

The Exposure of participative banks to changes in interest rates : Its emergence, impacts and potential measures to address them.

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Conflit d'intérêts : L'auteur ne signale aucun conflit d'intérêts.

Pour citer cet article MEZINE .A & YAACOUBI .A (2024) « The Exposure of participative banks to changes in interest rates : Its emergence, impacts and potential measures to address them», African Scientific Journal « Volume 03, Numéro 22 » pp: 0962 – 0998.

Date de soumission : Janvier 2024

Date de publication : Février 2024



DOI : 10.5281/zenodo.10824597
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Abstract

The specificities of participative banks expose them, not only to traditional credit, market and operational risks, but also to risks of a unique nature. Although their mode of operation is not based on interest rate, several studies have demonstrated that participative banks are susceptible to fluctuations in market interest rates. The balance sheet structure, customer behavior, the absence of a refinancing market specific to participative banks and the shortage of sharia-compliant hedging instruments, increase their exposure to interest rate risk and make its management more complex.

The objective of this paper is to provide answers to the problematic of exposure of participative banks to interest rate risk. To do this, we will adopt a theoretical approach based on a literature review, allowing on the one hand, to study the extent to which Moroccan participative banks may be impacted by changes in market reference rates, on the basis of the experience of participative banks operating in countries with a dual banking system and an underdeveloped or nonexistent Islamic financial market. Furthermore, we will illustrate the various practices and techniques developed to manage this risk.

We intend to initially investigate this issue, its potential effects, and the various measurement and management techniques that can be employed to mitigate it. And subsequently, to present the best management practices that Moroccan participative banks, considering their specificities, can implement with the aim of addressing their exposure to such risk.

Our study states that Moroccan participative banks are exposed to an extrinsic interest rate risk due to their operational environment. Despite their exposure, they lack the same flexibility as conventional banks when it comes to managing the potential impact on their financial situation. The recommendations provided in this paper focus notably on innovation and financial engineering in Sharia-compliant hedging financial instruments, the implementation of a reserve policy for risk management, and financial market education.

Keywords : Participative banks, interest rate risk, sensitivity, duration, ALM

Résumé

Les spécificités des banques participatives les exposent, en plus des risques classiques de crédit, marché et opérationnel, à des risques de nature unique. Bien que leur mode de fonctionnement est excepte du taux d'intérêt, plusieurs études réalisées ont démontré que les banques participatives se trouvent exposées aux fluctuations des taux d'intérêt du marché. La structure bilancielle, le comportement de la clientèle, l'absence d'un marché de refinancement propre aux banques participatives et la pénurie des instruments de couverture conformes à la charia, favorisent davantage leur exposition au risque de taux d'intérêt et rendent sa gestion plus complexe.

L'objectif du présent article est d'apporter des éléments de réponse à la problématique de l'exposition des banques participatives au risque de taux d'intérêt. Pour ce faire, nous utilisons une approche théorique basée sur une revue de littérature, permettant d'une part, d'étudier dans quelles mesures les banques participatives marocaines pourront être impactées par les variations des taux de référence du marché, en se basant sur l'expérience des banques participatives exerçant dans des pays caractérisés par un écosystème dual et un marché financier islamique sous développé ou inexistant. Et d'autre part, de présenter les diverses pratiques et techniques développées pour gérer ce risque.

Nous nous proposons d'étudier, dans un premier temps, cette problématique, ses effets potentiels et les différentes techniques de mesure et de gestion pouvant être utilisées pour en faire face. Et de présenter, par la suite, les bonnes pratiques de gestion que les banques participatives marocaines, tenant compte leurs spécificités, peuvent mettre en place dans l'objectif d'atténuer leur exposition audit risque.

Notre étude affirme que les banques participatives Marocaines se voient exposées à un risque de taux d'intérêt extrinsèque suite notamment à l'environnement dans lequel elles exercent. Toutefois, elles n'ont pas la même souplesse que les banques conventionnelles pour gérer ses répercussions potentielles sur leur situation financière. Les recommandations apportées dans cet article portent notamment sur l'innovation et l'ingénierie financière en matière des instruments financiers de couverture conformes à la charia, la mise en place d'une politique de réserve pour la gestion du risque ainsi que l'éducation financière du marché.

Mots clés : Banques participatives, risque de taux d'intérêt, sensibilité, duration, ALM

Introduction

Interest rate risk exposures are considered very important for both conventional banks and institutions offering Islamic financial services (Khaliq, Thas Thaker, Thas Thaker, & Pitchay, 2017). As defined by the IFSB (2005), interest rate risk exposure is defined as the rate of return risk. This reflects on the impact of changes in market interest rates, on the rates of return, on their assets, and on their liabilities.

(Khan & Ahmed, 2001) consider the rate of return as the most critical risk to which participative banks are exposed. Its management should be of great concern, particularly for participative banks operating in a hybrid ecosystem.

Several empirical studies, carried out in countries characterized by the existence of both conventional and participative banks, affirm the existence of correlation and causality relations between the interest rates of conventional banks, the rates of return offered by participative banks on investment deposits, the volumes of deposits of both banks, and the central bank policy rate.

Moreover, the assets of participative banks are mainly composed of financing granted at a fixed profit margin rate which are protected against changes in market rates. While their liabilities, largely composed of paid investment deposits are correlated with market interest rate movements. This rate position makes participative banks vulnerable to rate of return risk.

Threatened by market rates fluctuations, banks often wish to continuously assess their exposure to interest rate risk by referring to multiple financial indicators. They may also intend to anticipate the possible impact of unfavorable and/or favorable changes in interest rates on their earnings, the economic value of their equity and many other variables.

In order to measure their exposure to interest rate risk, banks generally rely on asset liability management techniques. (Bitner & Goddard, 1992), consider asset liability management as the set of techniques allowing the management of interest rate risk weighing on the bank's balance sheet, the management of liquidity needs inherent in banking activity, to preserve the capital of the bank and to increase its result.

Given their specificities, participative banks do not have the same flexibility as conventional banks in managing rate of return risk. Their balance sheet structure, customer behavior, the

absence of a clean refinancing market and the shortage of Sharia-compliant hedging instruments, make the management of such risk more complicated for these institutions.

We intend through this article to study the issue of participative banks's exposure to changes in market interest rates, its potential impact on these fledgling institutions and the various measurement and management techniques that can be used to face them.

To accomplish this objective, the present work will be organized into two parts, first, we will briefly provide the characteristics of participative banks with regard to financial intermediation, based on the principle of loss and profit sharing as an alternative to traditional interests. Then, in the literature review, we will examine the extent to which participative banks are exposed to fluctuations in market rates and what are its various potential effects that may impact the financial situation of these institutions, drawing upon a sample of work conducted in countries characterized on the one hand by a hybrid ecosystem, where the target clientele remains common, and on the other hand, an underdeveloped or non-existent Islamic financial market.

Subsequently, in the second part, we intend to present the different techniques of measurement and management of this risk. In this context, a brief review of conventional techniques in this area will be established.

Our objective will be to provide elements of response to the exposure of Moroccan participative banks to interest rate risk, by presenting the various potential measures that these institutions, considering their unique specificities, can set up to hedge against this type of risk.

1. EXPOSURE OF PARTICIPATIVE BANKS TO FLUCTUATIONS IN INTEREST RATES : EMERGENCE AND IMPACT

1.1. REVIEW OF THE SPECIFICITY OF PARTICIPATIVE FINANCIAL INTERMEDIATION

Participative finance differs from conventional finance by respecting the principles of Sharia Law and their application in its operating mode. The prohibition of interest is the essential distinguishing point between the two financial systems. As an alternative to traditional interest, participative finance is based on sharing losses and profits. In addition, the participative banks intervene as a partner with a profit and loss sharing whose shares are agreed in advance. This makes Islamic finance a participative finance following the various active and passive partnership contracts it has developed.

The origin of partnership contracts based on the principle of sharing losses and profits is due to the old financing practices used by Arabs even before the arrival of the Muslim religion (Rammal, 2004). For this historical reason, many researchers believe that financial partnership instruments, based on the principle of sharing profits and losses, present the most authentic formula of participative contracts (Ariff, 1988).

To carry out their intermediation activity, fulfill their commitment to their customers and keep their competitiveness in generally hybrid markets characterized by the existence of both conventional and participative banks, the latter offer a range of interest-free financing products and do not raise funds based on guaranteed and remunerated deposits at a fixed interest rate to avoid interest payments (Toumi, 2011).

Like conventional banks, participative banks collect customer resources to use in financing the economy. On the other hand, the typology and management of these resources differs remarkably from those of conventional banks. The mobilization of funds in the form of participative investment accounts is the originality of participative banks. These investment accounts are managed according to the Mudaraba principle. The latter connects an investor, provider of funds, and an entrepreneur who takes care of their management.

The holders of the participative investment accounts represent the contributors of the funds, while the participative bank plays the role of manager of these funds on behalf of its depositors. As a result, the relationship between investment account holders and the bank is not limited to a simple creditor-debtor relationship, as is the case with conventional banks, but rather an entrepreneur-investor relationship.

The participative bank mobilizes the funds collected through participative investment accounts, not to be remunerated based on an interest rate defined in advance, but rather on the basis of a variable rate of return generated according to the assets financed by these investment funds. The remuneration of these accounts is based on sharing the real profit generated by the investments of the bank financed by the participative investment accounts, according to a sharing established between the participative bank and the holders of the investment accounts. Moreover, the losses are borne by the fund providers, who hold the investment accounts, unless and only if they were the result of mismanagement or negligence on the part of the bank. In this case, they will be deducted from their share of the profit (AAOIFI, 2008).

As a result, participative financial intermediation develops a double agency relationship based on the principle of sharing losses and profits, two-tier Mudaraba, between the bank and the depositors of the investment accounts on the one hand and between the bank and the entrepreneurs on the other. (Ahmad, 1947), qualifies the two-tier Mudaraba as a suitable basis for participative financial intermediation. For his part, (Siddiqi, 1998), qualifies the intermediation of the double Mudaraba of pure intermediation.

Most authors of the participative economy have argued that the two-tier Mudaraba financing method, based on the principle of sharing losses and profits, offers ideal products of participative finance, because in principle, these products have the ability to bring socio-economic benefits (Badaj & Radi, 2017). However, this specific mode of intermediation does not exclude the exposure of these participative institutions to a certain number of risks related in particular to competitive aspects.

1.2. EXPOSURE OF PARTICIPATIVE BANKS TO FLUCTUATIONS IN INTEREST RATES : LITERATURE REVIEW

Because of their specificities, participative banks are exposed to two types of risks, traditional banking risks similar to their conventional counterparts, and risks of a unique nature due to the particularity of the contracts used, the remuneration system of the investment accounts employed and the generally hybrid environment in which they operate (Khan & Ahmed, 2001) (Sundararajan & Errico, 2002) (Grais & Kulathunga, 2007) (Causse & Hideur, 2010).

Displaced commercial risk is the main risk specific to participative banks. This risk results from the mobilization of funds by the participative bank in the form of participative investment accounts (Toumi & Viviani, 2013). The displaced business risk arises more specifically from the behavior of investment account holders, who, dissatisfied with the remuneration offered by their bank, can withdraw their funds, putting the institution at serious risk of liquidity (IFSB).

AAOIFI 1999, identifies the displaced commercial risk as the probability that the bank is not able to compete with other banks, conventional and/or participative, because of a low and non-competitive rate of return compared to those of the market on participative savings or investment accounts.

As evidenced by several studies conducted to analyze the correlation and causality relationships between the interest rates of conventional banks, the rates of return on participative investment deposits and the volumes of deposits of both banks, which we will present in the following,

participative banks are not completely immune to interest rate risk even if their products are not based directly on the latter.

A Malaysian study of data from Malaysian banks using the adaptive expectations model every month from January 1984 to December 1998 (Haron & Ahmad, 2000) concluded that there is a significant negative relationship between the interest rates of conventional banks and the stock of participative investment accounts of participative banks. The results obtained claim that an increase in conventional interest rates causes a decrease in the level of participative investment deposits. This means that customers who place their deposits in savings and investment accounts are guided by looking for the bank offers that offer the best profit.

Also, in Malaysia, (Kaleem & Isa, 2003), based on the Granger causal test, a study was conducted on a monthly basis on the rates of return offered by commercial banks, finance companies, and investment banks in a period from January 1994 to December 2002 to identify the relationship between interest rates offered on term accounts and interest rates offered on participative investment accounts. The results demonstrated a causal link between the studied parameters, and that the variability of conventional interest rates causes the variability of rates of return on participative investment deposits. The overall results conclude that participative banks take interest rates into account before adjusting the rates of return on their deposits.

For its part, (Bacha, 2004), conducted a study on the impact of a change in interest rates on rates of return and volumes of participative investment deposits, whose objective was to empirically examine the correlation and causality links between these variables based on the Granger causality model applied to the monthly aggregate data of the Malaysian conventional and participative banks of the period from January 1994 to July 2003. The results obtained confirm that there is a significant relationship between interest rates, the rates of return offered by participative banks on participative investment accounts and the volumes of conventional and participative deposits. Indeed, according to the results of the study, the fluctuation of conventional interest rates causes the fluctuation of the rates of return on the deposits of the participative banks. Similarly, variability in the volume of deposits in conventional banks causes variability in the volume of participative investment deposits. According to the author, by operating in a dual system characterized by the existence of both conventional and participative banks, the latter are exposed to interest rate risk.

(Kassim, Abd Majid, & Yusof, 2009) Conducted a study in Malaysia on monthly bank data between 1999 and 2006 using a VAR-based model to analyze the sensitivity of participative banks to changes in monetary policy. The results obtained indicate that participative banks are significantly more affected by monetary policy changes than conventional banks. The authors showed that changes in key interest rates have an impact on the stock deposits and financing of participative banks. Particularly, when interest rates rise, depositors from participative banks migrate to conventional banks and vice versa.

These different results are similar to the findings of other Malaysian market studies such as those conducted by (Kader & Leong, 2008); (Chong & Liu, 2009); (Zainol & Kassim, 2010); (Adebola, Dahalan, & Wan Sulaiman, 2011); (Ito, 2013); (Anuar, Shah, & Mohamad, 2014).

In a more recent study, conducted by (Khaliq, Thas Thaker, Thas Thaker, & Pitchay, 2017), where they tried to measure the sensitivity of the yields of Malaysian participative banks and to identify the different financial and economic variables contributing to duration spreads among these banks, including the size of the bank, its ROA, annual GDP and inflation rate, all based on a duration gap analysis applied on bank data covering 5 years (2008-2012). Overall, the results obtained clearly demonstrate that participative banks are exposed to interest rate and rate of return risk. In addition, they group size, equity and financings as the main financial factors determining the duration spreads of participative banks. While GDP, the rate of return on investment accounts and inflation are considered economic factors.

Even more recently, (Shifa, Islam, M. Kabir, & Mamunur, 2021), have studied the dependence of participative rates of return on conventional rates in the Malaysian market using a causality study model based on the Toda-Malaysian Yamamoto applied on monthly bank data covering the period from January 2009 to April 2018. The study found that rates of return on deposits and financings of Malaysian participative banks are influenced by both the Malaysian central bank's policy rate and conventional bank rates. Moreover, a profit maximization behavior was identified among clients of participative banks.

In Indonesia (Rachmawati & Syamsulhakim, 2004) conducted a study to determine the factors affecting the volume of deposits of participative banks, managed by the Mudaraba principle, including the rate of return served by the latter, using a co-integration model applied to quarterly time series recorded over the period 1993 to 2003. The results obtained indicate that there is a positive long-term relationship between the studied parameters and that the volume of deposits

based on Mudaraba in Indonesia depends on the rate of return offered by participative banks on these deposits. Thus, according to the authors, Indonesian depositors are indeed influenced by the principle of profit maximization.

In a similar study conducted by (Kasri & Kassim, 2009), looking at data from Indonesian banks from March 2000 to August 2007, using the autoregressive vector, whose objective was to present the determinants of the savings of Indonesian participative banks, the results obtained highlight the significant role of the conventional interest rate in determining the level of savings in participative banks. Specifically, a higher volume of investment deposits is significantly correlated with a higher participative rate of return and a lower conventional interest rate. In addition, the study reveals the existence of an inappropriate commercial risk between participative and conventional banks, so that depositors of participative banks, following a profit maximization behavior, transfer their funds to conventional banks when the rate of return provided by the participative banks is significantly lower than the interest rate of their conventional counterparts.

In the same context, a study was conducted in Pakistan, between 2006 and 2011, based on a cointegration and error correction model applied to monthly bank data from January 2007 to December 2012, where (Akhter, Shahbaz, & Akhtar, 2017) showed a significantly negative relationship between the volume of deposits of participative banks and the interest rates of conventional banks, and that the variation of interest rates of conventional banks impacts the volume of participative bank deposits, and that an increase in interest rates increases the volume of deposits of conventional banks but decreases that of participative banks.

In Turkey, (Yüksel, Canöz, & Özşarı, 2017) conducted a causal analysis on the monthly, quarterly, semi-annual and annual data of conventional and participative banks for a period from 2000 to 2016, to identify the relationship between profit-sharing and interest rates. According to the results of the analysis, it was determined that there is a significant causal relationship between the parameters studied. Thus, it was concluded that the interest rate of conventional banks is the main basic indicator of the profit participation rate of participative banks in Turkey.

As can be understood from this literature review, there are many studies by different researchers in several countries that have focused on the interactions that exist between rates of return on investment accounts, stock deposits of participative and conventional banks and interest rates.

These same studies also confirm that a significant proportion of clients of participative banks are motivated by maximizing their profits.

Following our review of the literature, all the studies presented show that there is a long-term relationship linking the rates of return offered by participative banks on investment deposits, the overall volume of deposits of the latter, the interest rates offered by conventional banks on term deposits, the stock deposits of the latter and the key rate of the central bank of the country.

Indeed, the fluctuation of interest rates of conventional banks leads to the variability of rates of return on investment deposits in participative banks. It also leads to an increase in the volume of conventional deposits and a decrease in that of participative banks. In addition, some studies reveal the behavior of participative banks, which under commercial pressure, adjust their rates of return up and down according to the fluctuations of conventional banks rates, in order to remain competitive on the market and protect against the risk of leaking deposits.

Moreover, unlike conventional banks, participative banks have less flexibility in terms of their assets, since the majority of their financing is granted at fixed profit margin rates and is protected against changes in market rates. This exposes the results of these institutions to changes in market interest rates and that an upward variation in the latter will lead to a decrease in their net bank margin. This leads to a higher exposure to the rate of return risk. ((Rosly, 1999); (Khan & Ahmed, 2001); (Kaleem & Isa, 2003); (Bacha, 2004); (How, Karim, & Verhoeven, 2005)).

Like the Malaysian, Indonesian, Pakistani and Turkish participative banks, the Moroccan Islamic banks, operate in a dual ecosystem characterized by the presence of both conventional and participative banks. As a result, the two banks' target clientele remains common. This reminds us of the different results obtained following various studies conducted on participative banks operating in countries with the same characteristics as Morocco.

Moreover, the Moroccan ecosystem is incomplete, following the lack of a financial market specific to participative banks, in addition to a shortage of refinancing and risk-hedging instruments. This implies that these institutions are somewhat dependent on their parent banks, in particular, for any refinancing.

To avoid any kind of interest loans, the Moroccan authorities have made available to participative banks a refinancing instrument governed by a Wakala contract, based on a rate of

return agreed in advance, between the participative bank and its parent bank. The rate of return corresponds to the share of profits accruing to Mouakil (Parent Bank), generated as a result of investments made by Wakil (Participative Bank), which on its part is entitled to a management fee. In practice, this rate of return is calculated by the parent bank and corresponds to the cost of the resource, based on the market reference rates, increased by a management cost, a risk cost and a profit margin.

In this context, Moroccan participative banks may be exposed to an extrinsic interest rate risk due in particular to the environment in which they operate. Therefore, we propose to present what follows the different techniques of measurement and management of the current risk, like the different conventional practices as well as the experience of the participative banks of other countries in this matter. The objective is to present in the form of suggestions, the best measurement and management practices that Moroccan participative banks can put in place to mitigate their exposure to this kind of risk.

2. INTEREST RATE RISK MANAGEMENT : BEST PRACTICES

2.1. INTEREST RATE RISK AND MEASUREMENT INDICATORS

Interest rate risk is defined as the risk incurred in the event of changes in interest rates for balance sheet and off-balance sheet operations, with the exception, where appropriate, of operations subject to market risks (Banque de France, 1997). The latter presents the risk of loss suffered in the event of unfavorable movements in commodity prices, currency prices and share prices (M'rad, 2008).

Interest rate risk is a key risk for credit institutions since almost all of their balance sheet stocks generate income and expenses that are, in the longer term, indexed to market rates. Market rates are volatile and this volatility affects results (Bessis 1995).

Generally, the risk of global interest rates is manifested as soon as there is an indexation on market rates. The main factors that may lead to the bank's exposure to this type of risk are :

Imperfect backing of uses and resources : A difference in maturity and/or type of rate between assets and liabilities leads to exposure to interest rate risk. A gap between the maturity of uses and resources with the same type of rate (fixed, variable indexed on the same market rate or with an identical revision date) leads to exposure to interest rate risk. Thus, a backing of the elements having the same amortization profile (an identical lifespan) but with different types of rates makes the institution vulnerable to changes in market rates.

An imperfect correlation between received and paid rates : Interest rate risk can cause a spread between received and paid rates on assets and liabilities with the same amortization profile (maturity) and type of rate (variable). This difference (spread) may be due to a reliance of uses and resources indexed on different market rates, or on the same rate but with a different revision date.

Implicit options : The exposure of financial institutions to interest rate risk may be due to hidden, even implicit, options related to banking products. The most well-known implicit options are prepayments of bank loans and withdrawals of deposits placed by the bank's customers. They generally come back to arbitrations conducted by customers according to market rate movements.

In particular, interest rate risk arises from differences in the bank's interest rate-sensitive assets, both passive and off-balance sheet, due to fluctuations in market rates. Unfavorable rate developments often lead to a decline in the result and/or economic value of the bank's equity. For this reason, banks pay particular attention to interest rate risk and its management.

Managing risks means defining them, identifying them, measuring them, pricing them, and ultimately sometimes assuming them, sometimes reducing them with appropriate tools (Hassoune, 2008). These are all management techniques and tools used to measure and control the risks to which financial institutions are exposed (Bessis, 1995).

The deregulation of financial activities, the acceleration of financial market volatility and the extensive competition between the various institutions involved in the markets contributed to the growth of asset liability management as a discipline in its own right in the banking environment.

Appeared in the United States in the early 1980s, as a technique close to actuarial and backing practices for specialists in the banking sector, asset liability management is now recognized by all financial institutions as an essential component of effective financial management.

Asset liability management focuses in particular on financial risks. The emergence of the latter is generally the cause of the vagaries of the financial markets. They precisely include the risks related to fluctuations in interest rates, obtaining liquidity and the risks of losses on market operations.

Several authors have been interested in asset liability management and have contributed to its development over time. The table below presents the visions of some authors on the ALM and its purposes.

Table N°1 : The purposes of asset liability management

Authors	Definition provided
(Levasseur & Quintart, 1990)	The use of asset liability management as a management tool, in development since the 1980s, is the result of a more active desire to limit risk. The techniques and tools of asset liability management allow better identification, accurate quantification, more elaborate planning and the most appropriate management of financial risks.
(Bitner & Goddard, 1992)	The objectives of an asset liability manager are summarized in the management of the interest rate risk weighing on the bank's balance sheet, the management of the liquidity needs inherent in the banking activity, to preserve the capital of the bank and to increase its result.
(Bessis, 1995)	Asset liability management consists of quantitatively defining the main balance sheet balances, according to funding constraints, prudential constraints, global risk limits, and performance objectives. It is indeed a global balance sheet management tool.
(Dubernet, 1997)	The function of asset liability management is to manage financial risks : interest rate, liquidity, foreign exchange and counterparty risks in the financial sphere. It also participates in the management of the institution's funds by helping to define the objectives of their level and profitability. So, it's managing the overall balance sheet.
(Dubernet, 1997)	Asset liability management aims to confine to the limits consciously determined the possible negative consequences of financial risks mainly liquidity risk, interest rate risk and foreign exchange risk. It seeks to achieve this objective under the best conditions of profitability. This requires the measurement and analysis of financial risks and leads to recommendations for action.

(Demey, Frachot, & Riboulet, 2003)	Asset-liability management refers to all liquidity, interest rate and foreign exchange risk management techniques within the scope of a banking network's commercial activities.
(Delimal & Roturier, 2007)	Asset-liability management can be defined as the process of planning, organizing and controlling volumes, maturity and rates of assets and liabilities to minimize interest rate risks, exchange rate and liquidity while maintaining a good level of profitability.
(Brom, 2009)	Asset-liability management is intended to measure and manage risks arising from factors such as interest rate volatility, exchange rates and the availability of funds (liquidity).
(Vintzel, 2010)	Asset liability management seeks to measure and hedge interest rate, liquidity and foreign exchange risk on the balance sheet. It is a global and coordinated method allowing a bank to manage the composition and adequacy of all its assets, liabilities and off-balance sheet.
(Coussergues, Gabteni, & Gabteni, 2020)	Asset liability management is about optimizing the profitability-risk relationship, which is the two essential dimensions of any financial decision. The risks considered by the GAP are liquidity, interest rate and foreign exchange risk.
(Rouach & Naulleau, 2020)	Asset liability management consists of coordinating the use of the bank's assets and liabilities to maximize profitability as part of sound management of risks, particularly interest rates, liquidity and foreign exchange and under regulatory constraints.
(Rouach & Naulleau, 2020)	The asset-liability management service provides information on refinancing and debt scenarios that can be considered given the growth and downside projections of activities, already scheduled launches, new offers or expected acquisitions.

Canadian Society of Actuaries ¹	Asset-liability management refers to a business management approach to coordinate asset and liability decisions. It is, therefore, an ongoing process, involving the formulation, implementation, control and revision of asset and liability strategies to achieve financial objectives, given a certain risk tolerance and constraints. Asset-liability management is crucial for any institution that needs to invest capital to meet its commitments and to ensure balanced financial management.
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Source : Established by the authors

The asset liability management of interest rate risk, the object of this work, consists in having the rules allowing to follow, measure and limit the exposure of financial institutions to changes in market rates and control their impact on economic value and earnings, following defined approaches that we will present in the following.

The measurement of interest rate risk according to asset liability management is based on two main methods : **the gap method**, which is relative to the analysis of margins – MNI – and **the duration method**, which is concerned with the sensitivity of the economic value – EVE- (Bitner & Goddard, 1992); (Bessis, 1995); (Dubernet, 1997); (Darmon, 1998). (Augros & Queruel, 2000). (Coussergues, Gabteni, & Gabteni, 2020).

The gap method

Several authors have referred to the rate gap method to measure the impact of interest rate fluctuations on the bank's bottom line. Its appearance dates back to the 1960s and 1970s in American banks. Recognized as a method that consists of analyzing the differences between assets and liabilities, sensitive to changes in market rates, may impact the bank's results following a change in the latter.

As a rate gap or deadlock, the level of the net interest margin obtained according to the difference between the returns of the uses (assets) and the cost of the resources (liabilities) at a given date taking into account the variations of the market rates. The rate gap is zero at the

¹ (CIA) is the national organization of the actuarial profession in Canada. It was incorporated March 18, 1965.

current date because the balance sheet is balanced, which is why the calculation of dead ends is projected.

The projection of dead ends represents the level of the margin to be perceived over a defined horizon. This horizon is determined in maturity classes (schedule) according to the maturities and revision dates of the rates of assets and liabilities, sensitive to changes in market rates, held by the bank. It makes it possible to anticipate the actions to be carried out to maintain the result of the bank at the desired levels.

The projection of interest rate gaps is a basic tool for measuring and managing interest rate risk. It requires, in advance, a breakdown of the stock and interest flows received and paid according to their maturities and type of interest rate. For their part, positions whose maturity and/or type of rate are not clearly determined, in this case, sight deposits, require in-depth analysis to assign them pay-out agreements.

Similarly, the hidden options, generally linked to the arbitrations conducted by the bank's customers according to changes in interest rates, of which there are mainly, on the one hand, changes in the characteristics of loans, such as early repayments and term changes, and on the other hand, changes in remuneration such as the change in the type of rate, require modeling choices in order to take them into account in the calculation of gaps.

Once the above measures have been established, the institution calculates and projects its rate gaps over a defined horizon and according to a defined schedule, in order to emerge, on the one hand, its long/short rate position based on the stocks held at the time of calculation (t_0) and on the other hand, in projection and for each schedule, its positions inflows at fixed and variable rates on the basis of interest paid and those received.

The accounting gap allows the bank to define its position, long or short, at a given time, based on the stock assets and liabilities held and recorded in the balance sheet. It is calculated as follows :

$$ACCOUNTING\ GAP_T = VRA_T - PTV_T$$

Of which :

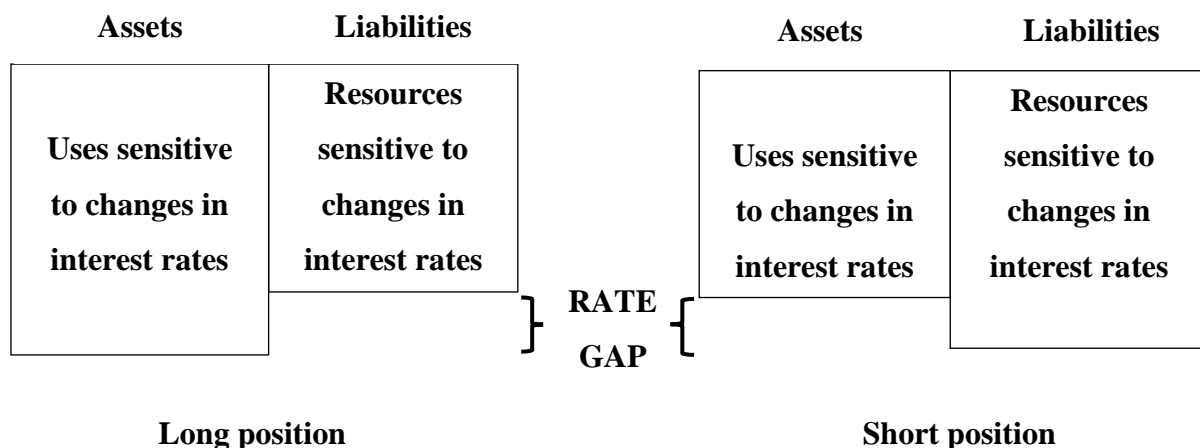
- VRA : Stock of variable-rate assets
- VRL : Stock of variable-rate liabilities

As previously presented, the accounting gap is an instantaneous gap, calculated based on the stock assets and liabilities held by the bank at a given date and according to a balanced balance sheet. Also, the accounting gap can be defined differently following the calculation of the interest rate sensitivity ratio, which is equal to :

$$IRSR = \frac{\text{Total assets sensitive to rate changes}}{\text{Total liabilities sensitive to rate changes}}$$

A zero-accounting gap or an IRSR² equal to 1, indicates that the current net margin obtained is insensitive to changes in interest rates. While an accounting gap greater than 0 or a sensitivity ratio greater than 1, means that the bank is in a long position. Otherwise reflects a short position.

Figure 1 : The Short/ Long Rate Position



Source : Established by the authors

- **A short position** represents a situation where the bank holds more liabilities than assets sensitive to changes in interest rates. This position is considered favorable when rates rise since the bank will be able to benefit from it to make investments in the market and improve its results. On the other hand, a change in interest rates may negatively impact its net margin.
- **A long position** means that the total assets stock exceeds the total liabilities. This situation is favorable in the event of a fall in interest rates because the bank will be able to take advantage of this to refinance itself on the market to cover its gaps. In a long position, a rise in rates will negatively impact the bank's results.

² Interest rate sensitivity ratio

The accounting or instantaneous gap is calculated in stock, based on the stock held, on the date t_0 . It measures the sensitivity of the current net margin to changes in interest rates. However, it does not conclude on the sensitivity of the future margin to rate changes. The fixed and variable rate flow gap method is derived from the instantaneous gap method. It is made in projection, on a defined horizon and divided into schedules, considering the interest received and paid.

The horizon $[0, H_n]$ of the projection is divided into sub-periods (timelines) constituting a maturity profile according to the maturities and the dates of revision of the rates of the assets and liabilities of the bank. It is generally presented as follows :

$$H = [0, H_1], [H_1, H_2], [H_2, H_3], [H_3, H_4] \dots [H_n, H]$$

The gap inflows at fixed and/or variable rates are calculated for each schedule to highlight the bank's fixed and variable net margin considering the inputs and outputs (interest received and paid) expected in the time interval.

- **The fixed-rate flow gap** allows the bank to determine its fixed margin to be received based on the expected cash flows in and out of a given schedule $[H_i, H_n]$ and which are known, certain and not subject to fluctuations in market rates up to maturity. The fixed margin is insensitive to changes in rates. The calculation of the gap in fixed rate flows is as follows :

$$\begin{aligned} & \text{GAP in Fixed Rate Flows } [H_i, H_n] \\ & = \\ & \text{Fixed Rate Asset Returns } [H_i, H_n] - \text{Fixed Rate Liability Remuneration } [H_i, H_n] \end{aligned}$$

- **The variable-rate flow gap** allows the bank to define the margin to be received based on the cash flows in and out of assets and liabilities sensitive to the rates expected for a given schedule $[H_i, H_n]$. The variable rate flow gap considers interest rate revisions, the date of the revision and the degree of the revision. Thus, the variable rate gap corresponds to the difference between assets and liabilities of a different rate nature (fixed rate assets versus variable rate or revisable liabilities and vice versa). This gap is defined according to the following calculation :

$$\begin{aligned} & \text{GAP in Variable Rate Flows } [H_i, H_n] \\ & = \\ & \text{Variable Rate Asset Returns } [H_i, H_n] - \text{Variable Rate Liability Remuneration } [H_i, H_n] \end{aligned}$$

Gaps inflows are generally calculated through a schedule table showing the margin to be collected for each period.

Table N°2 : Interest Rate Gaps

Horizon	[0, H ₁ ]	] H ₁ , H ₂ ]	] H ₂ , H ₃ ]	....	] H _{n-1} , H _n]	TOTAL
Returns Received	$R_{[0, H_1]}$	-	$R_{[H_2, H_3]}$		-	$\sum R$
Remuneration Paid	$V_{[0, H_1]}$	-	-		$V_{[H_{n-1}, H_n]}$	$\sum V$
Cash Flow GAP	$F_{[0, H_1]} = R_{[0, H_1]} - V_{[0, H_1]}$	$F_{[H_1, H_2]} = 0$	$F_{[H_2, H_3]} = R_{[H_2, H_3]}$	....	$F_{[H_{n-1}, H_n]} = -V_{[H_{n-1}, H_n]}$	$\sum F$
GAP in Stock	$S_{[0, H_1]} = F_{[0, H_1]}$	$S_{[H_1, H_2]} = S_{[0, H_1]} + F_{[H_1, H_2]}$	$S_{[H_2, H_3]} = S_{[H_1, H_2]} + F_{[H_2, H_3]}$	....	$S_{[H_{n-1}, H_n]} = S_{[H_2, H_3]} + F_{[H_i, H_n]}$	$\sum S$

Source : Established by the authors

Despite the ease of its application, the accounting gaps method remains limited since it provides only a static view, which only considers the balance sheet situation of an institution at a given date, on the latter's exposure to interest rate risk and its impact on the expected net margin. This is why various works on interest rate risk management, according to asset liability management, propose **the forward-looking interest margin method** as a complementary approach to interest rate gaps, which is based on a dynamic analysis considering the future evolution of the balance sheet (new production) and subsequent changes in rates.

The forward-looking interest margin method is a dynamic approach based on various simulations that consider multiple assumptions and scenarios of rate changes. These simulations complement the static gaps as they relate to the evolution of the balance sheet. The latter considers commercial projections, customer behavioral analyses³ and modeling of stocks.

The dynamic rate gap approach provides visibility into the changes that can be made by new production and future rate changes on the balance sheet structure and expected results. This

³ To identify hidden options

allows the institution to anticipate the actions to be taken to hedge against them and to be able to maintain a balanced balance sheet situation as well as results at the desired levels.

Based on the projected interest rate gaps, the institution will be able to measure the impact of interest rate changes on its projected net margin. Cumulative interest rate gaps are used to define the expected overall net margin over a defined time horizon. Shock simulations, based on assumptions of market rate changes, measure margin levels following rate changes.

The difference between the expected net margin level and that of the net margin due to a change in the yield curve allows the Risk Margin or Earning-at-Risk to emerge.

The gap method focuses specifically on the sensitivity of net bank margins to changes in interest rates. It offers no visibility into the impact of interest rate movements on the value of assets and liabilities held by the bank. In the following, we will focus on the duration approach which is relative to economic value and is considered a measure of interest rate risk.

The duration method

A second approach often mentioned in the literature on asset-liability management of interest-rate risk is the duration method. It focuses precisely on the impact of changes in interest rates on the economic value of the bank's equity. We propose to study, in what follows, its origin, its evolution over time and how it could be used to measure an institution's exposure to interest rate risk.

The notion of duration was first defined by Frederic Macaulay in 1938, in a study of interest rates, as "The essence of the time element of a loan"⁴. He rejected simple maturity⁵ and even average life⁶ as indicators of the residual time remaining before the last maturity of a security, particularly for securities generating financial flows.

Macaulay proposes to define duration as the average life of a security, expressed in units of time, considering its discounted future cash flows and weighted by their different maturities. This is how he differentiates duration from the simple average life of a financial security. And

⁴ Frederick R. Macaulay, *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856*, NBER Books, 1938.

⁵ Maturity represents the lifetime of an instrument in units of time.

⁶ The average life span is the weighted average of the durations between moment t and the different future dates of the flow falls. Each of these durations is weighted by the amount of the corresponding flow (Augros & Queruel, 2000).

for discounting purposes, he recommends using the security's actuarial rate of return as the discount rate.

For Macaulay, the duration of a security differs depending on the type of this last. A generating security of periodic flows (returns) must have a shorter duration than that of a security whose repayment of capital and return are expected in fine at its maturity date.

However, duration and average life remain relatively similar measures, because if the discount rate used to calculate duration is zero, we end up with weighting factors equal to those for average life. In this case, we adopt the classic definition of the average duration of a schedule (Mohseni & Plumyène, 1991).

Macaulay duration of an asset is expressed as follows :

With :

V_0 = Nominal value

F_i = Financial flows

R = Actuarial rate of return

T_i = Periods

$$D = \frac{\sum_{i=1}^n t_i \times \frac{F_i}{(1+R)^{t_i}}}{V_0}$$

Or even :

$$D = \frac{\sum_{i=1}^n t_i \times (F_i \times (1+R)^{-t_i})}{V_0}$$

The duration of Macaulay, calculated in absolute value, appears as a measure of the real maturity of a security, or the period necessary for an investor to recover his investment considering the future flows discounted and weighted by their maturities. It can also be used as a basis for measuring the effect of changes in interest rates on the price of a financial security.

Based on Frédéric Macaulay's work on duration, several authors have proposed variations of its concept and have contributed to its development. Some of this work was conducted to study the relationship between the price of financial securities and changes in interest rates.

John Richard Hicks is responsible for the notion of modified duration, defined as the price elasticity of a security relative to a movement in its actuarial rate of return⁷. He focused his work on measuring price sensitivity to changes in interest rates.

The utility of the modified duration defined by Hicks, is to allow a calculation of the duration of a financial security even if its future flows are not fixed, in other words, it allows to consider the variability of the rate of return of the security⁸.

According to Hicks, the relative change in the price of a security is proportional to the change in its actuarial rate of return. Therefore, the sensitivity of a security must reflect the reaction of its price following a change in the interest rate. It can be defined, based on the duration of Macaulay, by the following relationship :

$$S = - \frac{D}{(1 + R)}$$

Expressed in relative value, the Hicks sensitivity relationship measures the rate of change in the price of a security following a 1% movement in its actuarial rate of return.

Since duration is generally positive, Hicks' relationship confirms the existence of a negative correlation between the security's value and its rate of return, and that an upward change in the rate leads to a devaluation of the security's price, while a downward variation will value the price of the latter.

Duration and sensitivity are commonly used by banks to measure their exposure to changes in market rates. In order to examine its overall immunization against interest rate risk, the bank calculates the average duration of the various assets and liabilities on its balance sheet, to deduce the duration difference.

The literature states that duration is additive ((Bessis, 1995); (Augros & Queruel, 2000); (Bellalah, 2005); (Quittard-Pinon, Rolando, & Le Grand, 2012); (Coussergues, Gabteni, &

⁷ John R. Hicks, *Value and Capital*, 1^{ère} & 2^{ème} éditions, Oxford, Clarendon Press, 1939 / 1946.

⁸ Jean C. Augros, *Interest Rate Risk and Banking Management*, Economica, 2000.

Gabteni, 2020)). The average duration of the Asset/Liability of the balance sheet is obtained by adding the weighted durations of the various elements that constitute them. The weighting applicable to each item is equal to the relative value corresponding to its share in the total Assets or Liabilities.

The overall duration difference of the balance sheet can be obtained by subtracting from the average duration of the asset that of the liability :

$$\text{Global Duration GAP} = GD = DA - DL$$

The overall duration spread of a bank balance sheet, thus calculated, makes it possible to assess the overall sensitivity of the balance sheet to changes in interest rates. A zero-duration difference reflects an immunization against rate risk. A rise in rates may be favorable for a bank in the event of a negative duration spread, since the depreciation of its assets will be less than that of its liabilities, while a fall in rates will impact its economic value.

Moreover, a positive duration difference will lead to an appreciation of the economic value of the bank when market interest rates change downwards. A rise in rates may expose it to a major rate risk.

Table 3 : Duration gap and impact on economic value

Duration gap	Impact on economic value (Favorable / Unfavorable)	
	In case of Rate Increase	In case of a Rate Cut
Zero duration deviation = 0	no impact	no impact
Duration gap > 0	unfavorable	Favorable
Duration gap < 0	Favorable	unfavorable

Source : Established by the authors

The bank may estimate the overall sensitivity of the economic value of its funds to changes in interest rates based on the overall duration spread of its balance sheet according to the following calculation,

Calculated in relative value :

$$\text{Sensitivity of Equity} = -ED \frac{1}{(1 + R)}$$

Calculated in absolute value :

$$\Delta \text{Equity} = VE - (BSDG \times VE)$$

With :

VE : Value of Equity

BSDG : Balance sheet duration gap

A : Average Actuarial Rate of Return

In order to define its risk capital, the bank conducts interest rate shock simulations and assesses their impact on the economic value of its capital. Simulations are generally based on several assumptions and scenarios of market rate changes. This will allow the bank to define the impact of each scenario on its economic value, expressed as its risk capital.

$$CaR = EVE_E(r') - EVE_E(r)$$

With :

CaR : Capital at risk

$EVE_{FP}(r')$: Economic value of equity according to the shock scenario

$EVE_{FP}(r)$: Economic Value of equity according to the Reference Case

The measurement of the exposure of credit institutions, including participative banks to changes in interest rates, is based mainly on the two above-mentioned indicators of economic value and net interest margin. Each of these indicators has its measurement techniques. The net margin is estimated according to a projection of interest rate gaps. For its part, the economic value is estimated through duration and sensitivity techniques.

After quantifying their risk exposure, credit institutions, including participative banks, carry out a hedging and management approach to hedge their interest position⁹ and mitigate the potential impact of changes in interest rates on their earnings. To achieve this, they are encouraged to use appropriate hedging and management techniques.

Rate risk management seems more complex for participative banks than for their conventional analogs. Given their specificities, participative banks are encouraged to develop appropriate management methods, since they do not have access to all the management techniques available to conventional banks, in particular, financial hedging instruments. The latter, are instruments traded on the financial markets and are generally not compliant with the Sharia.

In the following, we will study the different management techniques on which sound asset liability management of interest rate risk is based.

2.2. BEST PRACTICES FOR INTEREST RATE RISK MANAGEMENT

Interest rate risk management techniques are linked on the one hand to the financial products available to the manager for risk hedging, which are generally financial instruments traded over the counter or on organized markets, and on the other hand, the measurement tools previously studied, namely interest rate gaps and duration spread. This second technique, commonly used in the asset liability management of interest rate risk, involves adjustments to cancel the differences reported by these two indicators and recognized as an immunization technique of the balance sheet (Augros & Queruel, 2000).

Management based on balance sheet immunization techniques

An effective asset liability management process for interest rate risk relies mainly on backup techniques that align the financial characteristics¹⁰ of bank assets and liabilities (Dubernet, 1997). When these characteristics are perfectly aligned, the bank is protected against changes in market interest rates. Backing is a basic concept of rate coverage (Bessis, 1995).

A perfect backing of the balance sheet requires a good understanding of its structure. A structural analysis of bank assets and liabilities is crucial for the immunization approach. It

⁹ Gap obtained due to a difference in characteristics between assets and liabilities.

¹⁰ The financial characteristics are : the depreciation profile (in fine, linear, conventional), the type of rate (fixed, revisable, variable) and the optional characteristics related to customer behavior (Dubernet, 1997).

consists of listing the various elements of the balance sheet according to their stocks, reference rates, maturity dates and revision of rates, optional characteristics and their durations (Bellalah, 2005).

An ideal immunization consists of an adjustment between asset returns and liabilities remuneration to ensure that the interest rate gaps are zero (Bitner & Goddard, 1992). The concept is based on adjusting assets so that their returns meet the required remuneration of liabilities. This is a technique known as cash-matching.

According to (Brom, 2009), interest rate risk management involves aligning asset and liability repricing ¹¹maturities. In other words, it is the fact of adjusting the stock assets and liabilities sensitive to changes in rates with identical repricing maturities.

According to (Coussergues, Gabteni, & Gabteni, 2020), maintaining an equal duration for the various assets and liabilities on the balance sheet is necessary for full immunization against changes in interest rates. To neutralize the sensitivity of the EVE, it is necessary to ensure that changes in the market values of the asset and the liability are identical during a change in rates (Bessis, 1995).

(Augros & Queruel, 2000), advocates the re-composition of the balance sheet as a technique to immunize the net interest margin of banking institutions. It involves modifying assets, redefining trade policy on resources, or resorting to securitization of receivables.

For their part, (Quittard-Pinon, Rolando, & Le Grand, 2012), consider the change in the composition of the balance sheet as the main technique for managing interest rate risk generated by duration spreads of assets and liabilities. It makes the credit institution insensitive to market rate movements by changing the composition of its balance sheet so that its duration spread is zero.

According to the literature, asset liability management of interest rate risk can take several forms of backing. A cash backup is based on an alignment of return-generating assets and remunerated liabilities. The idea is to back liabilities with assets having identical financial characteristics, including the amortization profile and the type of rate, to neutralize its rate

¹¹ Reference for variable interest rates calculated based on T-bonds

position expressed by the gap. This is a technique commonly used by asset liability managers to cover net interest margin.

Also, the asset liability management of that risk can be based on a duration backing. The objective is to cover the economic value of bank equity against changes in interest rates. To achieve this, the asset liability manager must ensure a zero-duration spread. This requires a constant adjustment of the balance sheet elements according to their durations.

The asset and liability manager determines the immunization approach to be applied based on the bank's long or short position. The cancellation of the position often requires restructuring, or even re-composition, of assets and liabilities. In practice, it seems commonly difficult to ensure perfect immunization based only on the elements of the balance sheet held to date. The use of the market for hedging financial instruments is often requested.

Management based on hedging instruments

In order to hedge their fixed-income positions, asset liability managers often use fixed-income financial instruments rather than influence the composition of the balance sheet (Bitner & Goddard, 1992). Also, rate instruments may be covered for residual asymmetries after immunization (Bessis 1995).

Depending on its interest rate position, the asset-liability manager will decide on the hedging strategy to be applied (Coussergues, Gabteni, & Gabteni, 2020). A macro-opening is intended to cancel the bank's overall rate position expressed by these cumulative rate gaps or its duration spread. On the other hand, a micro-hedge consists of canceling the different unit positions of the balance sheet rates.

There is a range of financial instruments commonly used to manage banks' interest rate positions. Divided into two families, instruments negotiated by mutual agreement and others negotiated in an organized market, these instruments require vigilance and a perfect understanding of their different modalities of use and their characteristics (Quittard-Pinon, Rolando, & Le Grand, 2012).

Hedging instruments are generally divided into three categories. The first category allows a limit to be set to fluctuations in interest rates. The second is to change the nature of the rate

position taken by the institution. The latter, on the other hand, guarantees a certain level of return on investments or remuneration for future loans (Augros & Queruel, 2000).

The first category includes instruments to protect against changes in interest rates during a future period. In the form of futures contracts, these instruments consist in fixing all the conditions for an exchange, between two parties, to be carried out at a certain later date and an agreed rate. These futures include several types of instruments, which can be traded over the counter, such as Forwards contracts, or on organized markets, such as Futures contracts.

The second category comprises instruments enabling the nature of the interest rate positions of banks to be transformed, namely interest rate swaps. They appear as instruments allowing a simple exchange of interest, calculated based on a notional nominal amount and a fixed duration in advance. Actually, they are used to transform a variable rate position into a fixed rate position, and vice versa, or to exchange variable rate positions indexed on different reference rates. These are instruments negotiated between two parties on over-the-counter markets.

Traded on organized or OTC markets, instruments of the third category take the form of conditional futures contracts (options). They make it possible to set all the conditions of an exchange which may or may not be made at a future date. The decision to execute the exchange rests with the buyer. These are instruments offering their purchasers the right and not the obligation to carry out the contractual exchange in return for the payment of a premium, paid on the date of the contract, the amount of which is freely negotiated by the contracting parties.

Optimal use of hedging instruments requires better knowledge of the markets in which they are traded, as well as the different techniques guiding their use. Each category of instruments, generated, includes a multitude of instruments that can be exploited for specific purposes. A poorly controlled use of these hedging instruments will expose the bank to a major risk, the repercussions of which can have a great impact both on the results of the bank and on its economic value.

Rate of return risk management with participative banks

Unlike conventional banks, the balance sheet assets of participative banks, including Moroccan participative banks, are mostly made up of fixed-rate items, mainly Mourabaha, Ijara and Salam

financings. On the other hand, their liabilities are largely composed of equity investment deposits, including the Wakala Bil Isthitmar received.

In the presence of the displaced trade risk, investment deposit risk presented earlier in this article, participative banks will be exposed to changes in market interest rates, since they will be able to provide higher compensation to their depositors to align with market trends and remain competitive when credit rates rise.

With assets generating fixed returns and liabilities having a rate of return correlated with market interest rates, participative banks take a vulnerable rate position, since fixed-rate uses are financed by part of the variable rate resources. This will negatively impact their result in the event of an increase in interest rates and vice versa.

Like conventional banks, participative banks are exposed to a rate risk that threatens their economic value. Most participative banks have a positive duration gap, expressed as asset duration greater than liabilities (Khaliq, Thas Thaker, Thas Thaker, & Pitchay, 2017). An upward shift in interest rates will negatively impact their economic value.

The use of interest rate derivatives as a hedging and rate of return risk management strategy appears to be inaccessible to participative banks (Bacha, 2004). In the participative financial environment, very few off-balance sheet hedging derivatives exist and when they do exist, they are often controversial from a Sharia compliance perspective (Aaminou & Moutahaddib, 2017).

As a technique to immunize the balance sheet against changes in interest rates that participative banks can set up, (Bacha, 2004), suggests the adjustment of assets by reducing the maturity of loans granted, and to favor, rather, short-term financing. This can reduce duration spreads and allow the bank to preserve its economic value.

In addition, participative banks should encourage financing based on profit-and-loss agreements such as Moudaraba and Mousharaka. The advantage of these sharing contracts is expressed by their independence from rate changes. The financing is rather related to the results generated from the financed activity, which leads to a variability in the returns generated by this type of assets.

In addition, participative banks can opt for a risk-sharing agreement with their clients. This agreement should take into account the fact that clients with long-term financing agree to

partially compensate the bank if the average rate of return on these resources exceeds the predetermined level (Zainol & Kassim, 2010).

Another technique, widely mentioned in the literature, for managing the risk of fluctuating rate of return is that based on the constitution of reserves (Toumi & Viviani, 2013). In order to smooth profits and absorb fluctuations in asset returns, participative banks can set up two types of reserves for managing the risk related to changes in interest rates, namely the PER¹² and IRR¹³. These two reserves are recommended by regulators and considered prudential reserves.

These different suggestions will allow participative banks to guard against the risk of the rate of return at a certain level. Nevertheless, if market rates continue an upward trend for a long time, this could affect the effectiveness of these different techniques. Moreover, the variability of the returns generated by the financing instruments based on the sharing of losses and profits depends on several external factors not controllable by the bank. It is important to mention that these financing products are not yet marketed by Moroccan participative banks.

Therefore, it is necessary to intensify efforts in innovation and financial engineering, in order to emerge new instruments of hedging and risk management, without interest rates and Sharia complaint, allowing participative banks to diversify into this area. This suggestion is consistent with that suggested by (Kassim, Abd Majid, & Yusof, 2009) and (Zainol & Kassim, 2010).

Thus, it seems appropriate to us that the participative banks promote a financial education to their depositors in participative investment accounts on the principle of operation of the latter, their mode of management and the risks to which are exposed. Because if the holders of the investment accounts do not seek the maximization of their profits and are convinced of the principle and mode of operation of this participative product, the recourse of the participative banks to the prudential reserves will no longer be asked. Our suggestion is similar to that recommended by (Aaminou & Moutahaddib, 2017).

¹² Profit Equalization Reserves – PER – is retained from the gross result of the participative bank before the allocation of profits between the shareholders of the bank and the holders of the investment accounts.

¹³ Investment Risk Reserve – IRR – is retained from net income, after withdrawal from the bank, which represents the share of the profit attributed to the holders of the investment accounts.

Conclusion

The objective of our article was to study the problem of the exposure of participative banks to changes in market interest rates, its repercussions and the different potential measures to cope with them. The literature affirms the existence of a long-term relationship linking the rates of return offered by participative banks on investment deposits, the stock deposits of these institutions, the interest rates offered by conventional banks on term deposits, their stock deposits and the central bank's key rate.

Indeed, the fluctuation of interest rates of conventional banks leads to the variability of the rates of return of the participative banks. It also causes deposits to leak to conventional banks. In addition, some studies reveal the behavior of participative banks, which under commercial pressure, adjust their rates of return according to the trend of market rates.

Banks measure the degree of their exposure to the risk of changes in interest rates by using various asset liability management techniques. As presented earlier in the article, the impact of interest rate changes on earnings is generally measured through the interest rate gap method. The sensitivity of the economic value of the institution to a movement of interest rates is measured based on duration techniques.

Moreover, participative banks do not have the same flexibility as conventional banks to manage this risk. With assets comprised of fixed-rate financing, variable-compensation resources, and a lack of Sharia-compliant hedging instruments, exposure to rate risk poses a threat to these institutions.

The recommendations in this article focus on innovation and financial engineering in hedging instruments, the implementation of a reserve policy for risk management and financial market education.

It seems to us that the issue of the exposure of Moroccan participative banks to interest rate risk requires particular attention from researchers. In view of the current economic situation, the consecutive raising of the policy rate by Bank Al Maghrib and their impact on the market interest rates, quantitative studies on the exposure of Moroccan participative banks to interest rate risks appear to be necessary.

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