

Les déterminants de la résilience des banques marocaines

The determinants of Moroccan banks resilience

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Résumé

Dans un environnement marqué par la succession des crises bancaires, la résilience des institutions financières est devenue primordiale. Une banque est considérée comme étant résiliente si elle est capable de prévenir, d'absorber et de se rétablir après la matérialisation d'un choc. Dans ce cadre les autorités financières ont instauré l'accord Bâle III qui cherche à améliorer la capacité des banques à faire face à d'éventuelles crises et à assurer leur pérennité. A travers notre étude empirique, nous visons à identifier les déterminants de la résilience bancaire liés aux fonds propres et à la liquidité en plus d'autres variables telles que la profitabilité, la rentabilité, le risque et la taille de la banque. Nous avons utilisé un panel de 6 banques marocaines sur une période de 16 ans allant de 2005 à 2020. Pour évaluer la résilience des banques, nous avons utilisé une étude de panel pour évaluer l'impact de 14 variables différentes sur la variable à expliquer. Les résultats montrent d'une part, que les fonds propres, la liquidité et la rentabilité sont les déterminants de la résilience bancaire et d'autre part, ils montrent que la taille, la rentabilité et le risque ne déterminent pas la résilience dans le secteur bancaire marocain.

Mots clés : Résilience ; Banques ; Réglementation ; Bâle III ; Crise.

Abstract

In an environment characterized by the succession of banking crises, the resilience of financial institutions has become essential. A bank is considered resilient if it is able to prevent, absorb and recover from a financial shock. In this context, the financial authorities have introduced the Bale III agreement, which aims to improve the capacity of banks to face possible crises and ensure their sustainability. This study aims to identify the determinants of the banking resilience. Through our empirical study we aim to identify the determinants of bank resilience related to equity and liquidity in addition to other variables such as profitability, rentability, risk and bank size. We used a panel of 6 Moroccan banks over a 16-years period from 2005 to 2020. To assess the resilience of the banks, we used a panel statistical analysis to evaluate the impact of 14 different variables on the response variable. Resilience has been presented in our study by Merton's distance to default formula. the results show on one hand, that equity, liquidity and rentability are the determinants of banking resilience and on the other hand, they show that size, profitability and risk does not determine resilience in the Moroccan banking sector.

Keywords : Resilience; Banks; Regulation; Basel III; Crisis.

Introduction

The 2008 financial crisis as well as the covid-19 pandemic, have brought back into focus the concept of resilience. As a dynamic and multidisciplinary concept that encompasses a multitude of fields including finance and banking ones; most resilience specialists agree that resilience is a dynamic and evolving process (Anaut ,2015). It's now a necessity to ensure the sustainability and proper functioning of the banking system in a fluctuating and unpredictable environment. In this context, the financial authorities have developed the new Basel III accord, which aims to improve the capacity of banks to face possible crises and ensure their sustainability.

Resilience is a concept that emerged in the 1940s through the studies of René Spitz and Anna Freud. These scientists studied the effects of World War II trauma on children placed in orphanages. Later on, the concept of resilience was developed in the 1970s by John Bowlby who published his theory of attachment in the 1980s. This theory served as a basis for the clinical observations conducted by Werner and al.,(1982) who revealed the resilience processes of children raised in deficient environments (Anout, 2005). Thereafter, the notion of resilience was borrowed in the 2000s by the ecological community. It was discussed by Adger, (2000) in his paper about the relationship between social resilience and ecological resilience. He defined social resilience as the ability of groups or communities to deal with external stresses and disturbances resulting from social, political, and environmental changes and the ecological resilience as the characteristic of ecosystems that allows them to persist in the face of disturbances.

According to Aschan-Leygonie, (2000) resilience is the ability of a system to integrate a disturbance into its functioning, without changing its qualitative structure. A system is considered as resilient when it is able to maintain itself while being affected by one or more disturbances.

According to these definitions we can see that the concept of resilience is closely linked to a context of instability and disturbances.

With financial development, financial liberalization and the emergence of risks, instability has become a central issue for financial authorities. Financial instability could be defined as the divergence from the economy's saving-investment plan that is due to imperfections in the financial sector (Haldane and al., 2005).

Thus, the challenge of financial stability can be characterized as the preservation of the proper functioning of the financial system and its ability to facilitate and to support the efficient functioning and performance of the economy (Fell & Schinasi, 2005).

This is the context in which financial regulation takes place. Its main objective is to correct market deficiencies, prevent financial crises and mitigate their consequences on the financial system and the real economy. Due to the effects of the 2008 financial crisis, 2010 was marked by the entry into force of the new Basel III financial reform. This new reform constitutes a cornerstone for a more resilient banking system.

Through our paper we will try to tackle the following problematic:

what are the determinants of the resilience of Moroccan banks?

The purpose of this article is two-fold. The first objective is to make a theoretical contribution to the concept of resilience, by clarifying in-depth the notion in its different dimensions, highlighting its elucidation for the finance and analyzing the contribution of regulation in improving banking resilience. The second objective is to empirically assess the resilience of the Moroccan banking sector.

The remainder of the article is structured as follows: the next section reviews the banking resilience literature; the section 3 examines the data, the variables and the model; section 4 presents the results and the discussion; and section 5 concludes.

1. Literature review

1.1. Resilience, a multidisciplinary concept

Several researchers have focused on resilience in their subsequent work in different disciplines including physics, ecology, psychology, entrepreneurship, management science and finance.

In physics a resilient material can bend when a force is applied and return to its original state once the force is removed (Jobin and al., 2020).

In psychology, resilience presents the ability of a person to cope with emotional shocks and traumas, and to learn from bad experiences (Cyrulnik & Jorland, 2012).

In entrepreneurship, resilience is rooted in a process of self-restructuring, of reconsideration and of learning from the shocks that the person has suffered (Bernard & Barbosa, 2016).

In management, several researchers have been interested in this concept. According to Pinel, (2009) resilience is the ability of a system to maintain or restore an acceptable level of functioning

despite disruptions or failures. A company's resilience presents its ability to anticipate, resist, absorb and adapt to disruptions. And to recover from disruptions to its original state (Lengnick-Hall and al., 2011; Madni, 2007; Madni & Jackson 2009) define resilience as the ability to anticipate, resist, adapt and recover from disturbances to find the original state. According to Välikangas & Romme, (2013) resilience presents the ability of a firm to resist and rebound against shocks. Resilience constitutes for Carmeli & Markman, (2011) a firm's ability to adapt, endure, quickly bounce back, and then thrive despite a catastrophic event.

Resilience requires three capacities: An absorptive capacity; a renewing capacity; and an appropriation capacity (Weick & Sutcliffe, 2011).

Holzheu and al., (2019) were interested in the resilience concept in the insurance sector. According to them resilience presents the ability of an economy or society to minimize damages to assets and losses of income after the occurrence of a shock. According to the same authors, macroeconomic resilience refers to the capacity of an economy to absorb shocks. The higher is this capacity, the more resilient is the economy.

From these definitions, we can deduce that resilience is a multidimensional concept "From the point of view of its theoretical construction, this concept is multidimensional" (Anaut, 2015, p29); and it requires three temporalities (Altintas & Royer, 2009; Wulff and al., 2015; Duchek, 2020). Indeed, resilience first assumes the materialization of a shock or disruption. Resilience requires several characteristics that can be presented in a three-stage process. the first phase is the period before the materialization of the shock. when the organization must develop a preventive and anticipatory capacity. During the disruption, the company must show resistance and absorb the shock. And the third phase after the materialization of the shock, which can be divided into two sub-phases. the first one is the restructuring phase, when the organization must return to its initial state and recover from the shock and the second one constitutes the learning stage.

The learning phase allows the organization to improve its resilience. After the materialization of the shock, the company must review its current situation and develop a capacity for renewal (Lengnick-Hall, 2011). The renewing ability, also called by other researchers the capacity for appropriation; allows the organization to learn from the previous crises and to protect itself against potential future shocks (Bégin & Chabaud, 2010).

Hence, learning from past crises allows the organization to develop its resilience (Duchek, 2020).

Hamel & Valikangas, (2004) distinguish four challenges of resilient companies: the cognitive challenge, the strategic challenge, the political challenge and the ideological challenge.

The cognitive challenge, according to which the company must be prepared for change. The strategic challenge, presents their capacity for innovation. The political challenge, refers to the allocation of resources required for their development and their ability to change. And finally, the ideological challenge represents their proactive vision.

Resilience requires a good knowledge of the environment and a capacity to mobilize the appropriate resources (McManus and al., 2008).

In the same line of thought; Berkes & Folke, (1998), Dauphiné & Provitolo, (2007) have distinguished between two types of resilience. Reactive resilience and proactive resilience.

The term reactive resilience was referred to as defensive by the two researchers Benyacoub & Abdellah, (2021). These two types of resilience are complementary; considering that proactive capacities may not be able to overcome crisis and deal with change (Rerup, 2001; Benyacoub & Abdellah, 2021).

By lending these ideas and applying them to financial institutions, we can say that a financial institution is considered as resilient if it is able to prevent the materialization of a risk, a financial shock or a crisis¹. Also, it must be able to absorb the shock and eventually recover and maintain its activity after the crisis and improve its situation to increase its resilience degree.

Meanwhile Haimés, (2009), in his definition, has focused on the term "system". According to him, resilience, is the capacity of a system to recover from an emergency.

Wellink, (2002) has specifically focused on the financial system. A financial system is characterized as stable and resilient if it is able to endure exogenous shocks and avoid their negative effects. For Bui and al., (2017) a resilience System refers to the ability of the financial system to withstand or recover from losses.

MacDonald and van Oordt, (2017) have defined the resilience of the financial system in the Financial System Review as "the ability of the system to resist a wide range of shocks and to recover rapidly from them".

¹ Frait and Komárková, (2010) have defined financial crisis as the situation in which a vulnerable financial system is exposed to shocks.

Bannani and al., (2014) have defined the financial stability as a state of the financial system in which it demonstrates resilience face to episodes of financial stress or real shocks. Thus, the stability and resilience of the financial system go hand in hand and cannot be dissociated.

1.2 The Regulatory reform, towards a more resilient banking system

The global financial crisis has brought into question the Basel II international regulatory accord and has also underlined the need to strengthening the framework regulation (Keys and al., 2009). In this regard, the G20 in conjunction with the Financial Stability Board have developed a reform program and regulatory guidelines to overcome the vulnerability of the banking system and to increase the resilience of individual banks, and the financial system, to shocks (Clerc, 2016; Keys and al., 2009). Under the combined effect of all the measures adopted, the resilience of the banking sector could be improved (the 83 BRI2 annual report). This reform program has mainly been materialized through the Basel III regulations.

In the 1980s, in a context marked by deregulation and a succession of crises, such as the Latin American debt crisis and the oil shock, the Basel Committee³ has adopted in July 1988 the "Basel capital accord" which is the basis of the international regulation. This agreement led to the introduction of the Cooke ratio, requiring banks to hold a minimum capital adequacy ratio of 8%.

Table N°1: The Evolving Basel Accord⁴

	Completion date (Date of implementation in Morocco)	Main objectives	Identified weaknesses
Basel I	1988	Increase capital requirements Establish a standard approach for risk and capital requirements	Limited risk awareness
Basel III	2004 (2008)	Improve risk sensitivity Enable the use of internal valuation models Expand risk coverage	Capital insufficient to absorb losses the negligence of liquidity risk, funding risk and the

² The Bank for International Settlements has a mission to support central banks' pursuit of monetary and financial stability through international cooperation, and to act as a bank for central banks.

³ The Basel Committee on Banking Supervision (BCBS) is the primary global standard setter for the prudential regulation of banks and provides a forum for regular cooperation on banking supervisory matters.

⁴ For more information on the Basel agreements visit: www.bis.org/bcbs.

			interconnection between institutions
Basel III	Risk-based capital: 2011 liquidity coverage ratio: 2013 the net stable funding ratio: 2014 Leverage ratio : 2014 (2019) ⁵	Increase the quantity and quality of capital requirements Improve risk sensitivity and comparability of risk weights Limit the leverage accumulation of the financial system Develop the resilience to short-term funding stresses Supporting long-term funding structures Decrease the procyclicality of bank lending Address the "too big to fail" problems Improve risk management and financial reporting	It is still being assessed

Source: www.bis.org/bcbs; MacDonald & van Oordt ,2017; Bank Al Maghrib supervision banking report, 2012,2013,2018)

Basel II has been adopted to complete the first accord in response to the various crises⁶ and weaknesses that have been identified (Table 2.1). It has three pillars:

The first pillar represents the capital requirements. It has introduced the McDonough ratio. This ratio maintains the same capital requirement threshold previously set at 8% by the Cooke ratio. However, it has modified the risk breakdown structure⁷.

The second pillar represents the prudential supervision procedure. Its aim is to control the adequacy of the bank's equity capital and to monitor its internal ratings-based (IRB) approaches. The third pillar, market discipline, aims to standardize banking disclosure practices to achieve financial transparency.

Banks were unable to absorb the financial shock of the 2008 crisis under the Basel II regulations.

5 Gradual implementation from 2014 to 2019, which presents the final phase-in for the implementation of the Basel III regulatory standards.

6 Here is a non-exhaustive list of a number of crises, the Asian crisis in 1997, the Russian crisis in 1998 and the Turkish crisis in 2000.

7 The three risks taken into account are set as follows: credit risk at 75%, market risk at 5% and operational risk at 20%.

This regulation had several limitations, including the capital requirement, the neglect of liquidity standards and the excessive financial leverage (MacDonald & van Oordt ,2017); (Table 2.1).

The Basel III accord was adopted in 2010 due to the severity of the crisis effects. Basel III contains a number of standards developed, in the light of the financial crisis lessons, by the Basel Committee on Banking Supervision to tighten the existing capital requirements and liquidity standards for banks (BCBS,2010b, 2010c and 2010d).

Their purpose is to improve the robustness and the resilience of financial institutions and to increase their ability of absorbing shocks.” The reforms strengthen bank level, or microprudential regulation, which will help raise the resilience of individual banking institutions to periods of stress” (BCBS, 2010a)

Basel III is centered on three pillars⁸:

The first pillar discusses minimum capital and liquidity requirements. The objective of these requirements is to ensure that banks worldwide have an adequate level of liquidity and capital that can absorb losses and cope with massive liquidity withdrawals.

The second pillar concerns prudential supervision. It allows financial authorities to assess the risks of banks not covered by the previous pillar.

The third pillar deals with market discipline. Its purpose is to provide financial markets with the necessary information for price variation and risk taking.

Basel III is an improvement of the Basel II framework. It aims to achieve a greater resilience of the banking sector. The financial base of banks has been consolidated continuously, (...) calculated for the first time according to the rules of Basel III, levels that allow banks to have a security buffer that increases their resilience. (Bank Al-Maghrib ,2014).

Increasing the resilience of banks will allow them to absorb shocks, to improve their financial health, and to maintain their activity even under financial stress; A healthy banking sector leads to a greater resilience of the financial system and contributes to strong economic growth.⁹ (MacDonald & van Oordt ,2017).

⁸ For more details check: BIS, Basel III: A global regulatory framework for more resilient banks and banking systems, 2010

A banking system can be characterized as being more resilient if it can resist and overcome several shocks. This requires three conditions: 1) development of its capital reserves and liquidity level; 2) decrease of the impact of shocks on the financial system; and 3) after the materialization of shocks banks must be able to reconstitute their capital by drawing on their profits. (MacDonald & van Oordt, M. R. ,2017).

1.3 Assessing banks resilience

Several authors have previously focused on the measurement of bank resilience. Among these authors we can mention Velliscig and al., (2022) who developed a resilience measure VOLARE inspired by the optimal capital allocation model of Markowitz, (1959). For those authors the resilience reflects the performance of the banks. Their study assesses the resilience of a panel of 84 international banks during and after the 2007 financial crisis.

Bui and al., (2017) analyzed in their paper the loan losses and their impact on banks' capital buffers and system resilience. They used a sample of Australian banks from 2002 to 2014.

Cao and al., (2022) used the covid-19 crisis as an exogenous shock on the banking system. They used the Difference-in-differences methodology to assess the effect of capital requirement in reinforcing the bank lending resilience during stress period.

MacDonald & van Oordt, (2017) discussed in their paper the market indicators of bank resilience assessment. They presented quantitative measures to assess the resilience of the banking system based on financial market information's. The two authors developed a resilience index composed of five market indicators: 1) market-based capital ratio (MBR), 2) Distance to Default (DD), 3) ΔCoVaR , 4) Marginal expected shortfall (MES), and 5) Long Run Marginal Expected Shortfall (LRMES). The banking system resilience index is designed by the standard deviation weighted averages of the different indicators.

2.Research method

The main objective of this study is to empirically analyze the evolution of bank resilience according to the variations of banks liquidity, equity and profitability.

2.1 Research model

We used panel data regression model. The main objective of this method is to estimate a fixed effects model and a random effects model. Then, by using the Hausman test, we will be able to choose the appropriate one.

We have used the following model:

$$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \dots + \beta_k X_{kit} + \varepsilon_{it}$$

With:

Y_{it} : is the dependent variable,

β_1 : is the intercept,

β_2 : is the regression coefficient

X_{it} : is the explanatory variables,

ε_{it} : is the error term.

(i) represents the bank, (t) represents the time.

By extending the equation to reflect the variables of our study, the complete empirical model is as follows:

$$DD_{it} = \beta_0 + \beta_{R1it} + \beta_{R2it} + \beta_{R3it} + \beta_{R4it} + \beta_{R5it} + \beta_{R6it} + \beta_{R7it} + \beta_{R8it} + \beta_{R9it} + \beta_{R10it} + \beta_{R11it} + \beta_{R12it} + \beta_{R13it} + \varepsilon_{it}$$

For $t=1,2,\dots,16$ and $i=1,2,\dots,6$.

2.2 Sample selection

The study focuses on Moroccan banks listed on the Casablanca Stock Exchange and covers the 2005 to 2020 period. The sample consists of 6 banks covering a period of 16 years. Thus, a total of 78 observations for each variable. This period is justified by the integration of 6 periods, 1) before the 2008 crisis, 2) during the 2008 crisis, 3) after the 2008 crisis, 4) before the covid-19 crisis, 5) during the covid-19 crisis and 6) after the covid-19 crisis.

Bank data are collected from banks annual consolidated financial statements. Stock market data are collected from the official website of the Casablanca Stock Exchange¹⁰.

¹⁰ www.casablanca-bourse.com

2.3 Variables description

In this section, we will present the study's variables. The selection of variables is based on the theoretical and empirical literature.

2.3.1 Response Variable

The literature distinguishes between two approaches of modeling the occurrence of default; the structural approach and the intensity approach.

According to the structural approach, the default occurs when the bank is unable to honor its obligations even if it liquidates all its assets.

The intensity approach states that the default is modeled by first jump time of the Poisson process; the incidence of the default is presented by the time of the first jump and the amplitude is modeled by the size of the jump. This approach is based only on market data; it neglects the financial structure of banks (Le Page, 2000).

Our paper is focused on the structural approach. Merton, (1974) has provided the foundation of this approach through the distance to default (DD) measurement. The distance to default constitutes the number of standard deviations that separate the market value of a bank's assets from the nominal value of its liabilities.

Merton model supposes that the company's assets are tradable and follow a geometric Brownian motion:

$$\frac{dV_t}{V_t} = r \times dt + \sigma \times dB_t \quad (1)$$

With:

V_t : Asset value;

σ : Asset Value Volatility;

r : the risk-free interest rate;

dB_t : standard Weiner's process.

According to the Black-Scholes' formula:

$$VE = V_t N(d_1) - e^{-rT} D_t N(d_2) \quad (2)$$

VE presents the market value of equity; $N(d_1)$ and $N(d_2)$ are the cumulative standard normal distribution functions of d_1 and d_2 .

$$d1 = \frac{\ln\left(\frac{Vt}{Dt}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \quad (3)$$

$$d2 = d1 - \sigma\sqrt{T} \quad (4)$$

with:

Dt is the book value of liability; and T presents a period of one year.

The distance to default presents the number of standard deviations between the expected asset value at maturity T and the liability threshold:

$$DD = \frac{\ln(Vt) + \left(r - \frac{\sigma^2}{2}\right)T - \ln(Dt)}{\sigma\sqrt{T}} \quad (5)$$

The distance to default presents the response variable in our study. The greater the distance to default is, the more the bank is able to absorb shocks. The shorter the distance is, the more the institution's equity will be eliminated by a less severe shock.

To calculate the distance to default according to the Merton formula, we went through an implementation on R. We mainly used the stock market data of the banks. The main variables are: the market value of equity, the volatility, the debt and the risk-free rate.

The values of the distance to default of the six banks are presented on the table below. (Table 3.1)

Table N°2 : Distance to default

	AWB	BMCE	CIH	CDM	BP	BMCI
2005	1083.5738	2305.8980	1307.5860	1535.6360	1733.8020	1574.1210
2006	1281.4300	1332.8870	33762.1500	1285.2270	1248.4970	1293.7510
2007	1355.0850	1357.5670	1503.3560	1307.8390	1314.4190	1330.6930
2008	1332.3890	1431.0170	1353.6320	1306.8770	1324.6660	1338.3800
2009	1336.8140	1298.8580	1316.1180	9790.1640	1427.2820	1327.8000
2010	1513.9630	1355.1790	1431.8590	1295.4090	1421.6290	1349.1760
2011	1322.6700	1308.7760	1317.8730	1305.6484	1393.8140	1288.9150
2012	1403.7310	1250.3040	1270.1450	1249.0890	2387.3480	1251.0500
2013	1512.5330	1472.9120	1230.0150	1217.0240	1631.0470	1226.4710
2014	1951.0110	1719.2790	1275.6920	1270.9570	1485.2660	1217.8190
2015	1513.8010	1397.3600	1190.4980	1145.6880	1439.4320	1183.2850
2016	1498.4470	1229.8020	1164.0920	1176.7220	1358.3520	1144.4530
2017	1380.4150	1296.3210	1230.9600	1129.2320	1185.5810	1150.6200
2018	1480.4510	1139.9270	1153.3120	1128.9580	1334.8780	1183.1420
2019	1445.4520	1502.4720	1125.9380	1110.7570	1633.6060	1131.6440
2020	1459.4556	1065.3710	1125.9380	1047.0540	1053.2210	1077.9650

Source: authors using R

2.3.2 Explanatory variables

According to Schweizerische Nationalbank report, (2021) the resilience of banks is assessed through the evaluation of their profitability and their equity. Indeed, profitability, i.e., stable profits, allows banks to absorb losses and to reconstitute their capital after the occurrence of a shock. Equity provides a buffer against shocks; they allow banks to absorb accounting losses. The profitability is defined according to Bennani and al, (2014) as the ability to generate profits on the asset based on the cost of liability resources; Stable profits will be conducive to the resilience of the financial sector (BIS,2013).

The assessment starts with the capital and liquidity regulatory measures that report on the adequacy of reserves that banks hold to absorb shocks (MacDonald & van Oordt ,2017).

A banking system is considered to be more resilient if it is more able to withstand a wide range of shocks and to recover quickly from them. All else equal, a banking system will be more resilient if 1) its initial capital and liquidity buffers built up to absorb shocks are larger; 2) the impacts of shocks on the financial system are lower; and 3) the banks are able to reconstitute their capital quickly by drawing on their retained earnings once the shock is over (MacDonald & van Oordt ,2017).

Capital constitutes a financial buffer against shocks. During a massive withdrawal of liquidity or a sudden investment loss, the bank can fail if it doesn't have adequate capital. Otherwise, it will use its own funds to cover losses and maintain its activity.

The objective of improving liquidity requirements, is to cope with a sudden deterioration in financing conditions.

From this, we can say that the assessment of bank resilience is mainly based on the appreciation of three parameters: equity, liquidity and Profitability. Our study retains the ratios presented in the (Table 3.2). In order to reduce the margin of error in the evaluation of the impact of the interest variables, we include in our study other commonly used control variables (Table 3.2). which are likely to influence the financial health of the banks and their default risk.

The analysis of the resilience consists in analyzing the eventual relationship between the distance to default and the ratios of profitability, equity, liquidity, which present in this study the variables of interest while taking into consideration the effect of the size, the rentability and the risk of the banks.

Table N°3: Explanatory variables

	Variables	Applied Formulas	Interpretations
Interest Variables	Profitability	$R1 = \frac{\text{overall margin}}{\text{total revenue}}$	It reflects the contribution of the banking activity including commissions reported to the net income.
		$R2 = \frac{\text{interest margin}}{\text{total revenue}}$	It reflects the contribution of the bank main activity, i.e. the interest earned reported to the net income.
	Equity	$R3 = \frac{\text{equity}}{\text{total Assets}}$	The higher this ratio is, the stronger and better capitalized the bank is. Yet, it will invest in higher-risk activities to make its capital more profitable.
	Liquidity	$R4 = \frac{\text{deposits}}{\text{total Assets}}$	This ratio reflects the liquidity level of the bank.
		$R5 = \frac{\text{liquid assets}}{\text{total assets}}$	The lower this ratio is, the higher the liquidity risk is and the less the bank can deal with liquidity shocks.
		$R6 = \frac{\text{liquid assets}}{\text{short-term liabilities}}$	The higher the ratio is, the more the bank has sufficient liquidity to cover its short-term debts.
Control Variables	Rentability	$R7 = \frac{\text{net income}}{\text{equity}}$	The higher return on equity is, the higher the bank's rentability is. Its decrease reflects either an increase in equity or a decrease in net income.
		$R8 = \frac{\text{net income}}{\text{total assets}}$	The return on assets ratio measures the degree of performance of the bank.
		$R9 = \frac{\text{general operating expenses}}{\text{total revenue}}$	The cost to income ratio presents the proportion of net income absorbed by operating costs.
	Risk	$R10 = \frac{\text{Total loans}}{\text{total Assets}}$	Loans constitute the main activity of banks; therefore, they present their structural fragilities. This ratio reflects the degree of diversification of the bank, the higher the ratio is the less risky the bank is.
		$R11 = \frac{\text{Provision for Risks \& Charge}}{\text{Total loans}}$	The riskier the bank is, the higher the bank is supposed to increase its provisions. A higher ratio reflects a higher level of risk covered by provisions
		$R12 = \frac{\text{Total liabilities}}{\text{equity}}$	A higher ratio reflects that the bank is very indebted and has a higher risk.
	Size	$R13 = \text{Logarithm of total assets}$	The size of the bank influences its risk-taking following the Too Big To Fail principle, and its liquidity risk. It also positively influences its reputation and enables it to collect more deposits.

Source: Authors

3. Results and discussion

3.1 Descriptive statistics

Table N°4 : Descriptive Statistics

Var	DD	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
Mean	1769. 153	0.864 583	0.706 385	0.119 635	0.697 781	0.967 823	1.156 208	0.112 01	0.0109 48	0.599 365	0.776 667	0.008 687	7.861 417	0.896 375
Median	1315. 269	0.888	0.750 5	0.096	0.673 5	0.936	1.088 5	0.102 5	0.009	0.474 5	0.736 5	0.007	7.967	0.899
Maximum	33762 .15	1.034	0.895	0.687	5.12	6.672	8.19	0.637	0.062	11.41 5	6.301	0.092	18.16 1	0.959
Minimum	1047. 054	0.38	0.125	-0.06	0.046	0.287	0.308	- 0.041	0	0.206	0.114	0	- 11.02 2	0.838
Std. Dev.	3417. 197	0.102 465	0.131 88	0.091 473	0.482 357	0.612 826	0.756 592	0.094 064	0.0083 24	1.120 825	0.588 201	0.010 719	3.721 848	0.042 126
Skewness	- 0.000 679	- 1.588 27	- 1.661 02	3.436 762	8.048 694	8.568 133	8.509 214	3.207 369	4.3088 34	9.505 544	8.714 23	5.631 487	- 1.127 9	0.042 289
Observed	96	96	96	96	96	96	96	96	96	96	96	96	96	96

Source: Authors , using Eviews 9

Based on the descriptive statistics presented on Table (4.1), we deduce that the variable R12 has the highest value of the mean and the median, while the variable R11 has the lowest values of these statistical parameters.

Generally, the variables present fairly similar values of the mean and the median, thus the difference between these two statistical parameters is minimal and even non-significant, which enables us to affirm that the distribution of the values is symmetrical.

The variables R3, R8, R11 and R13 have a low standard deviation, However, this statistical parameter has a high value for the two variables R9 and R12, which means that these two variables are the most dispersed from the mean.

In general terms, the skewness of a distribution is positive if the right tail (at high values) is longer or fatter, and negative if the left tail (at low values) is longer or fatter.

The skewness coefficient is a measure of the skewness of the distribution of a real random variable.

The variables R1, R2, and R12 have a negative coefficient. Therefore, they indicate a distribution shifted to the right of the median, and so a tail of distribution spread to the left.

variable R13 has a value of skewness that is close to 0.

the rest of the variables have a positive coefficient which indicates that the distribution is shifted to the left of the median, and thus a tail of distribution spread to the right.

3.2 Regression results and discussion

Table N°5: Unit Root Test

Variables and stationery		LLC		IPS		ADF – Fisher		PP - Fisher	
		C	C&T	C	C&T	C	C&T	C	C&T
D	I(0)	0.0000	0.0000	0.0000	0.0000	0.0008	0.0018	0.0000	0.0000
D	I(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R1	I(0)	0.0047	0.0062	0.0234	0.2119	0.0342	0.2062	0.0015	0.0155
R1	I(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R2	I(0)	0.1504	0.0023	0.1548	0.2922	0.2442	0.3742	0.0001	0.0046
R2	I(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R3	I(0)	0.0417	0.0179	0.2160	0.4087	0.2366	0.2788	0.1087	0.0120
R3	I(1)	0.0000	0.0000	0.0012	0.0015	0.0023	0.0021	0.0000	0.0000
R4	I(0)	0.0074	0.1724	0.0351	0.7524	0.0662	0.8832	0.0000	0.1197
R4	I(1)	0.0033	0.0183	0.0031	0.0299	0.0059	0.0293	0.0000	0.0000
R5	I(0)	0.0000	0.0077	0.0026	0.3087	0.0049	0.4172	0.0000	0.0025
R5	I(1)	0.0018	0.0061	0.0046	0.0957	0.0058	0.1058	0.0000	0.0000
R6	I(0)	0.0000	0.0074	0.0084	0.5456	0.0099	0.6977	0.0000	0.3598
R6	I(1)	0.0001	0.0001	0.0017	0.0068	0.0023	0.0081	0.0000	0.0000
R7	I(0)	0.1918	0.1393	0.3178	0.1412	0.2372	0.1668	0.0995	0.0139
R7	I(1)	0.0002	0.0000	0.0000	0.0001	0.0000	0.0007	0.0000	0.0000
R8	I(0)	0.8490	0.3262	0.5769	0.2701	0.3533	0.1086	0.0263	0.0351
R8	I(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0000
R9	I(0)	1.0000	1.0000	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000
R9	I(1)	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R10	I(0)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0045	0.0012	0.0065
R10	I(1)	0.9984	0.8637	0.9339	0.7564	0.7374	0.4593	0.0000	0.0000
R11	I(0)	0.0000	0.8637	0.0000	0.7564	0.0000	0.4593	0.0000	0.0000
R11	I(1)	0.0000	0.8637	0.0000	0.7564	0.0000	0.4593	0.0000	0.0000
R12	I(0)	0.0594	0.8996	0.0405	0.2102	0.0428	0.2335	0.0000	0.0000
R12	I(1)	0.8985	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R13	I(0)	0.3208	0.1128	0.8577	0.5850	0.9085	0.4332	0.9663	0.8536
R13	I(1)	0.0000	0.0000	0.0001	0.0024	0.0005	0.0042	0.0001	0.0000

Source: Authors, using Eviews 9 , the estimated values probability and significance level is at 95%

The stationarity tests allow to test if a series is stationary or not. The Table (4.2) shows the unit root test of our study. we have applied four panel unit roots tests, respectively Levin, Lin & Chu; Im, Pesaran and Shin W-stat; ADF - Fisher Chi-square and PP - Fisher Chi-square.

These tests are based on the following autoregressive specification. The previous tests differ from each other according to the hypothesis on the constancy or not of the autoregressive coefficient π . The Levin, Lin and Chu (LLC) test supposes that $\pi = \rho$. It considers as a null hypothesis the existence of a unit root. The IPS, ADF and PP tests suppose that the coefficient π differs according to the individuals.

The estimated values are probability of the respected variables and at a significance level of 95%. the result of the unit root test shows that some variables are stationery at level $I(0)$ while some variables are at first difference $I(1)$. The result of the units roots are contradictory to each other. Therefore, the decision will be based on the majority. The R2, R3, R4, R8 and R13 variables are stationery at first difference while the rest of the variables are stationery at level. Consequently, we will apply fixed and random effect model to analysis the empirical result of the study.

Table N°6 : Fixed effect regression

Fixed-effects (within) regression		Number of obs = 96		
Group variable: id		Number of groups = 6		
R-sq: within = 0.6774		Obs per group: min = 16		
between = 0.1588		avg = 16.0		
overall = 0.5058		max = 16		
F(13,77) = 12.44				
corr(u_i, Xb) = -0.3520		Prob > F = 0.0000		
DD	Coef.	Std. Err.	t	P>t
R1	517.0881	4854.442	0.11	0.915
R2	3146.654	3808.635	0.83	0.411
R3	11639.71	3470.04	3.35	0.001
R4	944.5832	483.984	1.95	0.055
R5	-15331.3	4034.393	-3.80	0.000
R6	12862.1	3282.33	3.92	0.000
R7	93890.34	11711.57	8.02	0.000
R8	-979091.8	118113.4	-8.29	0.000
R9	-277.6638	217.9034	-1.27	0.206
R10	230.9109	397.7364	0.58	0.563
R11	-3597.197	23277.35	-0.15	0.878
R12	-143.7046	138.8227	-1.04	0.304
R13	-11529.37	27534.73	-0.42	0.677
cons	8699.432	24609.33	0.35	0.725

```

sigma_u 1712.4579
sigma_e 2109.7017
rho .39717889 (fraction of variance due to u_i)
F test that all u_i=0: F(5, 77) = 5.75 Prob > F = 0.0001
sigma_u 1712.4579

```

Source: Authors, using Stata 13

The Table (4.3) presents the fixed effect regression.

According to the R-sq (within), we deduce that the independent variables, explain 67.7% of the the banks variance in our model. According to the R-sq (between) 15.8% between-Banks variation is explained by the independent variables.

The errors U are correlated with the regressors in the fixed effects model for about 35%.

39.7% of the variance in our model is due to differences across panel.

The first column of Table (4.3) indicates variables and the second one shows the coefficients of each variable.

Based on the t-values and the Two-tail-p tests, the variables that have a significant influence on the distance to default are: R3, R4, R5, R6, R7 and R8.

In addition, R5 and R8 have a negative influence on the distance to default variable and R3, R4, R6 and R7 have a positive impact on it.

The rest of the variables have an insignificant impact on the distance to default.

To validate the result of the fixed effect regression, we will apply the random effect model.

Table N°7: Random Effect Model

Random-effects GLS regression		Number of obs = 96		
Group variable: id		Number of groups = 6		
R-sq: within	= 0.6774	Obs per group: min	= 16	
Between	= 1.0000	avg	= 16.0	
overall	= 0.6911	max	= 16	
Wald chi2(18)	= 172.24			
corr(u_i, X) = 0 (assumed)		Prob > chi2	= 0.0000	
DD	Coef.	Std. Err.	t	P>t
R1	517.0881	4854.442	0.11	0.915
R2	3146.654	3808.635	0.83	0.409
R3	11639.71	3470.04	3.35	0.001
R4	944.5832	483.984	1.95	0.051
R5	-15331.3	4034.393	-3.80	0.000
R6	12862.1	3282.33	3.92	0.000
R7	93890.34	11711.57	8.02	0.000
R8	-979091.8	118113.4	-8.29	0.000

R9	-277.6638	217.9034	-1.27	0.203
R10	230.9109	397.7364	0.58	0.562
R11	-3597.197	23277.35	-0.15	0.877
R12	-143.7046	138.8227	-1.04	0.301
R13	-11529.37	27534.73	-0.42	0.675
D1	-1170.034	991.6257	-1.18	0.238
D2	-1437.451	823.9839	-1.74	0.081
D3	1633.513	2522.935	0.65	0.517
D4	-2818.063	2479.247	-1.14	0.256
D5	-2805.858	2008.53	-1.40	0.256
C	9799.081	25590.31	0.38	0.702
sigma_u	0			
sigma_e	2109.7017			
rho	0 (fraction of variance due to u_i)			

Source: Authors, using Stata 13

The Table (4.4) presents the random effect model of the empirical study. the R-sq value of overall 69% shows the variables R3, R4, R5, R6, R7 and R8 are statistically significant, D1, D2, D3, D4, D5 and C presents the dummy variables for the respect ID. The R5 and R8 variables has negative impact on the dependent variable and R3, R4, R6 and R7 have direct impact on the dependent variable. while rest of variables including the dummy variable are also insignificant.

Table N°8: Hausman Test

Variables	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	sqrt(diag(V-bV_B)) S.E.
R1	517.0881	4854.442	0.11	0.915
R2	3146.654	3808.635	0.83	0.409
R3	11639.71	3470.04	3.35	0.001
R4	944.5832	483.984	1.95	0.051
R5	-15331.3	4034.393	-3.80	0.000
R6	12862.1	3282.33	3.92	0.000
R7	93890.34	11711.57	8.02	0.000
R8	-979091.8	118113.4	-8.29	0.000
R9	-277.6638	217.9034	-1.27	0.203
R10	230.9109	397.7364	0.58	0.562
R11	-3597.197	23277.35	-0.15	0.877
R12	-143.7046	138.8227	-1.04	0.301
R13	-11529.37	27534.73	-0.42	0.675
D1	-1170.034	991.6257	-1.18	0.238
D2	-1437.451	823.9839	-1.74	0.081
D3	1633.513	2522.935	0.65	0.517
D4	-2818.063	2479.247	-1.14	0.256
D5	-2805.858	2008.53	-1.40	0.256
C	9799.081	25590.31	0.38	0.702

sigma_u	0
sigma_e	2109.7017
rho	0 (fraction of variance due to u_i)

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg
 Test: Ho: difference in coefficients not systematic
 $\chi^2(16) = (b-B)'[(V_b-V_B)^{-1}](b-B) = 0.00$
 Prob>chi2 = 1.0000 (V_b-V_B is not positive definite)

Source: Author, using Stata 13

In a linear regression model on panel data, the Hausman test enables us to test the difference between the fixed-effects model, which is assumed to be convergent under the null hypothesis and the alternative hypothesis, and the random-effects model, which is assumed to be convergent and efficient under the null hypothesis but not convergent under the alternative hypothesis

H0: The appropriate model is Random effects. There is no correlation between the error term and the independent variables in the panel data model.

H1: The appropriate model is Fixed effects. The correlation between the error term and the independent variables in the panel data model is statistically significant.

The null hypothesis is rejected if the Hausman statistic is bigger than its critical value.

The Hausman test of our panel data is presented on the Table (4.5). The results of this test confirms that the fixed effect test is appropriate for the empirical analysis. Because the P Value is greater than the 5% hence, we conclude that previous result is reliable and it constitutes final result of our empirical study.

Based on the statistical results presented above, we conclude that:

The equity ratio (R3) explains the bank's resilience, both vary in the same sense. If the equity ratio increases, i.e., if the proportion of equity to total assets increases, this will have an upward impact on the bank's resilience.

Regarding the liquidity, the ratios (R4, R5 and R6) explain the resilience of Moroccan banks. (R4) refers to the total of deposits over the assets of the bank, if the deposits held by the bank increase, its liquidity will increase and subsequently its resilience will be improved.

(R6) the higher this ratio is, the higher the bank's liquidity is to cover short-term debts, the more likely the bank is able to absorb shocks

For rentability, the ratio (R7) presents the report of the Net Income to the Equity. If the net income increases, the bank's resilience will increase at the same time.

From our statistical analysis, we conclude that the resilience of Moroccan banks is determined by the bank's equity, rentability and liquidity situation.

Our results support previous research that has shown that banks with high levels of capital and liquidity have maintained their activity even in times of distress. (Ivashina & Scharfstein, 2010; Cornett and al., 2011; Gambacorta & MarquesIbanez, 2011; Ratnovski & Huang, 2009; Arjani & Paulin, 2013; Bui and al., 2017; Goodhart, 2014). Contrary to what has been cited in the previous literature, profitability does not determine the resilience of Moroccan banks. Size and risk also have no significant impact on Moroccan bank resilience.

Conclusion

After the succession of crises, the concept of resilience has gained momentum in various fields, including finance. It has become essential to ensure the proper functioning of the banking system in a fluctuating and unpredictable environment. A banking institution is resilient if it is able to prevent a shock or risk from materializing. In addition, it must be able to absorb the shock and eventually recover and maintain its activity after the crisis and improve its situation to increase its degree of resilience. In this context, the financial authorities have developed the new Basel III Accord, which aims to improve the ability of banks to face eventual crises and ensure their sustainability. This accord brought various measures mainly related to the capital and liquidity of banks.

The objective of this paper is to provide a theoretical contribution to resilience and to define the determinants of resilience of Moroccan banks.

Our empirical study consists of evaluating the relationship between a set of 14 explanatory variables reflecting profitability, liquidity, equity, rentability, risk and size of banks and the response Variable measured by the distance to default of Merton which represents the resilience.

After conducting the necessary statistical tests on the panel, we can conclude that the results have shown that the resilience of Moroccan banks is determined by liquidity, equity and rentability. These results have to be interpreted with care as they are based only on Moroccan banks. They cannot be generalized over the other banking sectors who do not present the same characteristics as the Moroccan banking sector.

The assessment of resilience can be more precisely examined through the stress tests; Lewrick and al.,(2020) have complemented the market-based resilience analysis through a stress test application.

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