio improves the ability of banks to absorb the risks associated with the creation of liquidity. Thus, a high level of equity increases the bank's ability to create more liquidity. This result is consistent with those obtained by (Diamond & Dybvig, 1983), (Allen & Gale, 2004) , (Repullo, 2004) and (Berger & Bouwman, 2009).

As expected, deposits significantly and positively affect the liquidity of banks, this can be explained by the fact that liquidity problems occur when deposits in banks are withdrawn unexpectedly and to counter such situations, banks must hold adequate levels of liquidity. Thus, it can be said that if deposits increase, the liquidity held by banks should also increase. This result is consistent with Singh and Sharma (2016)

The results also indicate the existence of a negative and significant relationship between credits and bank liquidity. This confirms hypothesis (4) which states that the higher this ratio is, the worse the bank's liquidity is as the bank is more vulnerable to liquidity risk. This result is consistent with those obtained by (Vodová, 2011) , (Tran, Nguyen, & Nguyen, 2019), (Vu, 2012) and (Pilbeam, 2005).

Asset Quality, measured by the share of non-performing loans in total loans, negatively and

significantly affects the liquidity of banks, this confirms the hypothesis (5) that the accumulation of many bad loans decreases the value of assets, increases liquidity risks and makes banks unable to meet their financial obligations. This result is consistent with those of (Bloem & Gorter, 2001) , (El-Chaarani, 2019)and (Growe, De Bruine, Lee, & Maldonado, 2014) who show in their study that poor loan quality leads to poor asset quality, and the latter leads to low liquidity.

Our results (Model B) also show that the larger the size of the bank, the lower the bank liquidity. Our hypothesis (H1) states that large banks hold more liquidity than small banks and thus it is rejected. This result is confirmed by the estimation findings of model A which indicates that the variable "ownership" has a positive impact on the liquidity of Algerian banks (H8 is confirmed) . This means that public banks which are large in terms of size have lower liquidity ratios than private banks which are small compared to public banks. We explain this result by the fact that a large part of the financing of the national economy is provided by public banks that are much larger than private banks. The activity of public banks is focused much more on credits and the support of the programs engaged by the public authorities what reduce the level of liquidity at the public banks compared to the private ones. Public banks acquire the inherent ability to mobilize large numbers of deposits with less difficulty and are, therefore, able to grant more loans at any time.

As for operational efficiency, the table above indicates that it is negatively and significantly related to liquidity. The higher the general operating expenses, the lower the bank's liquidity hypothesis (7) is therefore confirmed. This result is consistent with those of (Ben Moussa, 2015) (Al□Homaidi E. A., Tabash, H. Farhan, & Almaqtari, 2019). The results of this study also indicate that Bank's profitability measured by ROA has an insignificant impact on liquidity.

Regarding the lending rate, the results indicate that it positively and significantly affects the bank liquidity. This result is not consistent with financial theory, which states that higher lending rates encourage banks to focus more on lending activities and, as a result, the share of liquid assets decreases. This result can be explained by the idea that presumes that a high interest rate leads to a decrease in the demand for credit from firms, which encourages banks to hold more liquidity. This result is consistent with those of ((Bunda & Desquilbet, 2008) and (Vodová, 2011). (Tran, Nguyen, & Nguyen, 2019)who indicate that the higher the interest rate on long-term loans, the higher the bank's capacity against liquidity risk.

The level of economic growth influences positively and significantly Algerian banks' liquidity (model A). This result contradicts the idea put forward by (El Khoury, 2015) that the business cycle affects banks' activities; the demand for loans is higher in expansion periods and lower in downturns. Therefore, in expansion, the number of profitable investments is higher, which encourages banks to lend more, resulting in fewer liquid assets. Thus, the hypothesis regarding GDP growth (H9) is not verified. The results of this study indicate also that the oil shock of 2014 has an insignificant impact on Algerian banks' liquidity.

5. CONCLUSION

This article aimed to identify the factors that determine the liquidity of Algerian banks from panel data from all banks operating in Algeria over the period 2010-2020. The ratio between liquid assets and total assets is used as a proxy for bank's liquidity. This ratio is explained by a set of internal variables (size, capital adequacy, deposits, credits, profitability, ownership, operational efficiency, asset quality) and external variables (GDP growth rate, lending rate, oil shock).

The results of our study indicate that capital adequacy and deposits positively and significantly affect the liquidity of Algerian banks, these results confirm our hypotheses. Contrary to our expectations, the lending rate and GDP growth positively affect the liquidity of Algerian banks. The impact lending rate can be explained by the low demand for credit that could experience the bank

following an increase in interest rates, this will increase liquidity in banks, while the positive impact of GDP growth rate can be explained by the fact that during expansion periods, companies, especially oil companies, generate surpluses that can be placed at banks, which results an increase of banks' liquidity

In line with the majority of previous studies, we found that the credit, size, asset quality and operational efficiency negatively influence the liquidity of Algerian banks. Regarding the effect of the profitability and oil shock on bank's liquidity, it is not significant.

The Bank of Algeria and the regulators must carefully monitor and control the factors that reduce the liquidity of Algerian banks and ensure that the banking market is properly regulated. In addition, they need to monitor banks during times of economic growth, especially the largest banks as they need more liquidity. On the other hand, the periods of crises and shocks should be given special attention because of their negative consequences on bank's liquidity.

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