Interest rate risk analysis in the Moroccan banking sector

L'analyse du risque de taux d'intérêt dans le secteur bancaire marocain

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Abstract:

The objective of this paper is to analyze the interest rate risk in the Moroccan banking sector while assessing the impact of the Baltic prudential measures. Considering the particularity of its activity, the bank is exposed to numerous risks. Interest rate risk is one of the risks threatening the stability and profitability of the banking industry. As a result of its transformation activity (long-short rate), the bank is structurally exposed to interest rate risk. Inspired by Stone's (1974) model, we apply a multifactor market model to the six Moroccan banks listed on the Casablanca Stock Exchange. To do this we consider a database observed over the period 2005-2019. In fact, we introduced four variables to the two-factor market model: the difference between the long-term rate (10-year bonds) and the short-term rate (52-week Treasury bills), the evolution of the total assets, the evolution of the interest margin and the dummy variable expressing the effect of the Basel prudential regulations. Our study has shown that the Moroccan banking sector is significantly threatened by rising interest rates. We have also shown that this threat is reinforced by the implementation of the Basel II restrictions.

Keywords: Interest rate risk; bank; prudential regulation; two-factor market model; bank risk.

Résumé :

Cet article a pour objectif d'analyser le risque de taux d'intérêt dans le secteur bancaire marocain tout en évaluant l'impact des mesures prudentielles baloises. En prenant compte la particularité de leur activité, les banques sont exposées à plusieurs risques. Le risque de taux d'intérêt est un risque bancaire parmi d'autres pouvant menacer la stabilité et la rentabilité de la place bancaire. Malgré qu'il a été pendant longtemps négligé en tant que risque bancaire de premier rang, l'établissement bancaire est structurellement exposé à ce risque de taux. Nous nous sommes inspirés du modèle de marché de (Stone, 1974). Il permet d'étudier l'effet des variations courantes de taux d'intérêt sur le rendement boursier des banques. Dans le cadre de notre étude, nous avons introduit quatre variables supplémentaires en fonction de nos objectifs de recherche : la différence entre les taux d'intérêt long terme (10ans) et court terme (52semaines), la taille du bilan, la marge d'intérêt et une variable muette exprimant l'effet de la réglementation bâloise. Ainsi, nous considérons les six banques marocaines cotées en bourse de Casablanca. Nous avons utilisé une base de données annuelle, observée sur la période de 2005-2019. Notre étude a prouvé que le secteur bancaire au Maroc est menacé par

le risque de taux d'intérêt, notamment en cas de variations haussières. Nous avons aussi montré que la réglementation prudentielle renforce cette menace.

Mots clés : Risque de taux d'intérêt, banque, réglementation prudentielle, modèle de marché à deux facteurs, risque bancaire

Introduction

Although interest rate risk has been relatively neglected as a primary banking risk, since the 1970s, many authors have been interested in analyzing interest rate risk for a banking institution. Since the end of the Bretton Woods fixed exchange rate system, the extent of interest rate volatility has increased and financial crises have multiplied. As a result, financial institutions, particularly banks, have realized the need to take seriously this risk. Especially since a small or large interest rate risk threatening one bank or banking group can jeopardize an entire financial system, whether locally or globally.

In a global financial context in perpetual mutation, we wanted to analyze the exposure to interest rate risk of the Moroccan banking system. the Moroccan financial center is among the most advanced in North Africa. also, the Moroccan banking sector is considered one of the most efficient in the MENA region. i plan to examine if it is threatened by interest rate changes (Sekali & Bouzahzah, 2021) .

This risk consists of the possibility of deterioration in the banking institution's situation as a result of a change in the structure and level of interest rates: capital losses on fixed-rate assets, narrowing of interest margins and triggering of off-balance clauses (Geissler et al., 1990). To analyze this risk for a banking institution, three main approaches are proposed:

- The market approach: This approach is based on stock market data and it would be the object of our work.
- The accounting approach: This involves using accounting data from the banks' balance sheets. In this framework, we use many methods based on the concept of duration.
- The mixed approach: This is based on both accounting and market data.

Our work consists in evaluating the exposure of the Moroccan banking sector to the interest rate risk while analyzing the effect of the Basel measures on this exposure. This by adopting the market approach. Thus we plan to answer the following problematic: Is the Moroccan banking sector exposed to interest rate risk?

To answer this question, we have adopted a hypothetical-deductive and econometric approach..

We will first discuss the measurement of interest rate risk according to the market approach. We will focus on the model proposed by (Stone, 1974) while reviewing the main results of the studies that have used it. Second, we will look at the consequences of the application of prudential restrictions. Third, we will specify the adjusted market model that we have adopted

to study the exposure to interest rate risk in the Moroccan banking sector. Finally, an analysis of the results will be the subject of the fourth part of this paper.

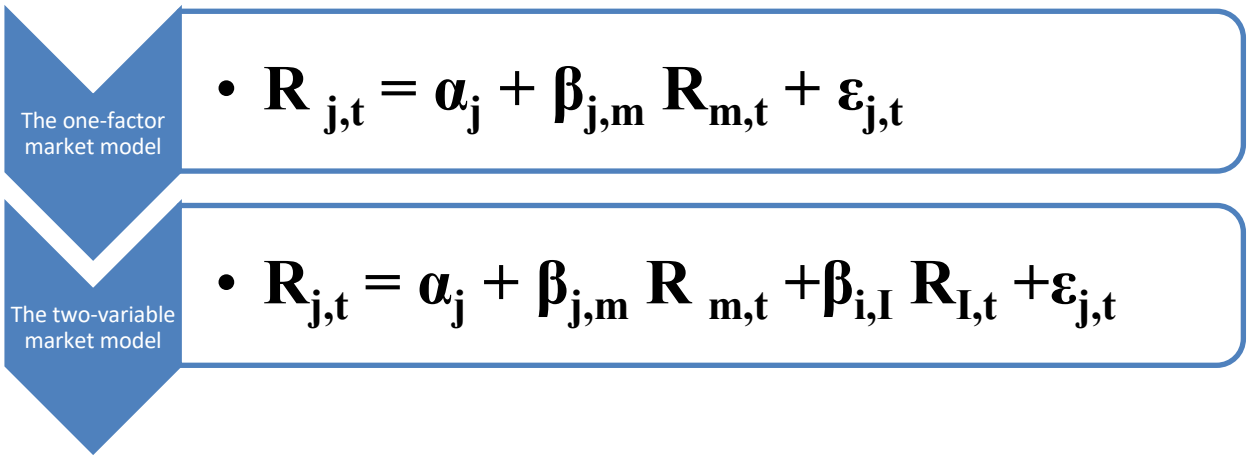
1. Interest rate risk analysis using the market approach.

The market approach consists of analyzing the effect of interest rate changes on the bank's market capitalization or share price.

1.1. Stone's model:

(Stone, 1974) was among the first to address this issue. Based on the one-factor market model proposed by (Sharpe, 1964), he developed a two-variable market model. In his view, the one-factor market model does not allow for the study of the bank's exposure to interest rate risk in an explicit manner. So he introduced the current interest rate variation in the basic market model.

Figure N°1 Market model adjustment



Source : Personal elaboration

Where Rj,t is the overall market return, RI,t is the return on the Zero Risk bond portfolio.

And:

$\beta_{j,m}$: measures the sensitivity of the stock market profitability of the j share to variations in the profitability of an equally weighted portfolio of all listed shares.

$\beta_{j,m}$: measures the sensitivity of the stock market profitability of the j share to variations in the profitability of a bond portfolio representing a wide range of maturities.

When the absolute value of the coefficient is large, the bank is exposed to interest rate risk. In other words, its value is conditioned by changes in the interest rate.

To express the effect of current interest rate changes, (Stone, 1974) used zero risk bond yields. Thus, when the coefficient $\beta i,I$ is greater than zero, the bank's stock return is unfavorably affected by short-term upward changes in interest rates, and vice versa.

Many authors have used the two-factor market model to highlight the effect of rate changes on bank stock returns.

1.2. Discussion of previous results

(Saunders & Yourougou, 1990) defended the existence of the sensitivity of banks' stock returns to changes in interest rates. They proved that commercial banks are the most sensitive. On their part (Bashir & Hassan, 1997) confirmed the causal relationship between the interest rate and stock returns of banks in the Arab Emirates. (Amarasighe, 2015) also confirms that bank stock returns are negatively and significantly sensitive to interest rate changes.

In principle, the results of the interest rate risk study for a bank converge towards the existence of a negative sensitivity between the stock return of banking institutions and rate variations. However, exceptions have been proven. (Vaz et al., 2008) found that Australian banks are rather positively sensitive to interest rate changes. (Ayub & Masih, 2013) demonstrated the non-existence of interest rate sensitivity in Islamic banks.

Other authors, such as (Scott & Peterson, 1986) and (Brewer & Lee, 1986), have introduced unanticipated interest rate changes. (Lynge & Zumwalt, 1980) and (Verma & Jackson, 2008), on the other hand, addressed the impact of the interest rate term in the analysis of interest rate risk exposure for a bank. In this sense, (Samarakoon & Hasan, 2000) suggest a positive sensitivity to the short-term rate, while (Gan et al., 2006) have verified the existence of a negative link between the bank's stock return and long-term rates.

In order to value the particularity of the banking institution, (Kwan, 1991) and (Borbolan, 1996) introduced the concept of accounting deadlocks as a function of maturity into Stone's (1974) model. They noted that the stock returns of banks are negatively sensitive to changes in long-term interest rates. On the other hand, the interest rate risk analysis remains independent of short-term accounting impasses.

Other studies dealing with the analysis of interest rate risk for a banking institution have focused on other accounting variables, in this case: the size of the balance sheet or bank revenues.

In fact, bank size has been a key accounting variable in several studies. (Galy, 1989) showed that small banks are the most threatened by interest rate risk. On the other hand, (Choi &

Elyasiani, 1992) suggested that the relationship between interest rate changes and size is a bell-shaped one. In other words, large and small banks are less exposed to interest rate risk.
(Goyau et al., 1998, 2002) have studied the impact of interest rate changes on bank performance. They deduced that the European, the Japanese and the American banking systems are immune to interest rate risk. They pointed out that the one-year rate positively and significantly affects the revenues of the banks studied.

2. Effect of the Basel prudential regulations

Prudential regulation is the set of rules that ensure the stability of the financial system, particularly the banking industry. It is an indispensable mechanism of banking banking supervision. It makes it possible to exercise surveillance over credit institutions, prevent and avoid the spread of systemic risk.
However, it must be recognized that on several occasions the expected results were divergent. Numerous studies have shown that the application of regulatory standards has perverse effects on the stability of the bank.

2.1. Adherents to prudential regulations:

(Berger et al,1995) have argued that the level of capitalization of a bank should reflect a sound financial position and a lower risk preference. This, they argue, reduces bank failures, especially systemic risk. (Jacques & Nigro, 1997) have shown that the introduction of risk-based capital standards significantly improves the capital ratios and reduces the portfolio risk of banks that have already capital ratios and reduces the portfolio risk of banks that have already met the regulatory the regulatory requirements.
(Godlewski, 2004), unlike (Koehn & Santomero, 1980), verified that the variation of capital and risk are negatively related. According to him, as is the case for (Van Roy, 2003), banks choose a riskier portfolio in order to compensate for the loss induced by the decrease in leverage. In fact, high capital ratios do not lead to increased risk, and thus provide greater financial stability.

2.2. Opponents of prudential regulation:

The works of (Peltzman, 1970) and (Mayne, 1972) are the first to clarify the debate on the effects of banking regulation on bank behaviour.
In this sense, (Barth et al., 1999, 2004) showed that the application of regulatory restrictions leads to a deterioration in the performance and stability of banks.This idea has been demonstrated by several authors, including (Quignon, 2008). He argued that most of the

banks that failed during the "Subprime" crisis were deemed adequately capitalized by the banking authorities. During the 2007-2008 crisis, (Bruno & Girod, 2008) have shown that banks respecting regulatory restrictions engage in riskier activities in order to increase their return on assets and cover their expenses. Indeed, after the subprime crisis, where banks were a key variable, the Basel Committee recognized the shortcomings of the Basel II prudential regulations applied during that period.

Other studies have elaborated on the need to take into account a number of contextual and bank-specific factors when imposing regulatory restrictions.

A bank's behavior with respect to regulatory standards differs according to its risk aversion. A bank with low risk aversion tends to engage in riskier portfolios. Of course, this is to improve profitability. (Koehn & Santomero, 1980), (Kim & Santomero, 1988) and (Rochet, 1992) have emphasized the importance of considering the risk weight associated with each asset. According to them, this measure hinders the bank from inflating the profitability of their capital by taking on more risk.

3. Multi-factor market model:

3.1. Specification of the model:

We adopted the market model of (Stone, 1974). In fact, we have adjusted the two-factor market model by introducing four new variables.

In this case, the interest rate spread and the size of the balance sheet to highlight the contribution of the accounting variable in the interest rate risk analysis for the bank. In order to reinforce the interest rate effect, we have introduced the effect of the slope of the term structure. Finally, we also evaluated the effect of the Basel prudential regulations on the bank's exposure to interest rate risk.

Thus, the adjusted multifactor market model is as follows:

$$R_{bt} = \beta_{0t} + \beta_{1t} V\_MASI_t + \beta_{2t} V\_52SEM_T + \beta_{3t} T10ANS\_T52SEM_t + \beta_{4t} V\_TOT\_ACTIF_t + \beta_{5t} V\_MI_T + \beta_{6t} Dummy * V\_52SEM_T + \varepsilon_t$$

Where :

- ✓ V_MASI: the overall stock market performance.
- ✓ V_52SEM: the 52-week Treasury Bill yield

✓ T10ANS_T52SEM: the difference between the long-term rate (10-year bonds) and the short-term rate (52-week Treasury bills)

✓ V_TOT_ACTIF: the evolution of the total assets

✓ V_MI : the evolution of the interest margin

✓ Dummy * V_52SEM : the dummy variable expressing the effect of the Basel prudential regulations

3.2. Data:

The multifactor model is estimated using annual data over the period 2005-2019. To carry out our study based on the market approach, we were interested in the six banks listed on the Casablanca stock exchange: ATW : AttijariWafa Bank, BCE : Bank Of Africa, BCI : Banque Marocaine pour le Commerce et l'Industrie, BCP : Banque Centrale Populaire, CDM : Crédit Du Maroc and CIH : Crédit Immobilier et Hôtelier.

For the rate variables, we chose the 52-week Treasury bill yield and the 10-year Treasury bond yield. As for the accounting data, we considered the evolution of the balance sheet size and the interest margin. The last variable dealing with the effect of prudential regulation is expressed by a dummy variable, taking the values: 0 before its implementation and 1 after its implementation. We have associated it with the evolution of the rate of return on 52-week Treasury bills. Given that the reference date is 2007, it corresponds to the date of implementation of the second Basel agreement.

It should be noted that our choice of variable was conditioned by the availability of data.

Tableau N°1: Summary of data used in the study

Variables	Abréviations	Signification
Bank's stock performance i.	V_ATW	$\frac{stock\ price\ (t) - stock\ price\ (t-1)}{stock\ price\ (t-1)}$
	V_BCE	
	V_BCI	
	V_BCP	
	V_CDM	
	V_CIH	
Rate of return on treasury bills.	V_52SEM	Rate (t) – Rate (t-1)
	T10ANS__T52SEM	Rate 10 years (t) – Rate 52 weeks (t)
Accounting variables	V_MI	$\frac{MI\ (t) - MI(t-1)}{MI\ (t-1)}$
	V_TOT_ACTIF	$\frac{TOT\ ACTIF(t) - TOT\_ACTIF(t-1)}{TOT\_ACTIF(t-1)}$
Market rate of return	V_MASI	$\frac{MASI\ (t) - MASI(t-1)}{MASI\ (t-1)}$

Periodicity	1. Data were collected as follows: o Bank stock prices and MASI index: daily. o Interest rates on 10-year and 52-week Treasury bills: monthly. o Banks' balance sheet totals and interest margins: annual. 2. The treatment in our work is on an annual basis.
Sources	✓ The Casablanca Stock Exchange. ✓ Bank-Al-Maghrib. ✓ Banque de données économiques, financières et sociales MANAR-STAT.

Source : Personal elaboration

3.3. Estimation procedure :

To estimate the multiple linear equations presented above, we adopted the least squares method.

However, to decide on the conservation of the variables introduced to the market model of (Stone, 1974), we have adopted the top-down approach. We adopted the top-down approach " backward"(Dujardin, 2008). We based ourselves on the coefficient R2 and the Akaike statistics. The equations considered for each bank are as follows:

Tableau N°2: The equations adopted for each bank

Banks	Equations
ATW	$R_{ATWt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} V\_TOT\_ACTIF_t + \beta_{4i} T10ANS\_52SEM_t + \beta_{5i} Dummy * V\_52SEM_t + \varepsilon_t$
BCE	$R_{BCEt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} Dummy * V\_52SEM_t + \varepsilon_t$
BCI	$R_{BCIt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} Dummy * V\_52SEM_t + \varepsilon_t$
BCP	$R_{BCPt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} V\_TOT\_ACTIF_t + \beta_{4i} T10ANS\_52SEM_t + \beta_{5i} Dummy * V\_52SEM_t + \varepsilon_t$

CDM	$R_{CDMt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} V\_TOT\_ACTIF_t + \beta_{4i} T10ANS\_52SEM_t + \beta_{5i} Dummy * V\_52SEM_t + \varepsilon_t$
CIH	$R_{CIHt} = \beta_{0i} + \beta_{1i} V\_MASI_{mt} + \beta_{2i} V\_52SEM_t + \beta_{3i} V\_MI_t + \beta_{4i} Dummy * V\_52SEM_t + \varepsilon_t$

Source : Personal elaboration

4. Estimation results:

Based on the explanatory variables adopted for each bank, we formed three groups. In the following, we will discuss the results group by group. The results of the estimation are as follows:

Tableau N°3: The equations adopted for each bank

	Banks	Variables	values of coefficients	R^2
Stone's model (1974) adjusted	ATW	V_MASI	1.2948*	92.45%
		V_52SEM	0.9286 (56%)	
		T10ANS_T52SEM	0.1435*	
		V_TOT_ACTIF	-1.0972**	
		Dummy*V_52SEM	-0.8098 (61%)	
	BCP	V_MASI	0.6027	87.95%
		V_52SEM	4.3890 (10%)	
		T10ANS_T52SEM	-0.0536	
		V_TOT_ACTIF	-1.0979*	
		Dummy*V_52SEM	-4.4256****	
	CDM	V_MASI	0.2450	92.59%
		V_52SEM	2.1364***	
		T10ANS_T52SEM	0.0731**	
		V_TOT_ACTIF	1.3437 (13%)	
		Dummy*V_52SEM	2.2510***	
	BCE	V_MASI	0.7047 (19%)	80.19%
		V_52SEM	5.5842**	
		Dummy*V_52SEM	-5.6420**	
	BCI	V_MASI	0.5111***	55.01%
		V_52SEM	-0.1672 (93%)	
		Dummy*V_52SEM	0.2123 (93%)	
	CIH	V_MASI	0.2011 (67%)	91.46%
		V_52SEM	12.1130*	
		V_MI	-1.7344*	

		Dummy*V_52SEM	-12.2239*	

Source : Eviews

In general, the explanatory power of the model is significant for all banks (R2 > 80%). however, it is relatively significant for the bank BCI (R^2 = 55%).

Group A:

We find that the coefficient associated with the variation in interest rates (of 52-week Treasury bills) is significantly different from zero, especially for CDM and BCP banks. It also has a positive sign for the three banks in group A. this means that all three banks are unfavorably sensitive to changes in rising interest rates. All three banks are long interest rate position.

Concerning the effect of the slope of the term structure of interest rates, the three banks react differently. In fact, the BCP and CDM banks are positively sensitive to the difference between long-term and short-term rates. On the other hand, the ATW bank is rather negatively sensitive to this rate variable. This is mainly due to the nature of their intermediation activity. In fact, when this coefficient has a positive sign, banks tend to commit to long-term, fixed-rate assets and short-term resources. While banks adopt a policy of credit and short-term investments and seek long-term resources, in the opposite case.

Similarly, the effect of changes in balance sheet assets is significatif, but the meaning differs from one bank to another. Thus for ATW and BCP banks, respectively first and second in terms of total assets in the Moroccan banking market, the sign of the coefficient is negative. On the other hand, the CDM bank, ranked seventh in terms of total assets, is positively sensitive to changes in balance sheet size. In this sense, (Goyeau et al., 1998) specified that the size of the bank conditions its exposure to interest rate risk. This was not observed in our study. In fact, these three banks react in the same way to interest rate variations.

The last explanatory variable expresses the effect of the Basel banking regulation. ATW and BCP banks are negatively affected by the implementation of the second Basel Accord in 2007. However, the CDM bank is favorably affected by prudential regulations.

Group B:

For this group we consider the BCE and BCI banks. We have retained the two explanatory variables of the (Stone, 1974) model and the dummy variable expressing the effect of prudential regulation.

We can see that the BCE bank is significantly and negatively sensitive to current interest rate variations. It is then said to be in a long position. It is therefore threatened by rising interest rates. This exposure is reinforced by the introduction of the Basel regulations in 2007 (β (Dummy*V_52SEM) <0).

As for the BCI bank, its share price performance is rather favorably sensitive to current interest rate changes, particularly upward ones. It is then said to be in a short position. In this case, it runs a risk if the trend of rate changes is downward.

Group C:

Group C consists only of the CIH bank. For the interest rate risk analysis, we adopted the four-variable market model. In addition to the two basic variables of (Stone, 1974), we introduced the effect of regulation and the interest margin.

We notice that the effect of the current variation of interest rates affects negatively and significantly the stock return of the CIH bank. It is then said to be in long position.

In the same way, the stock return of the said bank is also negatively sensitive to the evolution of the interest margin. This is an unexpected result. In fact, by introducing this variable, we wanted to analyze the indirect effect of interest rate changes.

Subsequently, the introduction of prudential regulations in 2007 increased exposure to interest rate risk, especially during upward movements in interest rates.

Tableau N°4: The Summary of the results of the analysis of the sensitivity of the stock return to interest rate changes

Groups	Banks	Interest rate position	Effect of the Baltic prudential regulation
A	ATW	Long	Negative
	BCP	Long	Negative
	CDM	Long	Positive
B	BCE	Long	Negative
	BCI	Short	Positive
C	CIH	Long	Negative

Source : Personal elaboration

Then we can say that whatever the vocation of the six banks object of our work, their reaction towards the current variations of interest rates is basically the same. Thus the share price of these banks, with the exception of the BCI bank, risks decreasing if the variations of rates are rising.

We suggest that the independence of our results from the composition of the shareholding, the legal status and the vocation of the banks is mainly due to the oligopolistic nature of the Moroccan banking market and its degree of concentration. However, our results converge with those found by (Stone, 1974).

Conclusion:

From the above, we can argue that the Moroccan banking place is significantly threatened by the current variations of interest rates, especially the rise in rates. Our result agrees with those found by many authors, namely, (Amarasighe, 2015),(Bulmash &Trovoli, 1991) and others. As we pointed out above, the Moroccan banking market is a concentrated one where banking intermediation is rather traditional (interest margins represent more than 60% of net banking income). We therefore expect a result similar to the one found by (Vaz et al., 2008). The latter have proved that Australian banks are positively sensitive to interest rate variations.

This exposure to interest rate risk has also been reinforced by the introduction of the Basel prudential regulations in 2007. In this sense, our result is consistent with those found by a large number of researchers, namely: (Koehn & Santomero, 1980), (Shrieves & Dahl, 1992), (Hellmann, 2002) and (Repullo, 2004).

In fact, taking into account the specificities of the banking markets, especially for emerging countries, is essential to achieve the expected objectives. this is not reflected in the Basel regulatory framework.

In this sense, several authors such as (Flannery & James, 1984), (Campbel, 1985), (Kwan, 1991) and (Borbolan, 1996) have insisted on the contribution of the introduction of accounting variables in the analysis of interest rate risk for a bank. Something we did not find in our study.

We hoped to verify the contribution of the accounting variable in the analysis of interest rate risk, but the confidential nature of these variables prevented us from achieving this objective.

In conclusion, we would like to emphasize that this work is only the beginning of a research process that will be very long. Thus, several avenues of research are possible:

- Enriching the analysis with accounting data and over a longer study period.

- Enrich the analysis by conducting a comparative analysis.
- Repeat the same approach by introducing variables specific to the Moroccan banking system.
- take into account unanticipated changes in interest rates.

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