Could Basel Regulatory Framework Have Saved Lebanese Banks?

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Abstract

This paper aims to enhance in-depth analysis of the impact of various risks: credit risk, interest rate risk, market risk and liquidity risk as well as the volume of activity on the capital adequacy ratio of the Lebanese banks. It is confined to 31 banks out of the 63 banks operating in Lebanon, non-probability sample, during the period 2012-2018 using the regression analysis. The findings indicate that all the independent variables have a negative impact on banks’ solvency; while the liquidity risk has a positive effect, the market risk and the volume of activity variables have no significant relationship with the solvency of banks. Meanwhile, credit risk has proven its largest and most important role in the ability to reduce or increase the Lebanese banks’ solvency. But banks still have to respect a liquidity ratio, which is confirmed by the Basel III agreements. The originality of this study comes from the particularity of Lebanese banks for its core role in the Lebanese economy. This research is the first attempt that models the relationship between the above stated variables and the capital adequacy ratio; especially in the pre-crisis period, that Lebanon went through, which immediately led to the liquidity shortage crisis.

JEL codes: G01, G21, G32, G38

Keywords; Banking system, banking risks, capital adequacy, prudential regulation
INTRODUCTION

In finance, the risk logic is inevitable throughout the business world. Indeed, the context of global economic crises that erupted in 1974 and the context of deregulation that increasingly developed in the late 1980s were a major reason for continued increase in risks faced by banks (Kroszner et al., 2014). For this reason, a group of central banks associated with a number of major international countries met in Basel to form a Basel committee on banking supervision as its key role. Hence the Cooke ratio, a solvency ratio, was constituted, representing a real revolution in terms of risk and capital requirements (Cieply, 2018). However, with the emergence of financial innovations, the need for regulatory changes is essential in the face of this recent financial dynamic. Therefore, a new Basel II reform is baptized, which reinforces the initial agreement, without changing its spirit. However, this new reform did not prevent the collapse of the housing bubble in 2007; thus, the crisis highlighted the shortcomings of the new Basel Committee agreements which forced the international authorities to discuss a new agreement for more reinforcements (Haloui, 2021).

The determinants that affect the resilience of banks are categorized into internal and external factors. The current research will examine the internal factors, which are influenced by individual decisions and banks’ directives, and which have been revealed in the differences in banks’ evaluation of risk-weighted assets, including their solvency’s evaluation.

The research aims to empirically examine the variables that influence the banks’ resilience in Lebanon through the study period (2012-2018). It intends to test the theories related to solvency determinants.

This study tries to boost the improvements in current research, through analyzing the solvency determinants of banks in Lebanon, using up-to-date published data related to these banks. However, the determinants of bank endurance and its effects on financial system stability differ from country to country; national bank supervisors therefore wish to understand these determinants. Within this framework, the originality of our study is to examine the compliance of Lebanese banks on Basel requirements.

LITERATURE REVIEW

In an effort to discover whether effective risk assessment, in line with prudential regulations, affects the solvency and thus the resilience of
Lebanese banks, our previous literature addresses the concepts of banking risk, reviews the basics of the Basel Accords, as well as techniques for risk assessment and key indicators for developing regulatory reforms. Thus, it seems interesting to discuss the decisions and reforms proposed by the Central Bank to protect the banking sector, and in particular to maintain the level of banks’ solvency operating in Lebanon.

**Basel Cushion to Maintain Banking Solvency**

Historically, banks’ activity had been deemed as "special" since the bank is the only institution legally authorized to collect deposits from the public used as means of payment. The reasoning can be presented as follows: on one hand, the bank is the only institution whose collapse would have a direct effect on households. And consequently, the protection of the saver is the essential counterpart of the right given to the banks to collect these savings. On the other hand, as banks use household savings to provide liquidity or even credit lines, the security of banking transactions has become a necessary factor for the stability of the global economy. (Dietsch, 1991).

The hypotheses adopted revolve around these two characteristics, notably that the liquidity of savings and the illiquidity of credits, aggravate the risk of bank insolvency. Therefore, the business of the bank is fraught with risk as serious disasters are possible with the worst potential consequences. In modern financial theory, banking regulations have tried to protect depositors and thus the economy, and have introduced the first prudential ratio, solvency ratio, which was implemented for the first time in Belgium, reporting the contribution of equity to the amount of savings collected; since the capital constitutes an ultimate means to absorb losses and thus limit bank failures. It is clear, therefore, that the long-term mission of prudential regulations is to maintain confidence in the banks’ solvency, which especially stimulates economic growth (Agénor, Gambacorta, & Kharroubi, 2018), ensuring the stability of the financial system and improving the contribution of bank capital, which tended to decline due to banking globalization. Therefore, prudential banking regulations must establish equity, solvency, financial stability and above all efficiency of the whole financial system.

The "Cooke ratio", named for Peter Cooke, a director of a Bank in England and who was the first chairman of the Basel Committee (1977 to 1988), dealt exclusively with credit risk, and was considered the critical
threat to the bank (Bronchain et al., 2016). The weaker a bank’s capital towards its customer receivables, the greater the credit risk and the greater the bank’s tendency to not be over-liquid and therefore non-performing (Greuning & Bratanovic, 2004) with the idea that the capital cannot even pay off the possible default. Therefore, bank management must take the utmost care in identifying the type and degree of its risk exposure and tackling it effectively. However, this prudential regulation cannot eliminate all risks to which the bank is exposed since the latter must take risks in order to make profits; but excessive risk-taking must at least be prevented.

Advances in risk management and measurement, and changes in the way banks do business led to the development of Basel II, the second capital agreement. In September 1998, the Basel Committee worked on a revision of the Basel I accord and revealed its intention to replace it with more flexible rules. Hence a new reform of Basel II is called, which reinforces the initial agreement, without ever changing its spirit. However, this new reform did not prevent the real estate bubble from bursting in 2007 and consequently the crisis highlighted the shortcomings of the new agreements of the Basel Committee, forcing international authorities to discuss a new agreement for further reinforcements.

Moreover, the bankruptcy of Lehman Brothers on September 5, 2008, showed how the default of a large institution, given its interconnections with many other institutions, could put the entire banking system at risk. To evade the renewal of such flow, the Basel Committee has provided for the constitution of a scale for imposing an additional capital requirement that are not related to the size of the bank, but also other elements that are more or less linked to others, such as its degree of interdependence with other institutions, its international presence, its transnational organization, and the difficulties that institutions face to assume responsibility in the event of default. Thus, this crisis brought to light the problem of risks taking by the bank (Borio & Zhu, 2012), i.e. the borrower’s inability to pay the interest due or to repay the principal according to the terms specified in the credit agreement (Hersugondo et al., 2021). US banks extended a large volume of housing loans to households that did not have adequate repayment capacity. This excessive risk-taking by banks led to the birth of Basel III (Ashraf et al., 2016). Within the limits of the capital context, the agreement aims to improve the quality and level of regulatory capital by improving the definition of capital, in addition to the introduction of a “standard liquidity
ratio” (LCR & NSFR), which represents one of the strongest measures of the new Basel III regulatory framework (Garba, 2016). Hence, the minimum solvency ratio was passed from 8% to 10.5%, as well as the need to add an additional capital reserve intended for so-called systemic banks. SIFI, the systemic ratio thus created, must vary between 1 and 2.5% of the capital in the strict sense of Tier 1. Thus, with the inclusion of systemic risk, the Basel III agreements have supplemented their micro prudential dimension with an essential macro prudential dimension (Buzelay, 2012), with the aim of strengthening the banking systems resilience to shocks, as well as reducing the likelihood of crises occurring, while sustaining the soundness of banking institutions.

**Theoretical Review**

In recent years, a large number of empirical studies on banks have been conducted on representative samples of countries that have highlighted the failures of banks at the heart of economic and financial crises. They have attempted to explain the contribution of a given variable to the solvency of banks. It should be noted that very often, the authors find different or even contradictory results. This is mainly due to the different data they use, covering different periods and regions. Some of them showed that troubled banks are those that have accumulated bad loans, whose amount in relation to the total amount of loans granted is the basis for measuring credit risk, such as the work done by Hajialiakbari et al. (2013), Fukuyama and Weber (2015), Kumbhakar et al. (2015), Fukuyama et al. (2017) and more recently Cherkaoui and Saber (2020). In this regard, credit risk has always been a major concern of regulators and academics. As well, the Basel Accords assert that credit risk varies in proportion to the risk profile of each borrower (Phuong & Thai, 2005). As a result, developed statistical tools (scoring, non-linear econometrics, etc.) have been established to measure the probability of a borrower defaulting on some of the key variables (family situation, salary, seniority, etc.). Likewise, a thorough analysis of corporate balance sheets and financial reports is conducted. And in special cases, the selection may apply indirect methods such as asking the borrower to provide a large amount of collateral (Diop, 2019). Despite all the preventive measures implemented by the banks, nothing can anticipate the future of the borrower, his ability to repay in the future or his goodwill. Debtors’ insolvency remains the main factor supporting the accumulation of the bad debts.
Likewise, credit risk has served as much as a powerful catalyst leading to the collapse of banks in financial crashes (Assia, 2018; Vazquez & Federico, 2015; Jordà, Schularick, & Taylor, 2013). Moreover, capital losses may affect the solvency of the bank, leading to a liquidity crisis and a chain of deterioration of all banks. Thus, with the worsening levels of non-performing loans, there is a risk of weak bank liquidity, leading to a systemic crisis and possibly a major economic recession, a systemic crisis and possibly a complete economic recession (Cherkaoui & Saber, 2020). As a result, efficient management of credit risk seems essential to ensure the sustainability and rigid solvency of banking institutions as well as their liquidity, and therefore a healthy and stable global financial system.

As such, it is particularly noticeable to show the relationship that links up the two concepts, liquidity and solvency; a bank is insolvent while the value of all its assets, despite their maturity, is less than all of its debts. Thus, we are talking about long-term, medium-term, and short-term solvency. Liquidity is in a mean of short-term solvency, it is the ability to meet immediate deadlines; Diamond and Rajan (2002) have developed a model where borrowers and investors consider liquidity. They pointed out that banks can go bankrupt either because they are insolvent or because of a lack of liquidity which affects their solvency. Likewise, they have shown that the liquidity provision leaves the banks exposed to solvency problems, due to the theory of asymmetric information about the returns on bank assets which makes banks more exposed to a source of panic. The main purpose of prudential regulation of banks is therefore the protection of depositors, particularly in the event of bankruptcy. In addition, the incapacity of depositors to oversee the activities of banks adds to the contagion risk of the financial and banking system. The need to rule out this risk and promote the sustainability of the banking system as a whole generates the rationale for prudential regulation of banks.

Accordingly, a bank is subject to interest rate risk when it grants loans at fixed rates. Indeed, in the event of rate variations, the present value of the loans which appear in its assets will vary. In October 2017, the European Central Bank (ECB) found that a rise in interest rates could generate higher net interest income over the next three years, however it would also reduce the value of regulatory capital for the majority of the 111 banks subjected to its stress tests (Diene, 2017); thus, the banks’ solvency would be affected due to the variation of interest rate. Whereas the interest risk is an essential component of the market risk, it is thus important to
The banks are subject to a number of market risks both in managing their balance sheets and in their trading operations. With regard to market risk, the bank with the most securities admitted to the market is the one that is most exposed to stock price fluctuations and thus would be the most threatened by this risk. The analysis of the solvency ratio shows that it is based on the calculation of the book value of bank assets, these assets being weighted by risk coefficients based on the counterparty risk. However, it is undeniable that the banking activity bears other risks, the most obvious being market risks (Siddika & Haron, 2020).

By taking into consideration all the above mentioned, we should not forget the role of the volume of activity and its impact on the banks’ risk. The protection that Basel III imposes on banks designated as "global institutions of systemic importance", is to offset the high risk they pose to the global financial system and the consequences of their failure. The systemic importance of a bank is determined by the G-20 in accordance with the standards for global financial institutions of systemic importance (G-SSI). These criteria include the size of the bank, its transnational activities and its interdependence; however, the study by Zhang (2017) recognized the importance of size over systemic significance. Thus, it is important to note that if the volume of banks’ activities increases, then their risk-taking becomes increasingly important, especially the risk of insolvency (Amara et al., 2019).

Our literature review allows us to conclude that the prudential regulations are formulated following a perspective, which no longer focuses on flows but on the actors within these movements, whether the banks, consisting of the bank’s requirements to constantly hold an appropriate proportion of the contribution of its own funds taking into account all of its commitments. To the extent that the capital is more expensive than the deposit, this adjustment induces the firm to control and reduce its risk, which in turn will reduce the solvency risk of the bank.

However, before going into the methodology, it seems important to highlight the financial problems encountered today in Lebanon, which threaten the endurance of Lebanese banks; The Central Bank's new regulations and decisions taken in this current crisis, will be presented in the following section highlighting the currency war from which Lebanon is suffering today.

Lorex vs. Lollar.
For years, the Lebanese economy, burdened with steadily increasing public
debt from year to year, has experienced an economic slowdown: a real
growth rate of only 2.8% on average since 2010 and has turned negative
since 2019; the public debt-to-GDP ratio has reached an instable level of
151.8%, high level of corruption, and deterioration in the sovereign rating
of the country and its banks. All these dangerous economic indicators have
reduced the confidence of Lebanese in their national currency. Likewise,
the dollar used to be the reference currency in internal trade: deposits with
Lebanese banks were over 65% in dollars, likewise more than 90% of loans
to the private sector, the major transactions, and a substantial part of
future liabilities (pensions, insurance, etc.) were in dollars.

Lebanon today is suffering from a crisis, a currency crisis, which
may be the worst in its history, mainly caused by a significant decline in the
exchange rate of the Lebanese Pound. According to Steve H. Hanke,
nicknamed "currency doctor" -professor of applied economics, Johns
Hopkins University- as per his interview at Lebanese Broadcasting
Corporation International (LBCI) « Sawt el Nas », this crisis is growing into
an inflation crisis, and the inflation rate has reached 270% per year by
measuring it every day using very accurate techniques, which is the third
highest inflation in the world (in Syria 229% per year). Thus, Lebanon
today ties up with a serious dramatically situation, and the main problem is
the currency; this crisis must be solved first and then other issues can be
addressed, such as the electricity crisis, banking, debt, subsidies and a long
list of other things.

Hopelessly, the dollars in Lebanese banks accounts have become
out of reach; account holder can only access them in Lebanon, and banks
only allow withdrawals in local currency. The point is that the dollars on
depositors' bank statements were/are fictitious and, if they were true, they
have been spent to finance imports and government deficit. They are
actually LBP which converted into dollars in the accounts only. In short,
there are very few real dollars left in the Lebanese financial system. So
those who put real dollars in Lebanese banks saw their dollars spent and
transferred overseas. To make matters worse, the exchange rate has
multiple values: official, subsidized, "gray-black", black, "black-black"....
Althought the official exchange rate USD/LBP in Lebanon is still 1507.5, the
«Lebanese dollars» has become a «lollar»; According to Urban
Dictionary:" a lollar is a U.S. dollar that is stuck in the Lebanese banking
system, really just a computer entry with no corresponding currency". The
term was coined by Harvard economic fellow following the fall of the Lebanese economy. Thus, the « lollar » is the black market of checks in dollars resold at a lower rate of 2.6 to 3 times the amount paid. As well, the « lollar » is the electronic platform launched by the Central Bank that sets the exchange rate at 3,900 compared to the black market rates, which has passed L.L.8,000 to the US dollar and may get even worse with no restrictions; Likewise, the trading in dollars deposited in the banks’ accounts are used exclusively in Lebanon and their price differs from that of « cash dollar » and cannot be transferred abroad; thus the real « dollar », has become the cash or fresh money collected exclusively from abroad, with which the accounts’ holders can manage whatever they want. It is worth to note that this situation not only affects the « Lebanese dollars », but all foreign currencies; Lebanon is suffering from a currency terrible war in which all foreign currencies are banned; thereby, « Lorex », the Lebanese foreign currencies, has become a specific system applied exclusively by Lebanese banks without restrictions, as well the Lebanese Pounds collapsed against other currencies and people’s savings were wasted; « Lorex » with the symbol of lor, i.e. « informal British used to indicate dismay », highlights the unhappiness and even the disappointment of the Lebanese people who put their trust in the banking system in Lebanon.

**Lebanese Central Bank Action to Mitigate the Crisis.**

Following these various economic, social and political problems, the Governor of the Central Bank, Riad Salameh, has issued a series of circulars to deal with the various problems encountered. The situation of banks in Lebanon is getting worse; more than half of the international transfers made in recent weeks are now made through money changers; banking services, which was one of the strongest in the region, are in sharp decline; customers use fewer checks and debit cards and more and more cash; bank loans are down 40% so far; Unemployment has exceeded 50% of the working population. The « Lorex » crisis’ symptoms, in the financial system as a whole, are no longer hidden; the decision to release fresh money from any restrictions or controls was the subject of a circular issued by the Central Bank (BDL circular 150); meanwhile, a confusion occurred while many banks forbid their customers to withdraw their fresh cash received in foreign currency from abroad, which required the intervention of the Banking Control Commission to address this issue. Banking sources
indicate that the oversight committee's follow-up is an indication of the extent of the monetary authority's concern in this issue, especially since losing customer confidence in the procedures related to fresh money will practically mean losing the last thing that could be bet on attracting transfers from abroad to the financial system. Also transfer abroad requested by depositors from their "Lebanese lorex" accounts has become limited to certain basic materials, with the approval of the Central Bank. The matter was further exacerbated when Salemeh declared that Lebanese banks that cannot increase their capital by 20% within a deadline not exceeding February 2021 as a maximum, must leave the market (BDL circular 567). Therefore, Lebanese banks are facing nowadays a crucial solvency challenge that may threaten their existence.

In addition, recent talks in Lebanon about the end of the phase of subsidizing the import of the basic materials at the official price have been discussed. As for Riad Salameh, as soon as the Central Bank's reserves, which he says do not exceed two billion dollars above the required reserves (expected within three months), expire, he will stop supporting the import of basic materials at the official dollar price. Thus, the assets of the Central Bank in foreign currency have expired. This means they continue to people’s money, and the latest manifestation is the mandatory haircut on foreign currency deposits. No one has a definitive or reassuring answer to how prices can be controlled. One economist says that imports will almost completely cease, and will be limited to those who are able to secure fresh money; others will have limited livelihoods. Moreover as per the last decision No.13262 issued on August 27, every bank must make fair assessments of its assets and liabilities. With the intention of reactivating the work of the banks operating in Lebanon, and enhancing their liquidity, especially with their correspondents abroad, banks must thrive their customers, that have transferred more than a total of 500 thousand dollars abroad during the period starting from July 2017 to urge them to deposit into a special account frozen for five years, equivalent to 15% of the transferred value (BDL circular 154).

All these circulars tend to achieve three goals; first: increasing banks' liquidity in foreign currencies; secondly, increasing foreign exchange reserves at the Central Bank. As for the third goal related to the need to increase the capital of banks; it is worth noting that one of the incentives that may lead holders to accept frozen recovered funds accounts is that to transfer them from an account that has been frozen for 5 years
into shares in the bank that can be sold on the stock exchange for dollars and re-transferred them abroad.

With all these decisions, the worst crisis can be postponed, but it cannot be avoided. The problem is the economic model itself because there was a possible alternative to this rentier economy based on imports and generating unemployment, an economy based on production and innovation generating employment. In fact, this is what the government’s plan has been accepted by the International Monetary Fund (IMF) but which it opposes. Finally, in addition to Coronavirus pandemic, US sanctions and the IMF’s refusal to finance Lebanon amid a corrupt government, there is no salvation for Lebanon. For this reason, the Lebanese will have to wait for solutions and political settlements before returning to the throes of searching for financial and economic solutions. But who knows how long the waiting period could be. Meanwhile, the country might collapse and famine could prevail.

**RESEARCH HYPOTHESIS**

with reference to our literature review, the research hypotheses have been formulated as shown below:

- H1: Credit risk is an explanatory parameter for bank insolvency risk in Lebanon.
- H2: Interest rate risk is a major determinant of bank insolvency risk in Lebanon.
- H3: Liquidity risk is a major determinant of bank insolvency risk in Lebanon.
- H4: Market risk is an explanatory parameter for bank insolvency risk in Lebanon.
- H5: The activity volume represents a major determinant of bank insolvency risk in Lebanon.

When formulating assumptions, we continue to refer to bank solvency as a function of its determinant. The approved basic model specification is expressed as:

\[ Y = f(X_1, X_2, X_3, X_4, X_5) \]

\[ Capital \ Adequacy \ Ratio = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \]
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**Figure 1: Conceptual Framework**

### Dependent Variable

**Capital adequacy ratio:** To calculate the capital adequacy ratio, Lebanese banks adopt the Basel III criteria; the total equity ratio (Tier I and Tier II) was supposed to rise up to 15% at the end of 2018 where it was 14.5% at the end of 2017. The capital adequacy ratio is computed as follows:

\[
\text{Tier}_1 + \text{Tier}_2 \sum (\text{RWA}_{\text{credit risk, market risk, operational risk}})
\]

In light of the results of studies developed by recent empirical work, we identified a set of explanatory variables:

### Table 1: Variable and measurement

| Variables         | Symbol | Measurement                                   | Source                  | Expectation |
|-------------------|--------|-----------------------------------------------|-------------------------|-------------|
| Credit Risk       | CR     | Total loans/ Total Assets                     | « BilanBanques »        | +           |
| Interest Rate Risk| ITR    | Interest charges/ Interest income             | « BilanBanques »        | +           |
| Liquidity Risk    | LR     | Total loans granted/ Total customer deposits  | « BilanBanques »        | +           |
| Market Risk       | MR     | Market capitalization/ Total equity           | « BilanBanques »        | -           |
| Activity Volume   | AV     | Natural logarithm of Total Assets             | « BilanBanques »        | +           |
Independent Variables

As per the above table, independent research variables are presented as follow:

Credit risk ratio

This ratio is the variable for determining credit risk. This is an indicator, which reflects the risk of quantitative information on-balance sheet and off-balance sheet about institutions and bank loan portfolios, i.e. counterparty risk.

Interest rate risk ratio

The interest rate risk for a financial institution is the risk that would be incurred if interest rates variation occurred as a result of all transactions in the balance sheet and off the balance sheet, except the transactions subject to market risks where applicable (CRBF Regulation n°97-02 of February 21, 1997). Interest rate risk is one of the major and natural risks facing banks.

The liquidity ratio

The liquidity ratio is defined as the ability of a business or individual to pay off short-term debts. Indeed, banks that have sufficient liquidity and can easily raise funds to cope with deposit withdrawals or loans demand are profitable and require less capital. Previous researches show a negative relationship between solvency ratio and liquidity risk (Yüksel & Zengin, 2016). Another group of researchers, Iqbal (2012), and Ghenimi and Omri (2015), indicate a positive relationship.

Market risk ratio

The concept of market capitalization is used as a synonym for the company’s market value. For Bougatefa et al (2016), market value is defined as the value resulting, for a given good or service, from the confrontation between supply and demand on a given market, under normal conditions of competition.

Volume

This ratio represents the ownership of assets by banks. The higher this property, the greater the ability of banks has the capacity to provide financial services at low cost. Assessing the size of banks is a difficult question because there are a large number of different indicators with
quite different characteristics. In line with previous studies on corporate governance, the size of banks is measured by the natural logarithm of total assets at the end of the fiscal year.

METHODS

This section will be devoted to methodological frameworks adopted and tests conducted in relation to our topic; this will enable us to respond to the problem that was presented at the beginning of the study, evaluate the impact of assessing the major banking risks encountered in the banking sector and their influence on the solvency of banks, and thus the impact on the resilience of the banking sector in general.

Moreover, our secondary data was taken from the published Financial Statements at "Bilan Banques".

Research Design

Our research design will be presented as follows:

Sample Selection.

With the aim of achieving the research objectives in determining the solvency determinants of banks in Lebanon, the study is based on the following:

The number of banks operating in Lebanon were 63 banks in 2018 (Association des Banques du Liban, 2018), subdivided into 4 categories according to their deposit amounts. We formed a convenient, non-probabilistic sample, to guarantee the representativeness of each category. Therefore, we selected 31 banks that represent 49% of the population; the banks that do not have at least five consecutive financial reports have been excluded.

Research Model

In this paper, the model will be the development that represents the determinants of the solvency of banks, and the variable to be explained, which is the capital adequacy ratio.

The following equation was used to represent the relationship between these variables based on the (Mbogori, Muthoni, & Wanyoike, 2017) model of a formula:

\[
\text{CAR} = \alpha + \beta_1 \text{CR} + \beta_2 \text{ITR} + \beta_3 \text{MR} + \beta_4 \text{LR} + \beta_5 \text{AV}
\] Eq(1)
Where, CAR, endogenous variable, is capital adequacy ratio which measures the bank insolvency risk; CR = credit risk; ITR = interest rate risk; MR = market risk; LR = liquidity risk; and AV = volume of activity; $\alpha$: a constant and $\beta_k$ is the coefficient of each model variables.

This study aims to use multiple linear regression to examine the effect of the above independent variables on the dependent variable (CAR).

**Data Analysis Techniques**

This paper uses multiple regression approach in analyzing the solvency determinants of Lebanese banks. Analysis of variance (ANOVA) was applied to test hypotheses and to assess the similarities and differences between banks conforming to their various characteristics. The Pearson Correlation Coefficient was also used to examine the correlation between the variables at 5% level of confidence as reported by the SPSS software package.

In what follows, the final discussions on the studied hypotheses and a response developed to the main research problem will be advanced.

**RESULTS**

**Descriptive Analysis**

To study the behavior of baseline variables, we first performed a descriptive analysis; we present the main statistical data on the studied variables, dependent and independent variables, which appear in the following table:

| Statistics  | CAR | CR  | ITR | MR  | LR  | AV  |
|-------------|-----|-----|-----|-----|-----|-----|
| N Valid     | 31  | 31  | 31  | 31  | 31  | 31  |
| Mean        | .2116 | .7855 | .5658 | .2016 | .7516 | 28.4903 |
| Mode        | .15  | .87  | .69  | .00  | .25a | 28.45 |
| Std. Deviation | .13176 | .14484 | .22506 | .25259 | 1.37671 | 1.89175 |
| Minimum     | .07  | .41  | .13  | .00  | .09  | 24.93 |
| Maximum     | .74  | .94  | 1.02 | 1.22 | 7.10 | 31.75 |
| Percentiles25 | .1400 | .7700 | .3900 | .0600 | .2900 | 26.8600 |

First, we can note the large heterogeneity of banks in our sample. In fact, standard deviations are relatively low for both CAR & CR ratios to become very high for ITR & MR ratio and more significant for LR & AV ratios; in addition, the interquartile data indicate the increasing importance of this dispersal along with the different ratios considered.
From this table, we can see that the capitalization ratio is on average 21% (mean 0.21), with a value of 15% for most banks (mode 0.15) which is higher than the required ratio; but at the same time we see that in a quarter of the banks this ratio is less than 14%, and another quarter it is above 21%. We can also see that the ratio varies between 0.07 and 0.74; we found some dispersion in CAR values due to the set of banks that fall within our sample, and this is being validated because our sample takes into account the different categories of banks. As a result, their solvency ratios vary in proportion to their exposure to increasingly significant risks. The same is true of the CR, which has a seven-years average of 78.55%, but with a quarter of banks below 77% and a quarter above 87%. Even the raw data is meaningful, actually ranging between 41% and 94%.

Examination and experimental validation were selected as follows.

**Correlation Matrix**

A correlation matrix was defined for the independent & the dependent variables. In this study, we used several variables, without knowing which variables are most relevant to the respective parameter analysis.

**Table 3: Correlation matrix**

|       | CAR | CR  | ITR | MR  | LR  | AV  |
|-------|-----|-----|-----|-----|-----|-----|
| CAR   | 1.0000 |     |     |     |     |     |
| CR    | -.501 | 1.0000 |     |     |     |     |
| ITR   | -.494 | .269 | 1.0000 |     |     |     |
| MR    | .047 | -.482 | .463 | 1.0000 |     |     |
| LR    | .423 | -.008 | -.461 | -.224 | 1.0000 |     |
| AV    | -.472 | .519 | .480 | -.179 | -.375 | 1.0000 |

From this table, for the volume of activity, the correlation between AV and CR is 0.519, and the correlation between AV and ITR is 0.480, both of which are statistically significant at the 95% confidence level. So it appears that CR and ITR deviate slightly from AV. We note that the correlations between the independent variables are weak, and all the Pearson correlation coefficients between these variables are less than 0.6, that is, there is no problem of multiple linear relationship.
Multi-collinearity

VIF of the variables is at most 3.046; VIF of the variables is less than 5; there is no problem of multi-collinearity problem in the presented analyses (Daoud, 2017).

| Collinearity Statistics | Variable | CR | ITR | MR | LR | AV |
|-------------------------|----------|----|-----|----|----|----|
| Tolerance               | 0.425    | 0.328 | 0.352 | 0.705 | 0.509 |
| VIF                     | 2.353    | 3.046 | 2.841 | 1.418 | 1.967 |

Studying this matrix makes it possible to detect the presence or absence of multiple collinearity, and therefore no multiple collinearity.

The Research Model’s Suitability

To analyse the fit of the research model, the F-statistic test was used to confirm whether the model was suitable to examine the effect of the independent variables on the dependent variable.

Decision principle says: With Sig. F < 5%, this indicates that the model is suitable.

| F-statistic value | Sig. | The decision |
|-------------------|------|--------------|
| 4.364             | 0.005 | Suitable    |

As per the above table, the Sig. F equals to 0.005, so the model is suitable, and this indicates that the considered independent variables are determinants of the solvency of the concerned banks.

The Model Coefficients Testing

The first step in this estimation is to consider that the variable, the capital adequacy ratio, is an explanatory and justification for all fixed variables identified. To explore the importance of each independent variable in the solvency performance of banks in Lebanon, the coefficient of each independent variable and its important value were determined in the research model.

| Var. | Coefficient | Significant | t | R Square | Adjusted R Square | Std. Error of the Estimate |
|------|-------------|-------------|---|----------|-------------------|--------------------------|
| Constant | 0.604 | .123 | | | | |
| CR | -3.67 | .084 | | | | |
| ITR | -1.46 | .337 | | | | |
| MR | 0.17 | .997 | | | | |
| LR | 0.29 | .995 | 0.683 | 0.466 | .359 | .10547 |
| AV | -0.02 | .909 | | | | |
The model is acceptable, because the value of $R^2$ equals 0.466 is about 50%. 46.66% of the dependent variable is explained using regression, while the adjusted coefficient of determination $R^2$ is equal to 35.9% which shows the overall significance of the model. The ANOVA table tells us that the model is good for our analysis $r=0.683$.

To strengthen and improve the quality of the model and to deal with the problem of significance of the variables (Sig>5%), the second step is applied, which will consist of estimating the linear model by resorting to the incremental method (step by step significant variable selection algorithm), which implements several multiple regression times; each time you remove the weakest correlated variable. In the end, the variables that best explain the distribution are left until the optimal significant combination is reached.

| Table 7: Significant variables |
|-------------------------------|
| **Variables Entered/Removed** |
| Model | Variables Entered | Variables Removed | Method |
| 1 | CR | | Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 2 | LR | | Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |

This table shows only two variables that were used to build the model: credit risk & liquidity.

| Table 8: Correlation, R-Square & Linear regression equation coefficients between (CAR) & (CR & LR) |
|---------------------------------------------------------------|
| **Model** | **Variable** | **Coefficient** | **Significant** | **r** | **R Square** |
| 1 | (Constant) | .570 | .000 | .501 | .251 |
| | CR | -.456 | .004 |
| 2 | (Constant) | .537 | .000 | .653 | .426 |
| | CR | -.452 | .002 |
| | LR | .040 | .007 |

For this table, it gives details of the general relationship between the remaining variables in the models and the dependent variable. In model 2, 42.6% of the variance in the CR & the LR, dependent variables, can be explained using the CAR ratio, independent variables.
The table above shows the linear regression equation coefficients for CR & LR model variables with significance at 95%. The equation is as follows:

\[
\text{CAR} = 0.537 - 0.452 \times \text{CR} + 0.040 \times \text{LR}
\]

We can also see the state of each model, where important variables have been removed.

From this table, this research leads to the following conclusion:

1. The factor determining credit risk is the most important element and negatively affects the solvency of banks in Lebanon.
2. The determinant of Liquidity risk positively affects the solvency of banks in Lebanon and is significant (Sig=0.007<0.05).
3. The Interest Rate risk, Market Risk and the determinants of the volume of Activity negatively affect the solvency of banks in Lebanon, but they are not significant ((Sig=0.172>0.05), (Sig=0.425>0.05) and (Sig=0.612>0.05) respectively).

Given the absence of banks’ financial statements for the year 2019 in light of the catastrophic situation of the economy in Lebanon, we allow ourselves to interfere a little in our study. Below, some interest rate ratios on loans in these three listed banks in Lebanon have been revealed:

| Table 9: CAR ratio values comparison with 2019 |
|-----------------------------------------------|
| Audi Bank | Byblos Bank | Blom Bank |
| Average 2012-18 | Average 2012-18 | Average 2012-18 | Average 2019 | Average 2019 | Average 2019 |
| 14.68% | 17.39% | 28.15% | 11.29% | 9.73% | 20.8% |

The decline in the value of the capital adequacy ratio is very noticeable, although it does not seem very serious so far, the capital adequacy ratio should be 8.5% and ideally 10.5% for any banking institution. But the situation would become very critical as long as reassuring solutions are not devised; a decrease in values in this ratio could be driven by a significant rise in risk weights of assets risk weights, making the banking sector insolvent. Within this perspective, the Central Bank (CB) requested banks, through a new circular, to increase their capital by 20% (i.e. USD 4.4 billion) by the end of February 2021, and not to redistribute any of the profits earned to their shareholders in 2019 by dividends. The short-term objective was to respond to the dollar
liquidity crunch, but this circular is also aimed at strengthening the solvency of banks in the face of rising bad debts and extending the scope of “safeguard” in the event of haircut. At the moment, most of the country’s major banks have announced their intention to respond to the Centrak Bank’s request. But even this increase will not be enough to recapitalize the banks. According to Ghazi Wazni, Minister of Finance in Lebanon, the sector will need a cash injection of 20-25 billion dollars to ensure its recovery (Ouazzani, 2020). Note that this crisis resulted from the state debts that brought the banks to this stage. Similarly, the public debt of Lebanon, which approached USD 86 billion, with the inability of the state to repay, is blurring the economic, financial and social environment in the country that is likely to worsen.

Meanwhile, in our credit ratio, we have aggregated all types of loans granted, ranging from loans to the private sector to discounts and loans to banks and finally loans to the government. Recent empirical evidence suggests that these loans should be compartmentalized because they carry different types of risk. In fact, while loans to the private sector have proven to be highly repayable, loans to the government and deposits in the CB contain much greater risk, given the debt trap in which the state falters and the bankruptcy of the CB due to a large financial gap in the foreign currency side of its balance sheet. By the time this article is completed, the Central bank’s foreign exchange reserves are at 18 billion, while its foreign currency liabilities to banks are at USD 72 billion, leaving a large insolvency gap affecting all operating banks. In parallel, the $10 billion in insolvent state bank loans in sovereign Eurobond holdings that the state defaulted on in March 2020 is on the rise. As a recommendation for future analysis, it will be interesting and also important to conduct a separate analysis of the exposure of banks to the state and the Central Bank and draw the necessary conclusions in terms of solvency.

DISCUSSION

There are two main indicators that help explain the solvency of banks in Lebanon: Credit risk and liquidity risk. We have come to the following conclusions:

- CR ratio has a negative impact on the CAR ratio meaning that banks with the largest level of credit risk have minor level of capitals. This result allows us to confirm the hypothesis (H1); this means that the credit ratio is an explanatory indicator of the capital adequacy ratio.
This finding was confirmed by the study of Maraghni and Rajhi (2015), Adamgbo et al. (2019) and Sinha & Basu (2019), which is contrasted with Al-Tamimi and Obeidat (2013).

- ITR ratio has a negative impact on the CAR ratio meaning that banks with higher interest rate risk generally have a lower CAR ratio. Our model neglects the effect of the interest rate risk in the presence of the credit risk; our result rejects the hypothesis (H2) which states that the interest rate ratio is a determinant of banks' capital adequacy ratio in Lebanon; this finding does not agree with the study by Al-Tamimi and Obeidat (2013), Dreca (2013) & Raharjo (2014).

- Market risk has no impact on the CAR ratio in the Lebanese banking system; this result was also confirmed by Kefi and Maraghni (2011) and Amara et al. (2019), but contrasted by Sinha & Basu (2019). This allows us to reject our research hypothesis (H3). In other words, market risk is not an explanatory factor for the capital adequacy ratio in the Lebanese banking system.

- LR ratio has a positive impact on the CAR ratio in the Lebanese banking system; this means that banks with a higher level of liquidity risk have a higher level of capital. This result confirms the hypothesis (H4). That is, liquidity risk is one of the determining factors of the capital adequacy ratio. This finding is contrasted with that of Mahmoud (2021), Salhi et al (2014), and Al-Tamimi and Obeidat (2013), who concluded that liquidity risk has no effect on the solvency of the bank.

- The volume of a bank's activity measured by its assets has a negative impact on CAR ratio in the Lebanese banking system. This means that banks with a greater volume of activity have lower CAR ratio. Our result rejects the hypothesis (H6). So the volume of the bank's activity is not a determinant of the solvency ratio in Lebanon. This finding was confirmed by Mahmoud (2021), Bateni et al. (2014), and is contrasted with Dreca (2013) which states that the volume is significant over the capital adequacy ratio.

The compliance with prudential standards by Lebanese banks remains a necessary but insufficient condition to be immune from the risk of insolvency. Other behaviors and factors must be considered by these establishments in order to minimize their exposure to this inevitable danger. Since the main function of the banks is related to the granting loans, among the defects a bank generates is a credit risk that it must
circumscribe by a good analysis to have a fairly correct evaluation; when it lends to its customers (private or commercial); While as far as liquidity risk is concerned, we did mention in our literature review that if the bank does not have sufficient liquidity, it may find itself in default even though it was able to meet the debts. In practice, a bank cannot immediately pay off all of its sight deposits, although the risk of a bank to withdraw all of its customers their money at the same time, it is not practicable. But banks still have to respect a liquidity ratio. It is simply a minimum level of liquidity that a bank must maintain relative to its short-term and demand commitments, to meet its deadlines and an unexpected increase in withdrawal requests. As a matter of fact, they could be two complementary concepts.

On the other hand, we came to the conclusion that market risk is not that great, and this is verified by the fact that regulatory bodies, central bank and control authorities have imposed, in addition to laws and regulations, stricter limits relating to investment decisions, thus setting approved standards, such as maximum limits and controls; in addition, the central bank prohibits banks from carrying out risky market transactions to achieve profit without its control and approval, only risk coverage is allowed. This explains the minimal effect of market risk on banks’ solvency. It is the same for both, interest rate risk and volume of activity; Interest rate risk is a determinant of credit risk and any fluctuation in interest rates will affect the bank’s credit function. Thus, when granting loans, these institutions must take this implicit risk into account. The Central Bank of Lebanon still maintains its authority to govern, control and fix the interest rate in the money market, and it constantly monitors the rates of lending and borrowing. Furthermore, the size of banks in Lebanon does not affect the banks’ solvency in Lebanon. As a conclusion, the main reason of our results is that, in Lebanon, the main function of all banks is to provide loans; they do not invest in the market, which is the policy of the Central Bank of Lebanon. Lebanese banks have served longtime in its history, as a funding channel for the state, carrying all the deposits to the central bank which in turn lent money to the corrupt government.

Finally, we have further demonstrated the crucial role of credit risk in the Lebanese banking system. It should be noted that this conclusion, which was reached at the level of Lebanon, might be its main reason, the public debt that overburdens Lebanese banks and which is part credit risk calculation that banks must protect and cover. Likewise, this is validated
by quotations provided in our literature review that many researchers and authors have spoken about; they validated that failure of credit management can lead to bankruptcy and even collapse of the entire banking system.

CONCLUSION AND RECOMMENDATIONS

The research findings point up the credit risk as the most significant variable among the studied variables. This can be explained by the high exposure of Lebanese banks to the risk of granting loans to the Lebanese state, which is largely in deficit. Liquidity risks in the Lebanese banking sector are considered low, since this sector is characterized by high levels of liquidity; As maintaining high liquidity has been the strategy adopted by banks for a long time for well-known reasons, especially to protect and enhance confidence in the banking sector. In addition, it is important to note that if loans are a major part of a bank’s assets, then the credit function can play a critical role in managing overall risk, as is the case in Lebanon. In this regard, effective and prudent management of credit risk is a way to create value for the bank.

Despite the theoretical and methodological relief, several obstacles can hinder or limit our study that reveals new research avenues. These limits entail the presence of macroeconomic and other variables that in turn determine the solvency ratio, such as inflation rate and growth rate, operational risk and the quality of information accessible to the bank regarding the quality of borrowers and the skills of its employees; furthermore, the ratios available at “Bilanbanques” may not reflect the exact financial position of each bank.

In this research, we tried to provide some answers to our problem: the impact of compliance with prudential standards on the solvency of Lebanese banks. Referring mainly to previous empirical studies, we identified a set of variables that could affect the solvency ratio of Lebanese banks. It is important to note that if loans constitute a significant part of a bank’s assets, then its fiduciary function can play an important role in managing its overall risk, as is the case in Lebanon. In this regard, effective and prudent management of credit risk is a method of creating value for the bank. Thus, for better valuation, all banks should use “stress test” scenarios to understand what might happen in extreme conditions. This may be an area in which the industry is expected to be highly concentrated in the coming years; however, the difficulty lies in identification of the risks.
Predicting the types of risks to be combined is consistent with an estimate of the probability of the event producing a risk and the economic impact of that event.

While on the other hand, a very fashionable "Fintech" technique, by the end of the first decade of the 21st century, the term has extended to all technological innovations in the financial sector, including innovations in financial literacy and education, retail banking, investment and even cryptocurrencies like bitcoin. Thanks to this technique, whose implementation date in Lebanon is estimated in two years, banks are starting to operate as virtual branches. It is a question of subjecting the banks to a boost of quality from which they will be incapable to determine their risks in the future to come. And so, will prudential regulations, under the protection of new technologies that can significantly disrupt the banking sector but also the global economy, live up to expectations?
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