Liquidity Risk Management in the Islamic Banking: Portfolio of Ijara and Murabaha

Abdellatif Mabrouk [1]
PhD-Student - Laboratory of Analysis and Modeling Systems for Decision Support (LAMSAD), ENSA of Berrechid, University of Hassan 1Settat, Morocco. mabroukabdellatif@yahoo.fr

Lamyaa Farah [2]
PhD- Senior consultant - ProximaB Group, Morocco.
Associate researcher in Laboratory of Analysis and Modeling Systems for Decision Support (LAMSAD), ENSA of Berrechid, University of Hassan 1Settat, Morocco
lamyaa_farah@yahoo.fr

Submitted May 2021, Revised August 2021, Accepted August 2021

Abstract- **Liquidity risk management in finance has always been well known as a necessity for conventional finance and Islamic finance. Conventional financing addresses this risk through known means. Unlike Islamic financing, this has few instruments suitable for Shari'a to manage this risk. If this risk accelerates, the Islamic bank faces significant challenges in the face of their depositors and investment projects. The objective of this study is to show that holding an optimal level of liquidity is necessary for Islamic banks to minimize the liquidity risk. In this paper, we also examine the relationship between profitability and liquidity. This importance is explained by the fact that these banks cannot always count on the support of the central bank, or on the Islamic money market. We refer in particular to the work of Ben Jedidia et al. (2013).Unlike Ben Jedidia et al. paper, our model of financial intermediation and liquidity risk management uses two factors: Murabaha and Ijara. Two analysis were used, the first one is static and the second one is dynamic, to determine the optimal amount to be held by an Islamic bank using the optimization method. The study reveals that the factors in the first analysis are: the anticipated penalty costs, the rate of return on financing, the sharing rate between the bank and the depositors. This study also reveals in a second dynamic analysis that the factors are: the expected marginal cost of penalty, the ratio of the change in deposits to the change in funding.**

Keywords: Ijara, Islamic Banking, Liquidity, Murabaha, Risk Management, profitability.

I. Introduction

The Islamic or participatory finance industry depends on how their banks manage their liquidity risks. Islamic banks are exposed to liquidity risk in a context of structural weaknesses in their financial system that weighs on their solvency and liquidity [2], [3], [4], [5], and [6]. A severe liquidity crisis can lead to a devastating spiral leading to the bank's insolvency and possibly bankruptcy. The possibility of an illiquidity crisis justifies the intervention of lenders at last resort. As a source of liquidity at last resort, central banks have an increased interest in liquidity risk. The nature and extent of the risks to Islamic banks may differ significantly from conventional banks [7]. In view of the interest ban, Islamic banks are deprived of conventional instruments for hedging risk on the basis of interest. Asset-liability management of liquidity is also difficult because of the lack of access to fixed-income instruments [8], moreover, which shows that Islamic banks have fewer instruments to hedge their liquidity risks, it is the prohibition of Gharar and speculation that do not allow Islamic banks to manage their exposure to these risks through derivatives. In general, compliance with Shari'a guidelines has placed restrictions on their management of liquidity risk. However, the nature of the relationship between the two types of banks is not the same. The

Islamic bank, like the conventional bank plays the role of intermediation [9], and draws from the liquidity of its investment operations, collecting deposits from its depositors, however, in Islamic finance, contracts must first of all be in perfect conformity with Islamic, religion.

The intermediation model of Islamic banks is presented as a financial innovation that integrates ethics and social dimension into contemporary banking practices [10]. Islamic financing mechanisms have different forms from the conventional financial institutions and must be Sharia compliant. There are two alternative mechanisms of financing namely equity financing (mainly Mudaraba and Musharaka) and debt financing (mainly Murabaha, Ijara and Istisnaa) [11].

Our study focuses on the Islamic bank using two products Murabaha and Ijara. On the one hand, it determines the optimal level of liquidity for an Islamic bank by considering the two products. On the other hand, it shows the interaction between the assets and liabilities of an Islamic bank.

II. Literature Review

Bank liquidity is the ability of the bank to finance the expansion of its assets and meet its commitments on time without incurring unacceptable losses [12].In this research; we will use the murabaha contract as it is considered the main mode of financing, which represents 66% of the financing offered by Islamic banks [13]. Each contract has different implications for liquidity risk [3]. The predominance of funding based on real assets only increases liquidity gaps [14]. Due to religious constraints, the liquidity management of Islamic banks faces significant challenges [15]. Diversification helps reduce this risk. As Matthews, [16] assume, Islamic banks can minimize the risks they face by building a diversified portfolio of holdings in a meaningful way. This reduction is similar to that when banks contribute to pooling risks by pooling risk-free financial assets, such as the Mutual Fund or the investment company with variable capital, which reduces unit risk per asset [17].

In fact, the majority of Islamic banks operate in a world where monetary markets are underdeveloped or inexistent [18]. In addition to the problem of the virtual absence of interbank and money markets, the majority of central bank loans and facilities do not face sharia law [19]. This poses a problem of maintaining a large volume of liquidity; moreover this operation will miss investment opportunities and generate other risks such as displaced business risk. [20], [21] and [22] study the determinants of liquidity risk in Islamic banks. [7], [23] and [24] emphasize that Islamic banks need to improve their liquidity risk management practices to strengthen their resilience. Sukuk Al Ijara is one of the most popular instruments for managing Islamic liquidity risk in the Middle East [25]. Liquidity risk and credit risk are serious risks for the Banca d'Italia [26]. Compliance with the principles of sharia law changes banking intermediation [4], [27]. In addition, Islamic banks have few risk hedging instruments and techniques [27]. Note also the closest studies on our subject are the following: [28], [29], [30], [31], and [32]. Consequently, the issue of liquidity and its management presents challenges for participatory banks. The problem of liquidity risk management is similar to a problem of determining the optimal liquidity stock that the Islamic Bank must hold.

A. Ijara

Ijara is defined as a medium-term financing method by which the bank purchases machinery and equipment and transfers the usufruct thereof to the addressee for a period during which it retains title to ownership of the goods. The Ijara contract is characterized by flexibility, which makes this instrument particularly useful in the case of project financing. It is possible to determine the amount of each payment not in advance but on the date on which delivery of the underlying asset is expected.

The Ijara technique used to finance investments in real estate or movable property is presented in the following stages:

- The client expresses to the Islamic bank the need to acquire real estate or equipment;

- The bank gives the customer the opportunity to choose the material that suits them;

- This equipment will be purchased by the bank, and will be rented with the customer using a rental contract;

- The duration of the rental, the payment deadline, the amount of the rent and the periodicity must be indicated and known at the signing of the contract. The customer will not start paying the rent until the goods are received;

- At the end of the rental contract, the goods will be assigned to the customer, according to a transfer contract, previously signed by both parties. In Ijara, it is necessary to determine by a separate act the manner in which the tenant acquires ownership of the property. The movable and immovable property acquired for use in the operations of Ijara and Ijara Muntahia Betamlik are included among the fixed assets at their acquisition

cost, namely the purchase price plus acquisition costs.

Ijara and leasing

The difference between Ijara and leasing is that there is no penalty for not making a monthly payment in the event of a delay. Given the penalties that would arise for these reasons would be considered interest, and Islamic Finance refutes this process.

The Sharia rejects any provision in a financial contract that penalizes a debtor in good faith who is already in difficulty. Ijara is very similar, in form and spirit, to a rental-sale contract. However, it is necessary to announce the differences according to this table:

Difference between Ijara and Leasing

In the case of the Ijara, the bank continues to be responsible for the property and the two contracts are separate. But, in the case of leasing, the risk of loss of assets is borne by the client and the contract is the same.

Also, for the Ijara, the payments begin as soon as the lessee has taken possession of the property in question. Otherwise, for the leasing, it is calculated when the lessor buys the underlying asset.

Moreover, in the Ijara, there is no change in rental price unless malicious or negligent, and the payments stop at the end of the payment periods, it's the bank that bears the expenses. But, In Leasing, when there is a late payment of Interest, the customer adds additional payments and supports the related expenses.

B. Murabaha

Murabaha[33] is a commercial transaction. It can be noted that this transaction is known most often, a deferred payment with margin. In all cases, delivery is immediate. In other words the Murabaha is a contract of sale at the cost price plus a profit margin known and agreed between the buyer and the seller. Murabaha assumes that the bank buys a given asset at a price known to both parties on behalf of its client. Then, the bank resolves this asset to the customer for payments staggered or not over a given period, at a price agreed in advance between the two parties in excess of the purchase price.

The main mode of financing is the Murabaha which represents 66% of the financing offered by Islamic banks [13].

This financial product, although singularly very close to a classic debt contract, is distinguished from it, nevertheless, on a few essential points. Indeed:

The bank has become the effective owner of the underlying asset; the transaction is actually backed by a real asset.

- It is therefore not a loan but a sale on credit (cash purchase and forward sale).

- In this transaction, the bank therefore bears the risks associated with holding the asset and this is the main justification for its margin.

- On the other hand, there is no explicit reference to an interest rate - The creditor pays himself by means of an increase in the purchase price of the property.
- The amount of the profit margin does not vary over time: it is fixed beforehand and does not vary during the duration of the financing[34].

Term Extension, Delay and Default

The bank must stipulate that in case of refusal of the client to receive the property at the planned time after the conclusion of the contract of Murabaha, it may sell the property by representation of the client and on its behalf and recover its rights from the selling price and turn against the client, if applicable, if the price is insufficient. The Islamic bank may not receive remuneration for the extension of the term or for any delay, whether or not the delay is justified. Any remuneration granted to postpone the date of payment of the debt (rescheduling of the debt), whether the client is creditworthy or not, is prohibited.

The amount due to the bank in the event of default by the debtor of the sums due corresponds only to the amount of the debt. The bank cannot compel the customer to pay remuneration for his benefit[35].

III. Methodology

This work examines the relationship between profitability and liquidity. The bank's objective is to maximize its profit taking into consideration the uncertainty regarding the amount of the withdrawal and the adjustment or penalty charges. This will be done using a two-factor liquidity management model that links the right balance between liquidity risk and profitability [7].

This model takes into consideration:

- The liquidity level of the bank.
- of the Ijara contract and the Murabaha contract);

The bank bears a refinancing cost. When these factors are not rationally handled, the investment

deposits allocated to the financing of Murabaha and Ijara are the subject of the intermediation model we have chosen, which is the most common for Islamic banks. Holding an optimal stock of liquidity for these banks plays an important role since Islamic banks cannot always rely on the support of the central bank or the Islamic money market.

Particularly, we refer to the work of [1]. Two analyses were used, one static and the second dynamic, to determine the optimal amount to be held by an Islamic bank using the optimization techniques.

A. The purpose of the model

The main objective of our model is to determine the optimal amount of reserves an Islamic bank should hold in order to guarantee unexpected withdrawals.

B. The assumptions

- Investment deposits (D) are assumed to be homogeneous and remunerated according to the result of the bank's assets.
- The assets of the bank (F) consist of financing offered to the economy according to the techniques of Murabaha and Ijara.
- The Funding (F) does not present a risk of capital loss.
- Reserves (T) are cash that does not yield.
- r_p Is an exogenous variable.

Let us first consider an Islamic bank whose balance sheet is as follows:

Asset	Liability
Reserves Funding	Deposits

The balance sheet equilibrium relationship is given by:

$$D = T + F$$

With: $F = F_M + F_I$

C. Definition of variables

- D: Investment deposits allocated to Murabaha and Ijara.
- Note r_α for Murabaha and r_β for Ijara: profit-sharing rates between the bank and depositors.
- r_m: The yield of Murabaha
- r_I: The yield of Ijara.
- F: Financing provided to the economy of Murabaha and Ijara.
- T: The reserves.
- r_p Is the unit cost incurred by the bank in an illiquidity situation.
- π The profit
- ε_F the elasticity
- T does not produce yield.
- A single time period is assumed (T = 1).

Supply and demand functions For Murayama

The deposit offer may be worded as follows:

$$D = D(r_\alpha)$$

With $\frac{\partial D}{\partial r_\alpha} > 0$

The request for funding shall take the following form:

$$F = F(r_m)$$

With: $\frac{\partial F}{\partial r_m} < 0$

For Ibarra

The deposit offer may be worded as follows:

$$D = D(r_m)$$

$$F = F(r_m)$$

With

$$\frac{\partial F}{\partial rm} < 0$$

$$F = F(r_I) \text{ with} \frac{\partial F}{\partial r_I} < 0$$

Random variables that represent net deposit withdrawals are continuously distributed in the interval [0; +1[according to a density function g (x). Then, two situations can be considered: If the liquidity constraint is met, the bank does not need to be refinanced and no additional costs are incurred.

The bank bears the unit costs r_p to deal with unforeseen drawdowns in a situation of illiquidity, then the use of supplementary funds is equal to the difference between x and T.

C (T): the cost of the liquidity requirement which is equal to:

$$C(T) = 0 \text{ if} x \leq T$$

$$\text{And } C(T) = r_p (x - T) if x \geq T$$

IV. Results and Discussions

1. Liquidity management model in a static framework

Let us suppose that a bank which is at arm's length from the risk receives at the beginning of the period an amount of investment deposit equal to D. It keeps a part in a liquid form T and invests the rest using Ijara and Murabaha contracts. The bank's objective is to determine the amount T that maximizes the expected profit.

The bank's profit is written:

$$\pi = r_m F_M + r_I F_I - r_\alpha r_m F_M - r_\beta r_I F_I - r_p E[Max(0, \tilde{X} - T)]$$

Noting:

- $\tilde{r}\gamma$ The average sharing rate.
- $\tilde{r}$ The average rate of return.

With

$$\tilde{r} = \frac{r_m F_M + r_I F_I}{F_M + F_I}$$

$$\tilde{r}\gamma = \frac{r_\alpha r_m F_M + r_\beta r_I F_I}{F_M + F_I}$$

Let's replace the rates in the profit equation:

$$\pi = \tilde{r}\gamma F - \tilde{r}\gamma\tilde{r}F - r_p E[Max(0, \tilde{X} - T)]$$

With $F = F_M + F_I = D - T$

Replace $F = D - T$

which gives us:

$$\pi = \tilde{r}\gamma(D - T) - \tilde{r}\gamma\tilde{r}(D - T) - r_p \int_T^{+\infty} (\tilde{X} - T) g(x) d(x)$$

The profit in case of no overshoot is described by the equation:

Profit without penalty

$$\pi = r_m F_M + r_I F_I - r_\alpha r_m F_M - r_\beta r_I F_I$$

The profit F from Ijara and Murabaha, which the bank must share with the holders of the investment deposit account at rates of r_α and r_β.
The second part of the equation:

r_p E[Max (0, X -T)] Relates to the expected amount of the penalties.

For r_m ,r_I ,r_α,r_β, r_p given,the bank's reserve holding curve is then defined as the amount of reserves that maximizes the bank's profit. It is obtained after optimality conditions:

$$\frac{\partial \pi}{\partial T} = 0$$

$$\frac{\partial \pi}{\partial T} = -\tilde{r}\gamma + \tilde{r}\gamma\tilde{r} + r_p[1 - G(T^*)] = 0$$

This results in:

$$r_p\,[1 - G(T^*)] = \tilde{r}\gamma - \tilde{r}\gamma\tilde{r} = \tilde{r}\gamma(1 - \tilde{r})$$

$$G(T^*) = 1 - \frac{\tilde{r}\gamma(1 - \tilde{r})}{r_p}$$

Replace $\tilde{r}$ and $\tilde{r}\gamma$ we get:

$$\tilde{r} = \frac{r_m F_M + r_I F_I}{F_M + F_I}$$

$$\tilde{r}\gamma = \frac{r_\alpha r_m F_M + r_\beta r_I F_I}{F_M + FI}$$

$$G(T^*) = 1 - \frac{(\frac{r_\alpha r_m F_M + r_\beta r_I F_I}{F})(1 - \frac{r_m F_M + r_I F_I}{F})}{rp}$$

Second method of derivation

The profit of the bank is:

$$\pi = r_m F_M + r_I F_I - r_\alpha r_m F_M - r_\beta r_I F_I - r_p \text{E [Max (0, } \tilde{X}\text{-T)]}$$

$$\pi = r_m(D - T - F_I) + r_I(D - T - F_M) - r_\alpha r_m(D - T - F_I) - r_\beta r_I(D - T - F_M) - r_p E[Max(0, \tilde{X} - T)]$$

$$\pi = r_m(D - T - F_I) + r_I(D - T - F_M) - r_\alpha r_m(D - T - F_I) - r_\beta r_I(D - T - F_M) - r_p \int_T^{+\infty} (\tilde{X} - T) g(x) d(x)$$

$$\frac{\partial \pi}{\partial T} = -r_m - r_I + r_\alpha r_m + r_\beta r_I + r_p[1 - G(T)] = 0$$

$$[1 - G(T^*)] = \frac{r_m + r_I - r_\alpha r_m - r_\beta r_I}{r_p}$$

$$[1 - G(T^*)] = \frac{r_m(1 - r_\alpha) + r_I(1 - r_\beta)}{r_p}$$

$$G(T^*) = 1 - \frac{r_m(1 - r_\alpha) + r_I(1 - r_\beta)}{r_p}$$

The second derivative of profit:

$$\frac{\partial^2 \pi}{\partial^2 T} = -r_p G(T^*) \leq 0$$

It is a maximum; it is a concave function.

2. Discussion(1)

The Islamic bank is exposed to liquidity risk. This is mainly due to the different maturities of the assets and liabilities of the bank. Like the conventional bank, the Islamic bank tends to collect short-term deposits to refinance long-term investments and is therefore exposed to liquidity risk.

Liquidity is an essential factor in the viability of any financial institution. Poor liquidity risk management can result in intensive financing costs and difficulties in liquidating assets at fair value. This risk can be increased if the bank reputation is damaged. In this case, liquidity risk could lead to massive withdrawals of deposits and thus threaten the solvency of the financial institution.

Following an optimization, we have found an optimal expression for reserve that the bank must hold and which should be written as follows:

$$G(T^*) = P[U < T^*] = \int_0^T f(x)dx = 1 - \frac{r_m(1-r_\alpha) + r_l(1-r_\beta)}{r_p}$$

U~$N(0,1)$

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} exp^{(\frac{-(x-\mu)}{2\sigma^2})^2}$$

We look for reciprocal functions

$$T^* = G^{-1}(r_\alpha)$$

$$T^* = G^{-1}(r_\beta)$$

$$T^* = G^{-1}(r_l)$$

$$T^* = G^{-1}(r_m)$$

$$T^* = G^{-1}(r_p)$$

Our objective was initially to find reciprocal functions for each variable; we have found for the property variables in relation to the rates the reciprocal functions are linear except in the case of rate r_p we have found the form shown in the figure 2.

The idea is to know how T reacts when varying the rates one by one.

For each variable ($r_\alpha, r_\beta, r_l, r_m, r_p$), we found linear functions as shown in Figure 1.

But compared to (r_p), we still found a relatively significant representation like this (Figure 1).

Therefore, the level of illiquidity is determined by the expected penalty fee, the rate of return on funding, and the sharing rates between the bank and the depositors.

r_m (1- r_α)+r_l (1- r_β) represents the opportunity cost of the reserves or the disadvantages of holding cash, which does not provide a return. It kills and gives the bank a bad reputation. Each currency unit of reserves held costs, in terms of opportunity r_m(1- r_α) + r_l(1- r_β):

The r_p[1 -G (T*)] part represents the expected adjustment cost. The benefit of holding liquidity allows the bank to cope with withdrawals and avoid the need for refinancing through central currency loans which, for each currency unit, cost

r_p [1 - G (T*)].

The following figure shows:

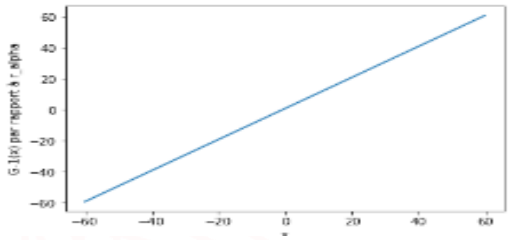

Figure 1: Distribution function of G (T*)

- That the distribution function G (T *) is a linear function for each variable.

This means that:

- If the rate of return on the Murabaha increases, the bank has no interest in retaining sufficient liquidity, so as not to miss a significant profit margin.
- An increase in r_α increases the remuneration of depositors and therefore the amount of deposits collected by the bank.

The distribution function G (T *) is a growing function with the rate r_β of profit-sharing between the bank and the depositors.

The following figure shows:

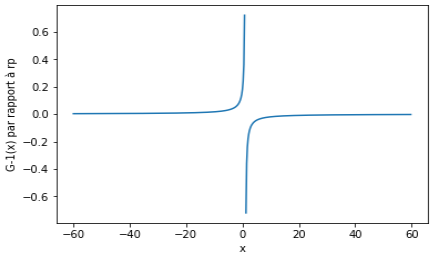

Figure 2: The distribution function of G (T)*

The allocation function G (T*) has a particular form in relation to the penalty rate r_p which represents the unit cost incurred in an illiquidity situation. We observe that the bank sets its amount of reserves in reference to the ratio of the opportunity cost of reserves to the penalty rate. If r_p is independent of r_m and r_β and it is the only adjustment variable allowing T to reach its optimal level. However, a bank with financial privilege in the market may

expect to dominate by increasing the penalty rate, which offsets the effect of the penalty rate on the demand for banks' reserves.

T reacts by varying the rates one by one. For each variable. We found that only for the penalty rate that counts. This means that the level of illiquidity is determined by the penalty provided for an Islamic bank. The penalty rate is considered for the Islamic Bank as the only adjustment variable allowing T to reach its optimal level.

The decision to increase the rates of remuneration of depositors increases the amount of deposits collected by the bank. In the end, the amount of the reserves is modified not by a direct effect of the penalty rate but by a change in the conditions of funding remuneration. Even if Islamic and conventional banks are subject to the same conditions of optimality, nevertheless, the specificity of Islamic banks is that they can use asset remuneration conditions as an instrument to solve their liquidity problem given the interdependence between assets and liabilities.

The study reveals that the determinants of the first analysis are: the expected penalty costs, the rate of return on financing, the sharing rate between the bank and the depositors.

3. Liquidity management in a dynamic environment

Suppose the reserve amount is a function of the number of deposits and funding. The deposit amount is a function of r_m Murabaha rate of return, r_I the Ijara rate of return, r_α rate of Murabaha profit sharing between bank and depositors, r_β rate of Ijara profit sharing between bank and depositors. Let us also denote by $\tilde{X}$ the withdrawals of a random amount and r_p the unit cost of refinancing in the event of bank illiquidity. We can write the reserve amount as follows:

$T(r_m, r_I, r_\alpha, r_\beta) = D(r_m, r_I, r_\alpha, r_\beta) - F r_m, r_I$

The profit function of a bank is expressed as follows:

$$\pi = r_m F_M(r_m) + r_I F_I(r_I) - r_\alpha r_m F_M(r_m) - r_\beta r_I F_I(r_I) - r_p E[Max(0, \tilde{X} - T)]$$

Replace T by its value:

$$\pi = r_m F_M(r_m) + r_I F_I(r_I) - r_\alpha r_m F_M(r_m) - r_\beta r_I F_I(r_I) - r_p E[Max(0, \tilde{X} - D + F_M(r_m) + F_I(r_I)]$$

The equation can be expressed differently:

$$\pi = r_m F_M(r_m) + r_I F_I(r_I) - r_\alpha r_m F_M(r_m) - r_\beta r_I F_I(r_I) - r_p \int_T^{+\infty} \left(\tilde{X} - D + F_M(r_m) + F_I(r_I)\right) g(x) d(x)$$

The bank then chooses two r_m and r_I rates that maximize its profit, which corresponds to the first-order optimality.

$$\frac{\partial \pi}{\partial r_m} = F_M(r_m) + r_m F'_M(r_m) - r_\alpha F_M(r_m) - r_\alpha r_m F'_M(r_m) + r_p Prob(X \geq T) D'(r_m) - r_p Prob(X \geq T) F'(r_m) = 0$$

$$\frac{\partial \pi}{\partial r_I} = F_I(r_I) + r_I F'_I(r_I) - r_\beta F_I(r_I) - r_\beta r_I F'_I(r_I) + r_p Prob(X \geq T) D'(r_I) - r_p Prob(X \geq T) F'(r_I) = 0$$

$$(1\text{-}r_\alpha)[r_m F'_M(r_m) + F_M(r_m)] = r_p Prob(X \geq T) F'M(r_m) - r_p Prob(X \geq T) D'(r_m)$$

$$(1\text{-}r_\alpha) \frac{[r_m F'_M(r_m) + F_M(r_m)]}{F'_M(r_m)} = r_p Prob(X \geq T) - r_p Prob(X \geq T) \frac{D'(r_m)}{F'_M(r_I)}$$

$$(1\text{-}r_\beta) \frac{[r_I F'_I(r_I) + F_I(r_I)]}{F'_I(r_I)} = r_p Prob(\tilde{X} \geq T) - r_p Prob(X \geq T) \frac{D'(r_I)}{F'_I(r_I)}$$

$$(1\text{-}r_\beta)[r_I + \frac{F_I(r_I)}{F'_I(r_I)}] \frac{1}{r_I} = r_p \text{Prob}\,(\tilde{X} \geq T) \frac{1}{r_I} - r_p \text{Prob}(X \geq T) \frac{D'(r_I)}{F'(r_I)} \frac{1}{r_I}$$

Consider ε_F the elasticity of the funding request:

$$\varepsilon_{F_M} = -r_m \frac{F'_m(r_m)}{F(r_m)}$$

And

$$\varepsilon_{F_I} = -r_I \frac{F'_I(r_I)}{F(r_I)}$$

The condition of optimality is:

$$(1 - r_\alpha) r^*_m = \frac{r_p Prob(\tilde{X} \geq T)(1 - \frac{D'}{F'_M})}{1 - \frac{1}{\varepsilon_{F_M}}}$$

$$(1 - r_\beta) r^*_I = \frac{r_p Prob(\tilde{X} \geq T)(1 - \frac{D'}{F'_I})}{1 - \frac{1}{\varepsilon_{F_I}}}$$

4. Discussion (2)

The rate of return on the Murabaha is fixed by reference to the expected marginal penalty cost, the

sharing rate between the bank and the depositors, the elasticity of the demand for financing, and the ratio of the variation of deposits to the variation of financing.
The rate of return of the Ijara shall be fixed by reference to the expected marginal penalty cost, the sharing rate between the bank and the depositors, the elasticity of the demand for financing, and the ratio of the variation of deposits to the variation of financing.

The increase in the penalty rate leads the bank to increase its rate of return on financing operations to maintain its profit margin[1].
This result depends on the funding elasticity, the ability ofr_m, and $r_I$to act on the supply of D' deposits.

From the previous equation, it is easy to see that the derivative of verses is positive. The management of bank liquidity must be integrated into an overall asset-liability management framework. In the case of Islamic banks, this notion can be demonstrated by rewriting the equation differently.

$$(1-r_\alpha)r^*{}_m = \frac{r_p Prob\left(\tilde{X} \geq T\right)}{1-\frac{1}{\varepsilon_{F_m}}} - \frac{r_p Prob\left(\tilde{X} \geq T\right)\frac{D'}{F'_m}}{1-\frac{1}{\varepsilon_{F_m}}}$$

$$(1-r_\beta)r^*{}_I = \frac{r_p Prob\left(\tilde{X} \geq T\right)}{1-\frac{1}{\varepsilon_{F_I}}} - \frac{r_p Prob\left(\tilde{X} \geq T\right)\frac{D'}{F'_I}}{1-\frac{1}{\varepsilon_{F_I}}}$$

The first term describes the optimality in the case of independence between the remuneration of assets and that of liabilities. The rate of return on assets depends only on the penalty rate and the elasticity of the funding. This is the same result found by [1] in the context of Islamic banks, [36]and [37]in the context of conventional banks, where the increase in the penalty rate increases the optimal rate of return on assets and reduces the amount of loans.

In the case of Islamic banks, the resulting increase in reserves means, for the bank, a decrease in the anticipated penalty cost and an increase in its marginal profit. An increase of r_p generates a smaller increase compared to the conventional case because the bank knows very well that there will be a positive return effect of this increase on the supply of deposits and therefore on bank reserves. Ultimately, according to our model, the optimal liquidity stock of the Islamic bank depends on different factors:

- Rates of remuneration of the asset: There is a special feature of liquidity risk management for the Islamic bank when changes in the conditions of remuneration of the asset are transmitted directly to the liability. Islamic banks can use asset remuneration conditions as an instrument to solve their liquidity problem.

- Sharing rates: a significant remuneration of depositors and a remarkable collection of deposits leads to a risk of low liquidity scarcity.

-Penalty rates: Increasing the cost of refinancing encourages banks to keep enough reserves to avoid high-cost overruns.

The practice of interdependence between assets and liabilities allows the Islamic Bank to manage its reserves using a single instrument which is the rate of return on financing. Conventional banks are obliged to use two instruments (lending rate and credit rate). It is said that the interdependence between assets and liabilities can be a source of competitiveness gain for these banks since they can finance the economy at a lower rate than their conventional competitors. Bank liquidity risk management must be integrated into an overall asset-liability management framework. The interdependence between assets and liabilities can be a source of competitive gain for Islamic banks as they can finance the economy at a lower rate than their conventional competitors. This study reveals in a second dynamic analysis that the determinants are: the expected marginal cost of the penalty, the ratio of the variation of deposits to the variation of funding that joins the study [1].

The results confirm the idea that banks' liquidity management must be integrated into an overall asset-liability management framework.

V. Conclusion

Liquidity risk is a real threat to Islamic banking activities. Islamic banks cannot always rely on the support of the central bank or the Islamic money market. Therefore, the holding of an optimal stock

[1] From the previous equation, it is easy to see that the derivative of$r_f$versus r_p is positive.

of liquidity plays an efficient role for these banks. As a result, an effective mechanism for managing this type of risk is a prerequisite. The importance of liquidity risk, the specificities of Islamic banks, and the challenges these banks face have motivated us to do this research on Islamic banks and liquidity risk. An attempt has been made to study the links between the financial intermediation of Islamic banks and liquidity risk. Thus, we tried to study the arbitrage between liquidity and profitability through a formalization of the IM[2] liquidity management model that uses two factors: Murabaha and Ijara. We tried to determine the optimal amount of reserves that an Islamic bank should have to cover unplanned withdrawals.

1. According to the model developed, the optimal amount of reserves is set according to the anticipated penalty fees, from the rate of return of the financing to the sharing rates between the bank and the depositors.
2. We found that the Ijara rate of return is set to the expected marginal cost of the penalty, the sharing rate between the bank and the depositors, the elasticity of the demand for financing, and the ratio of variation of funding and variation deposits.
3. Islamic financial engineering faces a multitude of obstacles.[38] suggested that the adoption of new liquidity risk management products such as the "Takaful Liquidity Risk Fund" can contribute to better liquidity risk management. Improving liquidity risk management requires a variety of measures. The Islamic money market obligation becomes a requirement to offer sharia-adjusted interbank instruments.
4. It is recommended that the regulatory and supervisory mechanism recognize the specificities of Islamic banks in the dual system where they coexist with conventional banks. To this end, the active use and incorporation of government financing instruments in money market operations and the Sukuk contribute to the development of the Islamic money market [19].

The limitations and implications of the research: Islamic banks reveal a difficulty that relates to Sharia compliance constraints, as well as the under exploitation of quantitative tools for liquidity risk management compared to conventional banks. Thus, the difficulty of modeling contracts according to nature (legal, religious, etc.).

[2]Ijara and Murabaha

References

[1]Ben Jedidia Khoutem, Jlassi Mouldi, "Le risque de liquidité pour une banque islamique Enjeux et Gestion", Etudes en Economie Islamique Vol. 7, No. 1 (71-96), 2013.

[2] V. Sundararajan, L. Errico, "Islamic Financial Institutions and Products in the Global Financial System: Key issues in risk management and challenges ahead, IMF Working Paper WP/02/192, International Monetary Fund, Washington, DC, 2002.

[3] S.A. Salman, "Islamic Modes of Finance and Associated Liquidity Risks, paper presented at the Conference on Monetary Sector in Iran: Structure, Performance and Challenging" Issues, Tehran – Février, 2004.

[4] D. El-Hawary Dahlia, W. Grais, Z. Iqbal: "Diversity in the regulation of Islamic Financial Institutions", *The Quarterly Review of Economics and Finance*, Vol 46, N° 5, pp. 778-800, 2007.

[5] I. Akkizidis, S. K. Khandelwal [2008]: *Financial Risk Management for Islamic Banking and Finance*, Palgrave Macmillan, Hardback, 252 pages.

[6] S. Al-Muharrami, D. C. Hardy, Cooperative and Islamic Banks: What can they learn from each other? International Monetary Fund, WP/13/184, 2013.

[7] Ben Arab, M., &Elmelki, A., "Managing Risks and Liquidity in an Interest Free Banking Framework: The Case of the Islamic Banks", International Journal of Business and Management, 3 (9), pp 80-95, 2008.

[8] A.Hassoune ,"Les fonds propres des banques islamiques face aux exigences réglementaires", Moody's Investors Services, Paris, Janvier 2010.

[9] K. Ben Jedidia"L'intermédiation financière participative des banques islamiques", *Etudes en Economie Islamique*, Vol 6, N°1, pp.17-31, 2012.

[10] O. Amrani and A. Najab, L'évolution de la gouvernance bancaire : d'une approche classique vers une approche fondée sur la charia (revue de littérature),‖ Revue du Contrôle de la Comptabilité et de l'Audit, vol.4(3), pp. 822-847, 2020.

[11] P.P. Biancone and M. Radwan, Social Finance and Unconventional Financing Alternatives: An Overview, European Journal of Islamic Finance, (10), 2018. https://doi.org/10.13135/2421-2172/2818

[12] Comité de Bâle, "LiquidityRisk : Management and Supervisory Challenges", Banque des Règlements Internationaux, Février 2008.

[13] Al-Jarhi et Iqbal, "Banques islamiques : réponses à des questions fréquemment posées", Document Périodique n°4, Institut Islamique de Recherches et de Formation, BID, Jeddah, 2002.

[14] E. Al Monayea , "Selecting the Right Business Model in Islamic Banking, paper submitted to Global Islamic Finance Forum", Kuala Lumpur, du 18 au 20 Septembre 2012.

[15] A.R. Abdul Majid, "*Development of Liquidity Management Instruments: Challenges And Opportunities*", paper presented at theInternational Conference on Islamic Banking: *Risk Management, Regulation and Supervision*, Jakarta-Indonesia, 30 Septembre-3 Octobre 2003.

[16] Matthews, Robin, IssamTlemsani, and Aftab Siddiqui. *Islamic finance*. working paper, Centre for International Business Policy, Kingston Business School, 2002.

[17] Daoud, Khoutem Ben. "L'intermédiation financière participative des banques islamiques." *Les Cahiers de la finance islamique* 5 (2013): 28-40.

[18] H. Hesse, Andreas Jobst, J. Solé, "Trends and Challenges in Islamic Finance", World Economics, Vol. 9, No. 2, pp. 175-193, 2008.

[19] Islamic Financial Services Board (IFSB) "Technical note on issues in strengthening liquidity management of institutions offering Islamic financial services: the development of Islamic money markets", 2008.

[20] Jedidia, K. B., & Hamza. H, "Determinants of Liquidity Risk in Islamic Banks: A Panel Study", Vol 2, No.2 (Special Issue), pp 137-146, 2014.

[21] Ghenimi, A., & Omri, M. A. B., "Les déterminants du risque de liquidité dans les banques islamiques : cas de la région MENA". La revue gestion et organisation IO, pp 127-136, 2018.

[22] A. Mabrouk, A. Talibi, O.Touri, B. Achchab, "Apport des techniques de sélection de modèles et de variables pour la modélisation du risque de liquidité en finance", Recherches et Applications en Finance Islamique, Volume 4, Numéro 1, pages : 36-57, 2020.

[23] Iqbal, A., "Liquidity Risk Management: A Comparative Study between Conventional and Islamic of Pakistan", Global Journal of Management and Business Research, 12(5), pp 54-64, 2012.

[24] Gomes, T., & Khan, N. Strengthening bank management of liquidity risk: The Basel III liquidity standards. *Bank of Canada Financial System Review*, *5*, 35-42, 2011.

[25] Reda, M. H. Islamic Commercial Law: Contemporariness, Normativeness and Competence. Brill, 2017.

[26] Hussain, A. Hameeda and Al-Ajmi, Jasim, *Risk management practices of conventional and Islamic banks in Bahrain. Bahrain: Department of Economics and Finance, University of Bahrain, Sekheer*. 2012.

[27] Greening, V., and H. Iqbal. "Risk Analysis for Islamic Banks. Herdon." 2007.

[28] Abdullah, A., & Khan, A. Q. , "Liquidity Risk Management: A Comparative Study between Domestic and Foreign Banks in Pakistan", Journal of Managerial Sciences, 6(1), pp.61-72, 2012.

[29] Goodhart C., "La gestion du risque de liquidité", La revue de la stabilité financière, Banque de France, 2008.

[30] S.A. Salman,"State of Liquidity Management in Islamic Financial Institutions", Islamic Economic Studies, Vol. 21, No. 1, pp.63-98, 2013.

[31] Tariqullah Khan et Habib Ahmed, "La Gestion des risques, Analyse de certains aspects liés à l'industrie de la finance islamique", 2002.

[32] A.El hamdi, M. Benmahane, " La gestion de la liquidité des banques islamiques Quelles perspectives pour le cas de la banque participative marocaine ? " Research and Applications in Islamic Finance. V3, N 2, pp 205-226, 2019.

[33]T.M. Youssef, The Murabahah Syndrome in Islamic Finance: Laws, Institutions and Policies, in Clement M. Henry and Rodney. Wilson, eds. Politics of Islamic Finance, Edinburgh University Press, Edinburgh, 2004.

[34] Wadi Mzid, "La Finance islamique: Principes fondamentaux et apports potentiels dans le financement de la croissance et du développement". Economic Agendas of Islamic Actors, PAPERSIE Med, 2011.

[35] Hassen Ben Ouhiba, Chartered Public Accountant, CPA. Les banques islamiques étude de positionnement, spécificités réglementaires et particularités d'audit. 2015.

[36] E. Z. Prisman, B. Slovin Myron, E.M. Sushka: "A general model of the banking firm under conditions of monopoly, uncertainty, and recourse", *Journal of Monetary Economics*, Vol 17, N° 2, pp. 293-304, 1986.

[37] X. Freixas, J. Rochet, "Microeconomics of banking", MIT Press Cambridge, 1997

[38] H. Ahmed,"Financial Crisis: Risks and Lessons for Islamic Finance", International Journal of Islamic Finance, Vol 1, N°1, pp. 7-32, 2009.

Editor in Chief

Editorial Board