Performance Measurement Standard Financial Transactions

⟨Ohaj - Kantakji⟩ Model

Mathematical alternative to LIBOR and its Siblings

MQAM

Fifth Edition - Enhanced and Revised Edition

BY

Dr. Samer Mazhar Kantakji

Ohaj Badanin Omar

KIE Publication

KAI Publications

The publications of (Free Islamic Electronic Economics Book) aim to:

- Adopting the publication of Islamic economics literature in the global market; To become available to researchers and practitioners in the research and applied fields.
- Providing all economic curricula for students and researchers with a solid Islamic character.
- Electronic publishing is more useful than paper publication.
- The use of paper is bad for the environment and depletes its resources.

And the God of the intent behind.
To browse and download publications
you can contact us through: www.kantakji.com

مركز أبحاث فقه المعاملات الإسلامية
Islamic Business Researches Center

Clarification

All that is mentioned in the book is the research rights of the author, and it is considered a research paper of the Islamic Business Research Center IBRC and Kai University.

The use of this book as an academic syllabus (as published) is permitted free of charge, subject to copyright.

www.kantakji.com www.kie.university

This Book

This book is a gift to:

- Each faithful longed himself for salvation from usury and its tools.
- Every student of knowledge seeks the face of God.

Samer Ohaj

جامعة كاي

جامعة أونلاين

خيارك الأفضل لدراسة الاقتصاد الإسلامي وعلومه

https://kie.university

Introduction to the fifth edition

We released the fourth edition of Mqam's book in July of 2021, and here is the fifth edition in your hands after less than three months.

Why this acceleration in the issuance of copies of MQAM book?

Since the third edition issued in 2017, we have announced the statement of the British Financial Supervisory Authority[1] on 27-7-2017 regarding the suspension of the Libor index at the end of 2021; That is, fifty years after its launch and implementation, because it has historically failed.

Because of the acceleration of the issuance of several studies last July in search of alternative solutions to the LIBOR index, which used R and VBA on data from Bloomberg and Reuters; to adjust the movement of interest in the market; Which led us to this fifth version.

The techniques of preparing the LIBOR rate since its establishment by the Bank of England in 1970 have been limited to predictions and estimates made by bankers and economists, to draw the average price for pricing investment opportunities and pricing future liquidity; While the alternative solutions that appeared last month of this year were adopted; On scenarios that tried to build indicators from the current market movement that would be an alternative to LIBOR for pricing usurious interest in the markets; The Bank of

[1] Financial Conduct Authority FCA

England chose to replace one data set with the LIBOR data set, the data set being the SONIA[1] overnight average that the Fed calls the OIS[2].

While LIBOR looks to the future and absorbs risk with its proven failing ratings, SONIA is effectively risk-free due to the nature of short-term loans, and this remains only an opinion.

We have observed the following scenarios:

1. The IRS interest rate swap scenario[3] as the swap of fixed interest rates for floating interest rates generates an influx of cash; Prices are set at a fixed rate for fixed cash flows and variable rates for variable cash flows; The first can be known from the market movement, and the second is expected on the basis of a forward price; As the first cash flow can be predicted almost with certainty, the subsequent cash flows will remain estimated and may be inaccurate.

The upshot is that IRS interest rate swap pricing, while young, is; However, he did not escape from the previous pricing flaws of the traditional economy, as he distinguished between fixed cash flows and considered them a rate of their own, and variable cash flows and singled them out at several rates, the first of which is discretionary and then affects what follows ambiguity and uncertainty, and the same for rates and discount transactions, which means that it is a deficient

[1] Sterling Overnight Index Average

[2] Overnight Indexed Swap

[3] Interest Rate Swap

pricing that does not It expresses the opportunities available to the swap parties.

2- IRS swap pricing scenario vs. Overnight swap discount (OIS): In Britain it is called the SONIA average overnight index, and it uses two curves: the first is based on a floating cash flow injection using forecasts from the adjusted LIBOR curve. The second is by discounting all cash flows from both fixed and floating legs using OIS overnight swap discount factors. The result is that pricing a Libor IRS with OIS is very simple and may make it possible to approach the problem more realistically.

3- Zero Curve Smoothing Scenario from IRS LIBOR Swap Rates: A zero curve is generated from these rates in the market. The result is that there are differences between the zero rate curve in the market, the curve of the introductory zero rate refinement, and the zero rate curve smoothed from the global optimization. Perhaps the calculation methodology of SIMM using Greek market variables hits the zero curve and re-pricing.

4- Delta sensitivity of interest rate swap: This scenario explains how delta sensitivities for interest rate swap are calculated; Where delta can be calculated by the method of delta zero or market delta. A set of proposals from the Basel Committee on Banking Supervision for new capital requirements related to market risk for FRTB banks can use both methods but SIMM[1] uses Greeks market variants.

---

[1] International Swaps and Derivatives Association

The result is that neither zero nor market delta has a meaningful value except at maturity because delta at maturities less than IRS (3 years) is very small (10~30). But this pattern is not absolute and is subject to changing market environment because these days interest rates are showing very low.

The bottom line

The Mqam index is the best choice for both traditional and Islamic markets, so the fifth edition included amending the name of the index to be the standard for measuring the performance of financial transactions without specifying Islamic standards, because the standard is suitable for all cases with its service for all Islamic products.

A Mqam indicator is built from the expected cash flows of the studied project, taking into account its characteristics and quality. The cash flows reflect the nature of the project and the environment in which it works or will work. As for LIBOR and its sister indices, as predictive wholesale pricing for various projects and in various global environments, they do not consider any specificity.

It is sufficient to build an indicator Mqam of cash flow forecast for the studied project; While other indicators such as IRR, mIRR, FV, NPV and similar ones, you need to determine the expected cash flows and the interest rate to determine the result, and this in itself is superior and precedent.

We have provided a Mqam sensitivity analysis since the third edition i.e. since 2017, and here is the last proposed LIBOR scenario trying to measure the sensitivity of the interest rate swap.

We have demonstrated the possibility of constructing an indicator established at the level of one or more specific regions; To pricing liquidity and investment opportunities by tracking a set of Mqam indicators, and here are the alternative methods that we have added in this version that try to calculate LIBOR based on the curves and data of global indicators familiar with them, and measure their results based on that.

Since the recent scenarios presented by data science and its models have focused in their solutions on the pricing of futures swaps in the medium term; We have included a new addition to the Mqam Index which is the pricing of forward swaps to forecast and their expected annual and total net cash flows.

Finally, after fifty years of the failure of LIBOR, and the insistence of Islamic financial institutions on its use and adherence to it, even though its owners have explicitly disbelieved in it, and despite the fact that we developed an index established nearly twenty years ago and developed its last version since 2017, we hear and follow the Central Bank of Bahrain in addition to Islamic financial infrastructure institutions such as the General Council of Islamic Banks and Financial Institutions and others; They pant for an alternative index, but their years and years of meetings have so far produced nothing useful, and they ignore a standing index entirely.

It is scientific ingratitude; They are not able to innovate, nor do they support innovation.

September 10, 2021

Preface

Islamic financial institutions spread in the financial markets using the legal formulas in their work, and they focus on the debt formulas (such as Murabaha, Istisna’ and Salam); Because they are formulas that help the borrower or financier bear the risks and the expected return from the investment process; However, the use of debt formulas requires the existence of guarantees that correspond to the remaining part of the debt owed by the financier; This freezes the guarantor assets (in most cases), and hinders their investment, depriving them of realizing their own returns.

Islamic financial institutions - including Islamic banks - are also reluctant to formulate Mudaraba due to the nature of the speculative contract, which leaves a space in defining the responsibilities of infringement and negligence on the one hand, and determining the participation rates on the other hand.

Islamic financial institutions resort to being guided by the index (Libor and similar) in their long-term transactions; As a pricing that is generally accepted and recognized, without moving a finger to find an alternative that distances it from the usurious similarities under the pretext of the general acceptance of this indicator, and on the pretext of its preoccupation and immersion in its daily field work. A justification school has emerged that includes some jurists; They justify the use of this indicator because they are unable to find an alternative to it.

As for usurious banks, interest is used in their lending and borrowing operations. The borrower bears the cost of the borrowed funds at the rate of interest as well as the risks. This behavior is a tiring weariness of the economy; Because of the imbalance between the parties to the investment process; The owners of the money achieve a guaranteed return, while the speculator worker bear the risks of the return of the owners of the money, at the very least; The result is zero, with the possibility that speculator worker will lose out.

Both types of Islamic banks (in the case of debt formulas) and usurious banks (generally) share the burden of charging the borrower the cost of freezing the guarantee funds, in addition to the cost of the financing itself.

They also use the interest index (LIBOR and its like) as the most widely used and effective (according to the prevailing belief); But if the usurious financial institutions are excused from using it because of the nature of their business with forbidden usury; There is no excuse for Islamic financial institutions to use this usurious indicator, even if this justified school justified them.

MQAM history

In view of all of the above, and as a result of ongoing discussions in the financial community, I wrote in 2003 a booklet in which it proposed a standard for measuring the performance of Islamic financial transactions as an alternative to the LIBOR index that simulates the mechanisms of adopting the LIBOR methodology. Rather, it is by measuring the opportunity cost through Islamic financial institutions' distribution of their profits instead of pricing money according to LIBOR techniques.

And after seven years; That is, in the year 2010 it was radically redesigned, and some universities began to subject it to their studies within the research and theses of their students.

And after another seven years; That is, in 2017, it was developed in its current form.

Perhaps we can emulate the plans of Joseph, peace be upon him, which are based on seven years; We contemplate better from Mqam.

Although the Mqam criterion is an effective alternative to LIBOR and its tools; net present value, internal rate of return and adjusted internal rate of return; Its flexibility lies in: the possibility of setting target return rates; Through the expected cash flows, and in determining the expected cash flows based on a target rate of return, without relying on LIBOR and its sisters.

Mqam adds that it provides a criterion for distributing the returns between the owner of the money and the speculator worker in the speculative companies.

Important improvements have been made to it; Such as adding a measure of the quality of investment efficiency in terms of expected flow, or profit, a measure of liquidity quality, and another measure of sensitivity.

Our view confirmed because the traditional economy has resorted to applying negative interest in the past period; What made his financial tools unable to meet his goal in credit studies.

The Libor era has officially ended

It was two days before the publication of the third edition of the book; The following news was issued by the British Financial Supervisory Authority responsible for preparing and publishing the LIBOR rate:

> Andrew Bailey, CEO of the British Financial Conduct Authority FCA announced on 7-7-2017: the abolition of the British interbank rate index Libor at the end of 2021, and its replacement with a more effective and efficient standard system; After his reputation was damaged by a series of manipulations; In which major banks were implicated, they were fined a total of $9 billion. The CEO said that the indicator had become inefficient; Due to the small number of transactions that are priced on its basis, in addition to the absence of data on the volume of transactions, it must be replaced by another indicator that reflects a greater role in the volume of transactions. There are suggestions circulating for some time to use other indicators. News link: www.fca.org.uk/news/speeches/the-future-of-libor

This is a favor from God Almighty…

List of Mathematical Equations Used

No.	Equation
1	Total cash flow ÷ (target discount rate)^n = target discount rate x capital invested
	$$\frac{\sum_{i=1}^{n}(CF_i)}{R^n} = R\,.\,C$$
2	Total cash flow = (target discount rate)^n x target discount rate x invested capital
	$$\sum_{i=1}^{n} CF_i = (R)^n\,.\,R\,.\,C$$
3	Total Cash Flow ÷ Capital Invested = (Target Discount Rate)^(N+1)
	$$\frac{\sum_{i=1}^{n}(CF_i)}{C} = R^{(n+1)}$$
4	Target discount rate = (Total cash flow ÷ Capital invested)^(1/(n+1))
	$$R = \left(\frac{\sum_{i=1}^{n} CF_i}{C}\right)^{\frac{1}{n+1}}$$
5	Target discount rate for the following periods
	$$R_1 = R$$
6	Or Target discount rate for the following periods
	$$R_{(i)} = R^i$$
	Mqam based on cash flows for several periods = (Total cash flows ÷ Capital invested)^(1/(n+1)) - 1

No.	Equation
7	$MQAM = \left(\frac{\sum_{i=1}^{n} CF_i}{C}\right)^{\frac{1}{n+1}} - 1$
8	Mqam based on cash flow for one period = (Total cash flow ÷ Capital invested)^(1/(n+1)) - 1
	$MQAM = \left(\frac{CF}{C}\right)^{\frac{1}{n+1}} - 1$
9	Minimum return (n) = Invested Capital x (n) years ÷ Assumed minimum coefficient (n)
	$R = C . \frac{n}{R^n}$
10	Sum of the annual DCF or Total Operating Profits at the end of each financial period plus the money invested
	$Share_1 = \sum_{i=1}^{n} \frac{CF_i}{R_i}$
11	Net operating profit = Total operating profit at the end of each financial period + Principal invested capital - Invested Capital
	$Profits_1 = \sum_{i=1}^{n} \frac{CF_i}{R_i} - C$
12	$Profits_1 = Share_1 - C$
13	Total Discounted Cash Flow reinvested CFp annually
	$CF_{p_1} = CF_1 + \frac{CF_2}{R_2} + \sum_{i=1}^{n} \frac{CF_{(p_{i-1})}}{R_i}$

No.	Equation
14	$CF_{p_n} = CF_{(n-1)} + \frac{CF_n}{R_n} . R_1$
15	Total cash flow = Invested Capital + Operating Profit + Reinvestment Profit
	$\sum_{i=1}^{n} CF = C + Profits + Share_2$
16	$\sum_{i=1}^{n} CF = Share_1 + Share_2$
17	Reinvestment Profit = Total Outflows Generated - (Operating Profit and Capital Invested)
	$Share2 = CF_{p_n} - Share_1$
18	An efficiency condition is when the total expected cash flows CF equal the total discounted and reinvested cash flows CFp
	$\sum_{i=1}^{n} CF = \sum_{i=3}^{n} CF_p$
19	$\sum_{i=3}^{n} CF_i = C + \sum_{i=j}^{n} \left(\frac{CF_j}{R_i} - C\right) + Share_2$
20	Efficiency quality in terms of profit
	$\frac{Share_2}{Share_1} \cong 1$
	Gross Operating Income Ratio = Total Operating Income ÷ Total Reinvested Cash Flow

No.	Equation
21	$Share_{1ratio} = \frac{Share_1}{\sum_{i=3}^{n} CF_i}$
22	Annual Gross Operating Revenue Ratio = Total Operating Revenue Ratio ÷ Number of Years
	$AnnualShare_{1ratio} = \frac{Share_{1ratio}}{n}$
23	Cash flow to be achieved = Financier's capital after the investment + Mudarib capital after the investment
	$CF_p = Share_1 + Share_2$
24	Financier's capital after investment = Invested capital + Invested capital x Expected return
	Financier's capital after investment = Invested capital x (1 + Expected return)
	$Share_1 = C\,.\,(1 + r)$
25	Mudarib's capital after investment = Financier's capital after investment + (Financier's capital after investment x Expected return)
	Mudarib's capital after investment = Financier's capital after investment x (1 + Expected return)
	$Share_2 = Share_1\,.\,(1 + r)$
26	Mudarib's capital after investment = Invested capital x (1 + Expected return)^2
	$Share_2 = C\,.\,(1 + r)^2$
27	Cash Flow
	$CF_p = C\,.\,(1 + r)\,.\,(2 + r)$

No.	Equation
28	Total cash flow for investment years
	$CFp_n = C\,.\,(1+r)\,.\,(2+r) + \sum_{i=1}^{n}\left(Share_{2i}\,.\,(1+r)\,.\,(2+r)\right)$
29	Sensitivity modulus
	Sensitivity modulus = (Average cash flow) x [SUM(R)^(N-i)]} ÷ {C x (R)^N}
	$SensPara = \frac{CF}{n}\,.\,\frac{\sum_{i=1}^{n} R^{(n-i)}}{C\,.\,R^n}$
30	Mqam sensitivity = Sum of the project's deducted flows at the Mqam rate ÷ Sensitivity modulus Mqam
	$MQAMsensitivity = \frac{CFp}{SensPara}$
31	Mqam = [(Sale Price ÷ Basic Cost)^((1 ÷ (n+1))] - 1
	$MQAM = \left(\frac{SellPrice}{CostPrice}\right)^{\frac{1}{n+1}} - 1$
32	Forward Sale Rate = (Mqam x 2) ÷ Financing period
	$ForwardSellingRate = \frac{2.MQAM}{FinancePeriod}$
33	Coefficient
	$Parameter = \sum_{i=1}^{n-1}\left(ForwardSellingRate + 1\right)^{i}$
34	Cash Sale Amount = (Forward Sale Rate + 1)^N x Base Cost
	$CashAmount = (ForwardSaleRate + 1)^n\,.\,Cost$
	Installment = cash sale amount ÷ Coefficient

No.	Equation
35	$Installment = \frac{CashAmount}{Parameter}$
36	Total Installments = Installment x Finance Period
	$TotalInstallments = Installment\,.\,FinancePeriod$
37	Net Cost = Total Premiums ÷ (Forward Sale Rate +1)^(N+1)
	$NetCost = \frac{TotalInstallments}{(ForwardSaleRate + 1)^{(n+1)})}$
38	Forward Paid = Premium Cost - Net Cost
	$DownPayment = Cost - NetCost$
39	Forward Rate = Swap Price for the year n ÷ n
40	Forward annual cash flow = Forward price x Investment amount
41	Total future net cash flows = Net cash flows ÷ (Mqam + 1)
42	Mqam for regular flows = net cash flows ÷ Investment cost
43	Mqam for irregular flows = (5-year Swap rate - 1) ÷ (Five-year Swap rate x Spot rate)
44	Forward annual cash flow for irregular flows = (Net cash flows ÷ (Mqam + 1)) ÷ Mqam modulus
45	Swap rate for year n for irregular flows = (Annual Cash flow ÷ Investment cost) x n

Contents

Chapter One - The Suicide of the Monetary School

The traditional banking system is based[1] on give and take interest; Where the usurious bank takes more interest from its customers; what is paid by his depositors; the difference to be his profit; The owner of the money earns and speculator worker. Interest rates range from completely larger than zero to multiples; This is called compound interest.

If interest shifts from this concept in monetary policy; The traditional banking institutions are no longer necessary, and they will withdraw on their own from the global monetary stage for losing everything; The profit that is its function and the reason for its survival has disappeared.

The traditional usurious system recognizes the periodic decline in the value of money; It has a strong positive correlation with the interest rate; It is the interest rate that determines its alternative opportunities, its rental price, and its sale price; For this reason, financial mathematics provided its dependents to serve this system as dependents: FV, NPV, IRR, mIRR and others, which cannot be imagined excluding the interest rate.

[1] See our article in the International Journal of Islamic Economics, Issue 51, 2016.

In our book[1] (Controls of the Islamic Economy in Dealing with Global Financial Crises) published in August 2008, we explained the role of usury in that crisis and its aggravation.

There have always been discussions (in 2010) with some members of groups who defend usury, represented by its basic price (LIBOR); As these people do not imagine that the global economy will abandon usury, even if it is just a conception. Among those discussions:

- Some - especially traditional bankers - were afraid of the idea of the Islamic index, asking: What if the Islamic index became cheaper than the traditional index? Will everyone go to Islamic banks?
- Some of them requested a steady progression in the application of any proposed Islamic indicator of the difficulty of such a goal, arguing that it requires tremendous, strenuous and collective efforts; It is as if we are in a kindergarten that teaches its children to walk.
- Some of them asked for clarification on the extent to which the current indicator (i.e. LIBOR) contradicts the purposes of Sharia, describing what is published and what is said as weak and general and that it does not touch reality, and does not contain any depth in the collection and clear link between the objectives and the details of the Islamic banking reality.

[1] Our book: The Controls of the Islamic Economy in Dealing with Global Crises, 2008, which was published by Dar Al-Nahda, Damascus, Dar Shuaa, Aleppo, and Dar Al-Sayed, Riyadh.

- Some have mentioned the failure of some attempts to present and build an alternative Islamic indicator; It is as if he is reprimanding their actions, and the experiments that take place - in his opinion - according to their historical sequence began (1978) with (Shehata, then Al-Jarhi, then Al-Hawari, then Zarqa, then Al-Abaji, then Mirakhour - and this man was the head of the International Monetary Foundation and is a Muslim - and then Al-Zamil, Then Al-Beltagy, then Al-Qattan, then Kantakji). And listen to the explanation of this dazzling feat on an absurd scale: I will tell you why it failed? Will everyone who comes after it fail? It is the Libor account mechanism and its derivatives, describing it as: a renewable mechanism that keeps pace with new developments in the field of legislation and communication and information technologies, and is governed by major market participants.
- There are those who mentioned a sure treatment, summarizing: The indicators of the Islamic financial market will continue to be linked to the international interest rate, as long as Islamic financial institutions continue to rely heavily on debt financing formulas, and that their inevitable intertwining with traditional financial institutions through the international financial markets is inevitable, and strong systems are inevitable. To impose its monetary system, the British Banking Association realized this and decided to study the

possibilities of expanding the use of LIBOR and its derivatives in the field of Islamic finance, and this is the remedy in its opinion.

And all of this is not true at all, and it represents the subordination of those to the prevailing thought, and it is just a claim that the last of its papers has fallen by resorting to negative interest, and this is our topic.

We had developed a standard for measuring Islamic finance tools, which we called (Mqam), which dispenses with (the usury index entirely), and provides better mathematical solutions than the functions: FV, NPV, IRR, mIRR and others, and we supported it with examples in all the necessary fields. as one of her PhD topics and discussed by many Western experts.

Now, ten years after the global financial crisis, the Chicago Monetary School finds itself in a suicidal position; A quarter of the global economy has shifted towards negative interest, and the stronghold of that school is still trying to preserve the last symbol of capitalism, which is usury; The European Central Bank cut interest rates to (minus 0.3%); to revive the eurozone economy; The interest rate on deposits in Denmark and Switzerland is (minus 0.075 percent) and in Sweden (minus 1.1%). The latest stress test scenarios suggest that there is a 30% chance of negative interest rate policy in the US by the end of 2017, according to Bank of America Merrill Lynch calculations.

Negative usury

Do you see why the world did not pass its way on the zero that lies between the positive and negative of numbers?

Interest is described as negative[1] when the depositor is obligated to pay interest or periodic fees on his deposits in the bank's vaults, and this is a new concept on the traditional economy; What was prevalent was the concept of positive interest (in the mathematical sense); The bank (whether central or commercial) pays periodic interest to depositors of money in its vaults.

As for the desired goal - according to the traditional monetary school - it is to strengthen markets through:

- It is a form of quantitative easing; Because it allows obtaining loans at very low rates.
- Deterring banks from depositing cash in the central bank; Banks use that money to lend to individuals and companies that put that money into the economic cycle.
- Pushing people to hold cash instead of seeing its value slowly fade away; due to fees.
- Dispel deflation and raise the inflation rate to 2%; As a target percentage for most economies, although the central banks of rich countries are beginning to be convinced that this target percentage is not feasible and that it will increase[2].

---

[1] Negative interest rates NIRP

2 This is what was mentioned in an article in The Economist, August 25, 2016 titled: When 2% is not enough.

- Depreciation of the currency of the country adopting the negative interest policy; This gives a price advantage to exporters.

But the initial effects of that suicidal policy were summed up as follows:

- The erosion of the power of central banks; Negative interest policy is a dangerous policy.
- Raising taxes on consumption; and this is; Which discourages consumption and does not stimulate it.
- Increased commodity prices due to taxes.
- Decline in the value of shares in various global stock swaps; Stock swaps are balancing indicators of the state of markets and their sensors.
- Negative returns on government bonds.
- Quantitative easing programs lose their impact on markets.
- Escalation of the currency war; Which will bring mutual destruction.
- The banking sector has been affected at the global level; Especially after the losses of the shares of European banks since the beginning of the year until now about 30%, the American 20%, and the Japanese 35%; This threatens the exit of many banks from the market and the layoffs of their workers.

That's why we hear complaints saying: (Save the savers)! How is that?

The global economy suffers from a glut of savings compared to investment opportunities, and the current monetary school sees the monetary authorities as helping to harmonize interest rates while directing investments through (market forces) that determine what savers will receive.

The savings glut is in countries with a current account surplus; such as Germany; But its investment market does not absorb this excess liquidity, while if the savings were directed to the rest of the world, it would find its way to employment; However, the general investment climate is not reassuring, as we will see later.

As for this situation, it was imposed by the conditions after the 2008 crisis, and it is summarized as:

- Excess savings for some and a deficit for others.
- Double the investment for everyone.
- Thus, productivity slows down.
- Most economies are sluggish with debts that are like someone who has entered an endless tunnel.

All this led to making the interest rate the lowest in the history of moneylenders. This is a result achieved by the central banks; It is not errors in monetary policy; Because this policy is nothing but a counterweight to aggregate demand and assumed supply, which determines long-run interest rates.

But what if many savers - countries and individuals - resort to refraining from investing their money in the stock market in light of the prevailing turmoil in it? What if they resorted to hoarding them in their homes instead of placing them in investment channels?

It is unfortunate that those countries that are well-developed in the world of civilization and brimming with scientists and economists have been learning by practice and are floundering in what they are doing; Interest trumps correct logic; Therefore, the cries of the wise remain echoes that have no effect, as we will mention later:

- The European Central Bank tried to raise the interest rate in 2011, and that policy returned to it with unimaginable consequences.
- There is a question: Did she (the chair of the US Federal Reserve) make a mistake when she raised the US interest rate in December 2015? Is her deputy's statement (on August 22, 2016) his intention to raise interest rates in an attempt to reassure the markets, ignoring the results of the stress test scenarios we mentioned about the US market?
- Was the Japanese central bank wrong when it adopted the negative interest policy in late January 2016?
- Or is the problem more complex and confusing?

It seems that the central banks will find themselves forced to try new tools to learn more and more!!

So since it is learning by doing, and this is costly in social experiments; The world has tried positive rates of interest, and now it is trying negative rates, and the result is still continued confusion; Why not try the zero[1]? I mean absolute zero; Because zero in the interest rate (by definition Wikipedia) is a macroeconomic concept that describes cases of very low interest rates; Therefore, we find that they do not recognize absolute zero, or that they find it difficult to do so despite its simplicity and the stability of its success in the 2008 crisis, even though Islamic banks used to come with licenses and sometimes less; So what if they came from the financing formulas?

So; What we mean as a desired solution to a world that has been learning economic crawl:

It is the absolute zero that God Almighty commanded by saying:(2:279) but if you do not do so, then you are warned of the declaration of war against you by Allah and His Messenger. If, however, you repent even now (and forego interest), you are entitled to your principal; do no wrong, and no wrong will be done to you.

وَإِن تُبْتُمْ فَلَكُمْ رُءُوسُ أَمْوَالِكُمْ لَا تَظْلِمُونَ وَلَا تُظْلَمُونَ (البقرة: ٢٧٩)

This is one of the constants of Islamic Sharia, which came with well-established scientific facts over the centuries, and then left people a wide space of freedom within those constants.

- In the eighties of the last century, the French economist and Nobel Prize winner in economics - Maurice Alli - touched on the structural crisis in the global economy under the leadership of "savage liberalism", considering that the

[1] Zero interest-rate

situation is on the edge of a volcano, and is threatened with collapse under the weight of the double crisis (debt and unemployment). What he predicted 25 years ago, and he had proposed two conditions to get out of the crisis and restore balance:

- Reducing the interest rate to zero.
- Revision of the tax rate to approximately 2%.

As for what Islam brought 14 centuries ago, it is the order to abolish usury and impose zakat on money at a rate of 2.5%. This balance between monetary and fiscal policies is the key to balancing economic policy, as we will show later.

The contemporary monetary theory arose because of the limitations of Keynesian thought, and its inability to explain the phenomenon of inflation that coincided with the phenomenon of economic stagnation at the time; An economic thought based in its foundation and methodology appeared on the theses and theories of the traditional school.

The (Chicago School) or "Friedman's theory" is an extension of traditional economic thought in a new dress and with more effective and realistic analytical tools. This coincided with the emergence of an economic crisis during which inflation and depression coexisted in the United States of America after World War II and until the end of the fifties.

What made matters worse was the approach taken by this school by applying what was known as the Bretton Woods Agreement in 1971 AD, whereby the gold deed was abolished, and the conversion of the dollar into gold was abandoned; Its value decreased directly by 7.89%, then it decreased by 10% in 1979 AD, and this was negatively reflected on the price level of many commodities. And that was the biggest robbery in world history that was led by that tide Rasa cash that we all live in floundering.

Friedman's introduction of financial assets into the function of demand for money as substitutes for money is another cause of monetary confusion; Because it increased the volume of global debt; financial assets; Either (fake sales) or (derivatives that represent debts that are neither sold nor bought) and all of this is prohibited in Islamic legislation.

We have mentioned more than once[1] the collapse of symbols, in which the collapse of material communism took seventy years, and the Chicago Critical School is one of the most important pillars and symbols of greedy capitalism for eighty years. This is the case with social experiences. We explained in our introduction to the book The Three Wise Men[2] (George Cyrus - Warren Buffett - Paul Falk) that they have absorbed the lessons of crises, and they have learned the extent of the deviation of the Chicago Critical School led by skilled academics such as (Milton Friedman), which formed a bridge between the two giant financial crises, the collapse of 1929 AD and the crisis of 2008 AD and their conclusion: that markets have an effective ability to achieve equilibrium, in

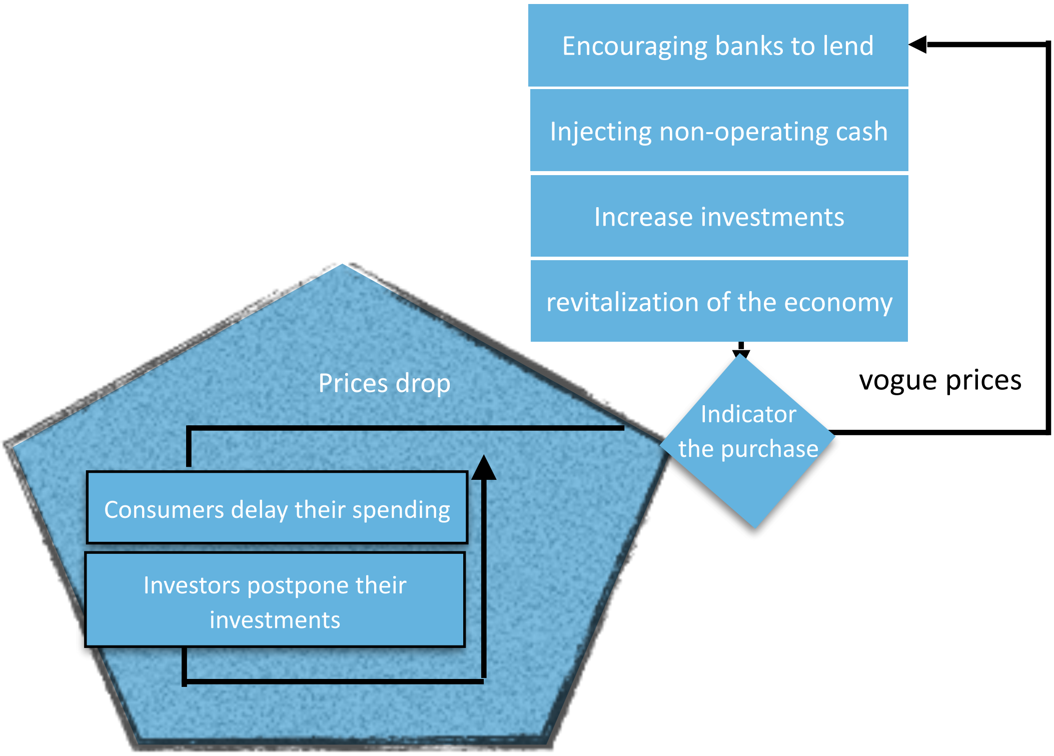
[1] See our inaugural article for the eighth issue of the International Journal of Islamic Economics (January 2013).

[2] The Book of the Three Wise Men (George Cyrus - Warren Buffett - Paul Falk), translated and published by Al-Sayed House in Riyadh.

contrast to what the Keynesians approached in intervening; Soros even asked: If markets are so efficient, why are they crashing?

Therefore, it is necessary to re-adjust the monetary and fiscal policies together in order to control the public financial policy's obSection with public debt and to curb it. It becomes limitless when the price of borrowing falls, and this is what is happening in the traditional economy, of course.

The hypothetical scenario of the negative interest mechanism can be drawn as follows: banks will be encouraged to borrow; To evade the cost of depositing money in central banks, injecting their passive liquidity to increase investments and stimulate the economy; If the buy index moves positively; The objective has happened, otherwise a decline in prices and a contraction in spending will cause the markets to enter into a vicious cycle frightening, Figure (1).

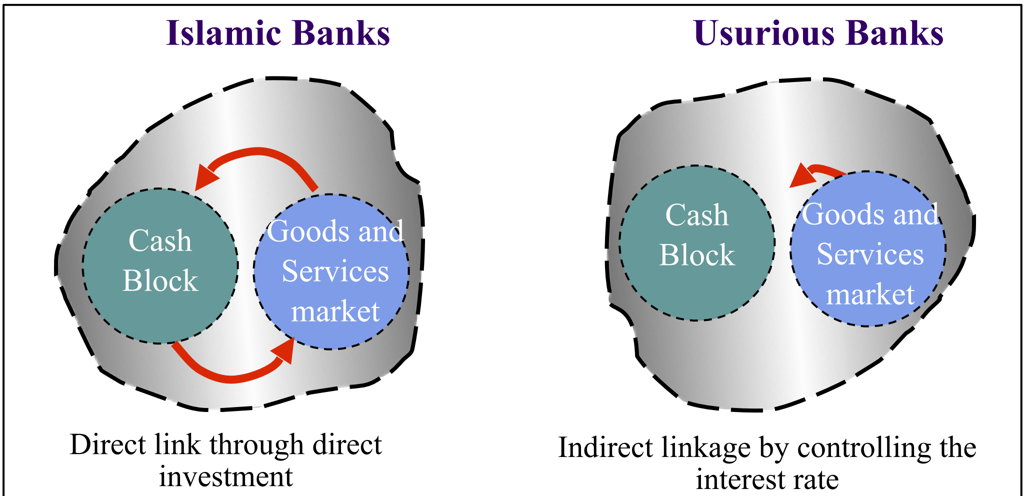


contraction cycle

Imagine how this scenario contained all the contradictions? Liquidity is available and investment is stagnant!.. and this is the state of the markets today. The explanation for this, in our opinion, is that the money cycle operates independently in the money market through its engine (the interest rate); If the engine power fades and becomes old; Recession and deflation are its natural fate. Indeed, it seems that this engine has lost its luster, and the critical school must recognize the limitations of its thought in order to establish a better school than it as it arose on the ruins of the limitations of Keynesian thought - as we mentioned earlier -.

In our opinion, if the link between the two markets (money and commodities) was an organic and real link, and not just a link with indicators; By brokering goods and services within the financing process; We find that the solution lies in the rules and regulations of Islamic finance; The two markets will pull each other together, and stagnation will never reach them; Because the sustainable financing of the poor with a completely marginal propensity to consume makes the wheel of the economy never rest and never stops; The poor - and they are the broadest segment - represent the function of buying and its market leverage, and they are in a state of continuous purchase to satisfy their needs. As for their minimum sustainable financing, it is achieved by the zakat rate of 2.5%, which (Dr. Munther Al-Qahf) described as: a quiet redistribution of income; It does not impoverish the rich and improve the condition of the poor; So the markets move away from stagnation, and thus give them a space to regain their popularity, and the condition of the people in them improves; Thus, monetary and fiscal policy are integrated into an effective and credible economic policy.

The difference between this tight geometric structure and the next diagram[1]; that the traditional monetary policy has made liquidity sit in the coffers of banks, while investors are idle; Due to the lack of liquidity in their hands, and the markets are waiting, and therefore pessimism will spread among market leaders, and consumers' expectations will move towards more contraction.



The role of banks in linking the money markets and the markets for goods and services

Figure (2)

This is the state of the global market now:

On this day 12 years ago, Lehman Brothers declared bankruptcy under Chapter Eleven of the US Bankruptcy Code. Since then, markets and economies are still experiencing the effects of the "hurricane" that was left by the largest

[1] See our book: (The Finance Industry in Islamic Banks and Financial Institutions), p. 171.

bankruptcy in the history of the United States of America. A Deutsche Bank report showed that:

- Central banks around the world have cut interest rates 672 times since the collapse of Lehman Brothers, without specifying how many times these banks have implemented quantitative easing policies to support the economy.
- The yield on US 10-year bonds fell from 3.389 percent to 1.698 percent. The yield on the two-year bonds fell from 1.706 percent to 0.758%, and the yield on the thirty-year bonds fell by about half to reach the yield of 2.45%. This decline indicates an increase in the demand for these bonds in light of the low appetite for risk, since the relationship between the return on bonds and their prices is an inverse relationship.
- In the major commodity markets, the report indicated an increase in the price of an ounce of gold from $787 to $1,323. Oil fell more than half.

If a questioner asks about the secret of the persistence of wrong practices around the world, despite what has happened and is happening; The answer is: that social experiences need time and sometimes generations need to be changed; Convictions were entrenched until they became a Muslim belief. And the days are enough to complete the fall of the social theories that are harmful to people when the wisdom of their wise and rational people is of no use.

This is the worst thing about learning by doing.

Chapter Two - Interest Index Preparation Scenarios

Banks[1] have become an important part of economic life in all parts of the world, and in the midst of the storming waves of those eager to find a justification for usurious interest as a result of their lack of understanding of the spirit of Islamic Sharia, which seeks to achieve justice among all people, and their lack of understanding of the real role of interest in the world of money. I began the search for a legally acceptable alternative that relies on profitability indicators as a measure witnessed by professionals and researchers alike, as we have proven in our published research entitled: “Which is more suitable in investment: the profit criterion or the interest criterion?”, benefiting from the vision of distinguished jurists who enlightened us the path of truth. And right.

Fiqh councils, seminars and conferences of an Islamic nature have recommended the necessity of finding an alternative to the interest indicator in order to achieve the independence of Islamic financial engineering and to get rid of the burden of the prohibition of usury.

[1] Consider our book: The Standard for Measuring the Performance of Islamic Financial Transactions as an alternative to the Libor Index, published in 2003, in which we dealt with the importance of indicators in investment decisions, techniques for preparing the Libor index, the proposed alternative and the standard for measuring the performance of Islamic financial transactions. We will only mention the last two axes.

Section One

Preparing Libor Index Techniques

Based on the importance of the role of indicators in the economic decisions taken, and since banks represent the nervous system of the economy, the interest indicator is the main driver of monetary policy and the management of the monetary system, and it is the standard for investments and the guide for savings. It is the discount rate that is used; To obtain the necessary liquidity, with which banks price their products, and it is an indicator for evaluating projects and identifying alternative investment opportunities.

What are the techniques used by international banks in preparing this indicator?

LIBOR SYSTEM

LIBOR[1] is the main indicator used by banks, credit institutions and investors to fix the cost of borrowing in money markets around the world. The word Libor is an acronym for the London Inter-Bank Offered Rate.

LIBOR is used to calculate the usurious interest rates applicable to a large segment of short-term contracts, loans and trade. It is set by the Association of British Banks[2].

[1] From the British Banking Association website www.bba.org.uk.

[2] British Banker‘s Association BBA

The association swaps opinion when fixing the LIBOR rate with the LIBOR management group[1] in the association - which leads an activity; London money market practitioners.

Elements of the definition of LIBOR by association[2]:

- The sworn participants are a minimum of eight banks whose mission is to express the equilibrium of the market by setting an interbank rate. Banks are selected by the British Banking Association and the Financial Markets[3] Advisory Board after a special nomination and after discussions with the management group and on the basis of reputation[4] and activity in the London market in addition to the observations of currency experts and considerations of the credit situation.
- The Society, in consultation with the group, reviews the jury's arrangement at least once a year.
- The given rates constitute a range of values, two mathematically closest mean values are chosen and then averaged to arrive at the proven[5] LIBOR rate. Banks' jury rates are published shortly after the proven interest rate is published.

---

[1] BBA Libor Steering Group

[2] Some amendments have been made to the definition of LIBOR, such as: the effect of the member, the period between the date of confirmation and the date of the value, and others. These amendments took effect after 1-2-2001, and since they are not relevant to the research in our hands, the interested person can review them on the website of the British Banks Association.

[3] Markets Advisory Panel

[4] BBA Libor Steering Group

[5] BBA Libor Fixing

- The Association, in consultation with the Group, reviews the LIBOR installations from time to time and may intervene to modify the calculation methodology for various considerations in addition to making important comments; In order to bring about planned changes.
- Fixed LIBOR cannot be rationalized by the usual methods; Therefore, the Association, in consultation with the Group and other market practitioners, uses best efforts to determine alternative rates. Where this alternative is resorted to in the market at the right time.
- If a participating bank violates the spirit of this definition or the association's instructions, it, in consultation with the group, will warn the bank, asking it to remedy the situation, and may act on its own to disqualify the bank from the jury.
- If a participating bank is suspended from the jury, the association consults with the group to select a replacement as soon as possible.

Rules and instructions for banks participating in the association

- The bank participating in the LIBOR body contributes to determining the interest rate at which the funds will be loaned, and it must do so and accept the rate offered in the market.

- The rate of each participating bank is determined regardless of the other participants.
- Deposit rates will be:
  1. It is used in the London market.

2. Simple and not fixed.
3. Subject to the laws of England and Wales, and its parties to it.

- Averages are in decimal values plus at least two decimal places after the comma and no more than five.
- Participants make their entries to the distributor between 11.00 and 11.10 London time. The distributor corrects material errors in the rates entered by participating banks before 11:30, and the average rate is published around 11:30 London time. Obvious errors are corrected within 30 minutes as the necessary adjustments are made, and the fixed interest rate is finally published at 12:00 London time.

Example:

Suppose the proposals of the banks participating in the jury panel charged with preparing the LIBOR index are M1, M2, M3, M4, M5, M6, M7, and M8, as follows:

Table 1: LIBOR calculation

Basic Suggestions		Suggestions after ranking	
Participating bank	proposed rate	Participating bank	proposed rate
M1	4.55	M1	4.55
M2	4.90	M4	4.75
M3	5.25	M2	**4.90**
M4	4.75	M7	**4.95**
M5	5.42	M8	5.09
M6	5.33	M3	5.25
M7	4.95	M6	5.33
M8	5.05	M5	5.42
Therefore, Libor is equivalent to the average of the two nearest values, i.e. 4.925			

Section Two
Interest Pricing with IRS SWAP Rates

Suggest a pricing scenario[1] (IRS Interest Rate Swap); On 7-10-2021, the programming language R was used, and illustrations were used; swap rates, and zero-curve data from Bloomberg, given the 5-year Libor 3M IRS.

The swap of fixed rates for floating rates generates a stream of cash flows, the rates of which are determined by:

1. A predetermined fixed rate, which fits the fixed cash flows.
2. Variable rates to be determined periodically in the future in a row, in proportion to the changing cash flows. But due to the uncertainty of the evolution of variable prices in the future, the forward rate of the alternative variable coupon rate is used, which implies forward-looking information; Market participants expect the forward rate to be the expected future rate from a fair pricing perspective. It should be noted that the variable rates are set on the re-fixation dates before the corresponding interest periods in advance. When pricing the swap, the first variable cash flow is known, but the cash flows that follow it remain unknown. So are their rates, so forward rates are used for their corresponding interest periods, which are embedded in the current market yield curve.

Granting credit has been complicated after the global financial crisis of 2008, and its traditional tools have fallen, as the

[1] Di Cook, Interest Rate Swap Pricing using R, R-Bloggers website, July 10, 2021, Link

British Financial Conduct Authority FCA predicted that the Libor index would stop at the end of 2021, then interest rates fell to zero and even became negative in some global markets, as a result of which some financiers took an approach that suits The so-called pre-GFC2008, and some others have taken a post-global financial crisis approach.

Therefore, the calculation of the IRS LIBOR swap rate is suitable for discounting cash flows using the LIBOR discount modulus included in the LIBOR curve, an approach that fits before the global financial crisis. As for after the crisis; The Overnight Indexed Swap or OIS is the most appropriate approach.

SWAP PRICING

The pricing of the swap corresponds to the net present value (NPV), which is the difference between the sum of the constant present values and the variable present values; The expected cash flows are discounted at LIBOR for the period in which the flows are realized (i for the fixed period, j for the variable period).

The participant in the swap process receives fixed cash flows, and then pays them as variable flows, and therefore the value of his swap at time t is calculated from the following equation:

$$NPV(t) = \underbrace{\sum_{i=1}^{n_i} CF_{t_i}^{fixed} . DF^{libor}(t, t_i)}_{PV\,of\,fixed\,CFs} - \underbrace{\sum_{j=1}^{n_j} CF_{t_j}^{float} . DF^{libor}(t, t_j)}_{PV\,of\,floating\,CFs}$$

$$DF^{libor} = \,libor\,discount\,factor$$

$$DF^{libor}(t,t_i) = DF^{libor}\, from\; t_i\; to\; t\; for\; the\; fixed\; leg$$
$$DF^{libor}(t,t_j) = DF^{libor}\, from\; t_j\; to\; t\; for\; the\; floating\; leg$$
$$t_i = i - th\; payment\; date\; for\; the\; fixed\; leg, i = 1,2,\ldots,n_i$$
$$t_j = j - th\; payment\; date\; for\; the\; fixed\; leg, j = 1,2,\ldots,n_j$$
$$s = spot\; date$$

CASH FLOW

Because the discount modulus is related to **market information**, the cash flows must be calculated in both fixed and variable terms, with NA being the hypothetical amount.

Flows on a Fixed Interest Basis:

$$CF_{t_i}^{fixed} = \underbrace{\underbrace{\underbrace{C}_{coupon\; rate} . \tau\,(t_{i-1},t_i)}_{semi-annual\; fixed\; copoun\; rate} . NA}_{semi-annual\; fixed\; coupon\; amount}$$

$$C = fixed\; rate$$
$$\tau\,(t_{i-1},t_i) = day\; fraction(30I/360)$$
$$= (360\,.\,\Delta Year + 30.\Delta Month + \Delta Day)/360$$

Flows on Variable Interest Basis:

$$CF_{t_j}^{float} = \underbrace{\underbrace{\underbrace{FD^{libor}(t,t_{j-1},t_j)}_{forward\; rate} . \tau\,(t_{j-1},t_j)}_{quarterly\; variable\; copoun\; rate} . NA}_{quarterly\; variable\; coupon\; amount}$$

$$FD^{libor}(t,t_{j-1},t_j) = forward\; rate\; between\; t_{j-1}\; and\; t_j\; implied\; in\; the\; time\; t\; Libor\; curve$$

$$\tau\,(t_{j-1}, t_j) = \ day\,fraction\,(ACT/360) = actual\ days\ in\ between/360$$

DISCOUNT FACTOR AND FORWARD RATE

The discount factor and forward rates must be calculated; To complete IRS interest rate swap pricing; In the following way:

The discount factor at time t:

$$DF^{libor}(t, t_i) = exp\Big(- R^{libor}(t, t_i)\,.\,\frac{t_i - t}{365}\Big)$$

$$R^{libor}(t, t_i) = \ zero\,rate\,from\,t_i\,to\,t\,impleid\,in\,the\ Libor\,curve$$

Forward discount rate at time t:

$$FD^{libor}(t, t_{j-1}, t_j) = \frac{365}{t_j - t}\,.\,\Big(\frac{DF^{libor}(t, t_{j-1})}{DF^{libor}(t, t_j)} - 1\Big)$$

CHARACTERISTICS OF THE IRS INTEREST RATE SWAP

Bloomberg, as of June 30, 2021; Market Information Source (Swap Rates and Zero Curve), IRS Next 5-Year Interest Rate Swap as per Libor 3M Index.

Curve Date	06/30/2021	Valuation	07/02/2021

Leg 1:Fixed	Receive	Leg 2:Float	Pay
Notional	10MM	Notional	10MM
Currency	USD	Currency	USD
Effective	0D : 07/02/2021	Effective	0D : 07/02/2021
Maturity	5Y : 07/02/2026	Maturity	5Y : 07/02/2026
Coupon	**0.96495**	Index	3M : US0003M
Calc Basis	Money Mkt	Reset Freq	Quarter
Pay Freq	**SemiAnnual**	Pay Freq	**Quarter**
Day Count	**30I/360**	Day Count	**ACT/360**

Maturity Date	Market Rate	Zero Rate	Discount
2021-10-04	0.14575	0.147746193	0.999619575
2021-12-15	0.13960987	0.144337758	0.999343775
2022-03-16	0.203838571	0.166389742	0.99882912
2022-06-15	0.197747864	0.175294805	0.998330092
2022-09-21	0.266249272	0.196071375	0.997607037
2022-12-21	0.359490949	0.224582505	0.996701321
2023-03-15	0.512603195	0.264462839	0.995510617
2023-07-03	0.328354999	0.328408009	0.993444424
2024-07-02	0.571049988	0.57153017	0.982984857
2025-07-02	0.793000013	0.795496282	0.968659961
2026-07-02	**0.964949995**	0.970003867	0.952631838
2027-07-02	1.105400503	1.113416388	0.935349065
2028-07-03	1.218425035	1.229010329	0.917473358
2029-07-02	1.307229996	1.320660292	0.899671854
2030-07-02	1.380100012	1.396222829	0.88184713
2031-07-02	1.442600012	1.461391065	0.863968316
2032-07-02	1.497749984	1.518876914	0.846029289
2033-07-05	1.543799996	1.56735962	0.828332361
2036-07-02	1.644599974	1.673867348	0.777817359
2041-07-02	1.736799955	1.771539831	0.701488591
2046-07-02	1.765799999	1.798302077	0.637710328
2051-07-03	1.773699999	1.801516859	0.582253179
2061-07-05	1.709860027	1.707008589	0.504891658
2071-07-02	1.62075001	1.580574449	0.453478751

The table above shows that the fixed coupon rate for the straight installment is 0.96495, which is the market swap rate for 5 years (the study date is 2021 and after five years it is the year 2026). The frequency of payment and the number of days agreement varies between fixed and variable. These specifications are not absolute but have been selected in the traditional way. Moreover, there are many types of daily count conventions. Before moving to the account, six dates must be specified, namely:

- Interest start date and end date.
- The beginning of the entitlement, and the date of its end.
- Reset date, payment date.

Determining these dates requires market conventions and is somewhat complex and important. The general swap pricing includes determining these dates. However, because most internal pricing systems, Bloomberg, or Reuters provide this information, the following cash flow tables and NPV can be calculated at these dates. They will be hypothesized using Bloomberg's cash flow schedules (payment dates) and zero rate curve.

Any way; To quote a 5-year IRS interest rate swap on spot date (s) (working days from the trading date); where (s) is replaced by (i) so that the pricing formula is as follows:

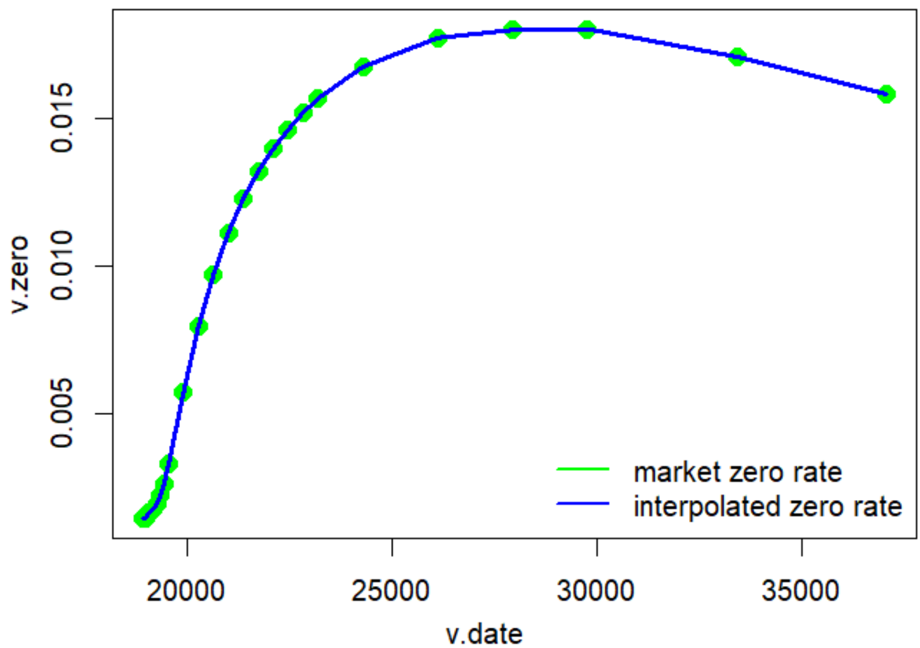
$$NPV(s) = \sum_{i=1}^{n_i} CF_{t_i}^{fixed} . DF^{libor}(s, t_i) - \sum_{j=1}^{n_j} CF_{t_j}^{float} . DF^{libor}(s, t_j)$$

$s = \ spot\, date$

The IRS interest rate swap on the spot date is zero; As there is no gain or loss between the two parties to the swap initially. The swap pricing model can be checked whether the swap rate at the spot date is zero or not. In real pricing, a linearly interpolated zero curve is used because the dates of payment do not correspond to the dates of the zero market price curve.

The result

The following figure plots the zero market price curve (Bloomberg) and the linear interpolated zero rate curve from the approxfun() function of R[1] at 6-30-2021.



The results indicate that the swap price is $2,713,318, which is expected to be $0, but cumulative numerical errors or unknown aspects of interpolation make this difference. This swap is considered to be zero because the ratio of price to nominal amount is:

[1] يُنظر الملحق (ب) الذي يضم نص برنامج لغة R Code.

2,719,318 ÷ 10,000,000 = 0,000,00027 which is close to zero from the point of view of numerical arithmetic.

```
> #-------------------------------------------------------------
> #  3)  Swap Price at spot date
> #-------------------------------------------------------------
> df.fixed[,-2]
          ymd     zero_DC        DF      rate       CF       PV
1  2022-01-04 0.001491843 0.9992401 0.0096495 48783.58 48746.51
2  2022-07-05 0.001795349 0.9981915 0.0096495 48515.54 48427.80
3  2023-01-03 0.002307545 0.9965289 0.0096495 47711.42 47545.81
4  2023-07-03 0.003284080 0.9934444 0.0096495 48247.50 47931.21
5  2024-01-02 0.004503021 0.9887873 0.0096495 47979.46 47441.48
6  2024-07-02 0.005715302 0.9829849 0.0096495 48247.50 47426.56
7  2025-01-02 0.006844336 0.9762837 0.0096495 48247.50 47103.25
8  2025-07-02 0.007954963 0.9686600 0.0096495 48247.50 46735.42
9  2026-01-02 0.008834672 0.9609657 0.0096495 48247.50 46364.19
10 2026-07-02 0.009700039 0.9526318 0.0096495 48247.50 45962.10
> df.float[,-2]
          ymd     zero_DC        DF        rate        CF        PV
1  2021-10-04 0.001477462 0.9996196 0.001457500  3805.694  3804.247
2  2022-01-04 0.001491843 0.9992401 0.001486182  3798.021  3795.135
3  2022-04-04 0.001682490 0.9987286 0.002048573  5121.433  5114.922
4  2022-07-05 0.001795349 0.9981915 0.002105260  5380.109  5370.379
5  2022-10-03 0.001998311 0.9974957 0.002790429  6976.072  6958.602
6  2023-01-03 0.002307545 0.9965289 0.003796133  9701.228  9667.554
7  2023-04-03 0.002755079 0.9951808 0.005418473 13546.183 13480.902
8  2023-07-03 0.003284080 0.9934444 0.006914610 17478.597 17364.015
9  2023-10-02 0.003890220 0.9912773 0.008648774 21862.179 21671.481
10 2024-01-02 0.004503021 0.9887873 0.009853964 25182.351 24899.989
11 2024-04-02 0.005109162 0.9860308 0.011059250 27955.326 27564.813
12 2024-07-02 0.005715302 0.9829849 0.012258447 30986.631 30459.389
13 2024-10-02 0.006279819 0.9797680 0.012847834 32833.355 32169.069
14 2025-01-02 0.006844336 0.9762837 0.013965218 35688.891 34842.482
15 2025-04-02 0.007396582 0.9726193 0.015070139 37675.347 36643.771
16 2025-07-02 0.007954963 0.9686600 0.016170192 40874.651 39593.638
17 2025-10-02 0.008394818 0.9649121 0.015198659 38841.017 37478.169
18 2026-01-02 0.008834672 0.9609657 0.016069784 41067.226 39464.196
19 2026-04-02 0.009264965 0.9569154 0.016930835 42327.089 40503.442
20 2026-07-02 0.009700039 0.9526318 0.017788490 44965.351 42835.425
> print(paste0("Fixed Leg = ", round(sum(df.fixed$PV),6)))
[1] "Fixed Leg = 473684.337614"
> print(paste0("Float Leg = ", round(sum(df.float$PV),6)))
[1] "Float Leg = 473681.618295"
> print(paste0("Swap Price at spot date = ",
+              round(sum(df.fixed$PV) - sum(df.float$PV),6)))
[1] "Swap Price at spot date = 2.719318"
>
```

It is clear that the pricing of the IRS Interest Rate Swap, despite its recentness, did not escape from the previous pricing shortcomings of the traditional economy. The same for rates and discount transactions, which means that the assumed pricing is a minor pricing that does not reflect the opportunities available to the swap parties.

Section Three
IRS Interest Rate SWAP Pricing vs. OIS Overnight SWAP Discounting[1]

In this scenario, we present a simple example of Libor IRS[2] pricing with an OIS[3] discount. Unlike pricing a Libor IRS with only one Libor curve, pricing a Libor IRS using an OIS discount uses two curves:

1. It is based on floating cash flows using modified LIBOR curve predictions.
2. Discount all cash flows from fixed and floating legs using OIS overnight swap discount factors.

Among them, the first part is a little complicated so that this problem (creation of modified forward Libor curve) is covered in some subsequent publications. Instead, at this time, we are borrowing Mikael Katajamäki's VBA functionality.

If functions that are useful for a particular purpose have already been created by other researchers, we can use these functions without converting from VBA code to R code.

Excel example with a VBA macro

The following figure shows the operation of the macro1() function.

---

[1] RDCOMClient: A Simple Libor IRS Pricing with OIS Discounting, K & L Fintech Modeling, Jul 31, 2021, Link
This scenario shows a simple example using the RDCOMClient R package where Libor IRS quotes with OIS rebate are rendered with the help of a VBA macro from Mikael Katajamäki source.

[2] Interest Rate Swap IRS

[3] Overnight Indexed Swap OIS

	A	B	C	D	E	F	G	H	I	J
1				Input : Market Swap Rate				Output		
2		no	t	OIS(0,t)	Libor(0,t)	Run macro1		OIS DF(0,t)	OIS-adj Libor Forward Curve(0,s,t)	
3		0	0							
4		1	0.25	0.100%	0.500%					
5		2	0.5	0.620%	1.040%					
6		3	0.75	1.100%	1.580%					
7		4	1	1.640%	2.120%					
8		5	1.25	2.004%	2.440%					
9		6	1.5	2.354%	2.760%					
10		7	1.75	2.676%	3.080%					
11		8	2	2.958%	3.400%					
12										
13				: Input Range					: Output Range	

Clicking [Run Macro 1] calls the Macro 1 rectangle button which also calls an internal function for OIS discount factors and modified forward modifiers.

	A	B	C	D	E	F	G	H	I	J
1				Input : Market Swap Rate				Output		
2		no	t	OIS(0,t)	Libor(0,t)	Run macro1		OIS DF(0,t)	OIS-adj Libor Forward Curve(0,s,t)	
3		0	0							
4		1	0.25	0.100%	0.500%			99.98%	0.500%	
5		2	0.5	0.620%	1.040%			99.69%	1.582%	
6		3	0.75	1.100%	1.580%			99.18%	2.667%	
7		4	1	1.640%	2.120%			98.39%	3.760%	
8		5	1.25	2.004%	2.440%			97.55%	3.743%	
9		6	1.5	2.354%	2.760%			96.57%	4.400%	
10		7	1.75	2.676%	3.080%			95.48%	5.062%	
11		8	2	2.958%	3.400%			94.34%	5.730%	
12										
13				: Input Range					: Output Range	

Mikael Katajamäki's VBA code for the OIS boot rebate is as follows (see Appendix C), to which I've added some modifications (shaded area) to return the OIS rebate factor as well (the original version only returns the forward price). When the rectangular button is clicked, the VBA Macro1() function is called, which calls the VBA OIS bootstrapping function.

The following R code (see Appendix D) performs three operations:

1. Write the input set to Excel
2. Run the macro 1.
3. Read the output array from Excel
4. Using OIS DFs and Adjusted Forward Rates,

Calculate the swap rate at the start.

THE RESULT

The following console displays two outputs:

- OIS discount factors and adjusted forward rates,
- Swap rates at the start of each maturity. So that swap rates can be obtained from the outset that are correct at the face value (zero).

```
>
>     print(cbind(m.input, m.output))          print(paste0(i," quarter swap price = ", swap_pr))
        [,1]   [,2]      [,3]       [,4]
[1,] 0.00100 0.0050 0.9997501 0.00500000      [1] "1-quarter swap price = 0"
[2,] 0.00620 0.0104 0.9969096 0.01581539      [1] "2-quarter swap price = 0"
[3,] 0.01100 0.0158 0.9918175 0.02667091      [1] "3-quarter swap price = 0"
[4,] 0.01640 0.0212 0.9838646 0.03760244      [1] "4-quarter swap price = 0"
[5,] 0.02004 0.0244 0.9755027 0.03743071      [1] "5-quarter swap price = 6.93889390390723e-18"
[6,] 0.02354 0.0276 0.9657012 0.04399545      [1] "6-quarter swap price = 6.93889390390723e-18"
[7,] 0.02676 0.0308 0.9548372 0.05061840      [1] "7-quarter swap price = 6.93889390390723e-18"
[8,] 0.02958 0.0340 0.9433651 0.05729832      [1] "8-quarter swap price = 1.38777878078145e-17"
>
```

The main part of the swap pricing above is based on VBA macros from other sources. So, when we have some good VBA resources other than R, they can be used for efficient operation. The upshot is that pricing Libor IRS with a very simple OIS overnight swap discount may make it possible to approach the problem more realistically.

Section Four
Smoothing the Zero Curve of the IRS LIBOR SWAP Rates[1]

In the previous scenario, the pricing of the 5Y Libor IRS swap was given the zero curve. In this scenario, a zero curve will be generated from the market's IRS swap rates using smoothing.

Market instruments and swap rates

As of June 30-2021, consider the following IRS 5-year swap rates (Pay Float & REC Fixed), zero rates, and their sources Bloomberg.

Maturity Date	Market Rate	Zero Rate	Source
2021-10-04	0.14575%	0.14775%	CASH
2021-12-15	0.13961%	0.14434%	FUTURE
2022-03-16	0.20384%	0.16639%	FUTURE
2022-06-15	0.19775%	0.17529%	FUTURE
2022-09-21	0.26625%	0.19607%	FUTURE
2022-12-21	0.35949%	0.22458%	FUTURE
2023-03-15	0.51260%	0.26446%	FUTURE
2023-07-03	**0.32835%**	**0.32841%**	SWAP
2024-07-02	**0.57105%**	**0.57153%**	SWAP
2025-07-02	**0.79300%**	**0.79550%**	SWAP
2026-07-02	**0.96495%**	**0.97000%**	SWAP

Market swap rates have three types depending on their sources; Such as cash (deposits), futures contracts, and swaps.

[1] Di Cook, Bootstrapping the Zero Curve from IRS Swap Rates using R code, July 18, 2021, Link

The zero rates in the table above are only used for comparison.

1- Smoothing deposits

Since the market deposit swap rate is a quarterly compound rate, the discount factor is derived from the swap rate, and the zero rate is calculated from the discount factor as follows:

$$DF(s,t_i) = \left(1 + R^{mkt}_{t_i}\,.\,\frac{\tau(s,t_i)}{360}\right)^{-1}$$

$$R(s,t_i) = \frac{365}{\tau(s,t_i)}\,.\,log\left(\frac{1}{DF(s,t_i)}\right)$$

$$DF(s,t_i) = discount\,factor\,from\,t_i\,to\,s$$

$$R(s,t_i) = zero\,or\,spot\,rate\,from\,t_i\,to\,s$$

$$R^{mkt}_{t_i} = market\,swap\,rate\,at\,t_i$$

$$\tau(s,t_i) = day\,count$$

2- Preliminary futures contracts

Bloomberg provides the market swap rate for Euro futures contracts for dollars as a rate rather than a rate (some screens provide it as a rate). In principle, this rate needs to be adjusted for convexity bias. But since we don't fully know Bloomberg's methodology, convexity adjustments are not taken into account.

Since the maturities of consecutive 3 million futures contracts are not overlapping, the zero rates can be found in the following order:

1- The determinant of $t_{i-1}\ to\ t_i$.

2- The discount factor from the immediate date to t_i.

3- The zero rate of the discount factor.

These three steps can be represented as the following equations:

$$DF(t_{i-1}, t_i) = \left(1 + R_{t_i}^{mkt} \, . \, \frac{\tau(s, t_i)}{360}\right)^{-1}$$

$$DF(s, t_i) = DF(s, t_{i-1} \, . \, DF(t_{i-1}, t_i)$$

$$R(s, t_i) = \frac{365}{\tau(s, t_i)} \, . \, log\left(\frac{1}{DF(s, t_i)}\right)$$

Since the optimization technique to find zero rates is not necessary for deposits and futures, zero rates are recovered directly using the above equations. Therefore, we can calculate zero rates for this range of maturities and make the following table:

Maturity Date	Zero Rate Bootstrapped	Discount Factor	Futures DF(ti-1,ti)	Date	Interpolated Zero Rate
2021-10-04	0.14775%	0.9996		2021-10-04	0.14775%
2021-12-15	0.14505%	0.9993	0.9997	2021-12-15	0.14505%
2022-03-16	0.16685%	0.9988	0.9995	2022-01-04	0.14984%
2022-06-15	0.17563%	0.9983	0.9995	2022-03-16	0.16685%
2022-09-21	0.19634%	0.9976	0.9993	2022-04-04	0.16868%
2022-12-21	0.22480%	0.9967	0.9991	2022-06-15	0.17563%
2023-03-15	0.26465%	0.9955	0.9988	2022-07-05	0.17986%
2023-07-03	**0.10000%**	0.9980		2022-09-21	0.19634%
2024-07-02	**0.20000%**	0.9940		2022-10-03	0.20009%
2025-07-02	**0.30000%**	0.9881		2022-12-21	0.22480%
2026-07-02	**0.40000%**	0.9802		2023-01-03	0.23097%
				2023-03-15	0.26465%
	← 4 unknown variables			2023-04-03	0.23621%
				2023-07-03	**0.10000%**
				2023-10-02	0.12493%
				2024-01-02	0.15014%
				2024-04-02	0.17507%
				2024-07-02	**0.20000%**
				2024-10-02	0.22521%
				2025-01-02	0.25041%
				2025-04-02	0.27507%
				2025-07-02	**0.30000%**
				2025-10-02	0.32521%
				2026-01-02	0.35041%
				2026-04-02	0.37507%
				2026-07-02	**0.40000%**

The zero rate for deposits is calculated directly from the zero market rate but for futures there is some difference as the convexity adjustment is not applied. But just because there is some inconsistency, this does not mean that this result is not accepted. This difference is even smaller than expected. As we will find out later, the effect of futures contracts on zero swap rates is minimal.

We have already calculated zero rates for deposits and futures and only need to calculate *4 zero rates for swaps*, which are *4 unknown variables*. Since *4 unknown equations are the swap rates for these 4 swaps*, this *nonlinear problem with 4 variables and 4 equations* is solved numerically using optimization.

3- Bootstrapping the SWAPs

The slightly tricky part is running zero rates from the IRS market swap rates. Deposits and futures have one payment at maturity but the IRS has inter-cash flow.

For example, zero rates for 3 years are calculated using 3-year swap pricing. This process needs information on rates of 0.25, 0.5, 0.75,..., 2.5, 2.75, 3 years. But we can only note 2 and 3 year market swap rates and some maturities less than 1 year. Zero rates for other remaining maturities are not observed and must be met.

For these properties we need to interpolate the unobserved zero rates using adjacent unknown zero rates which will be found numerically and correspond to the observed maturities in the market like 2, 3,..., year.

For example, a 3.25 year swap rate is not observed but zero rates at 3.25 years are necessary for pricing other swaps. In this case, the zero rates at 3.25 years are met using the zero rates for 3 years and 4 years.

This process is described in the right part of the table above, which shows interpolated zero rates with 4 unknown zero rates. *Unknown zero rates were found using optimization* but *unobserved zero rates were found using interpolation*. The maturities of all zero rates consist of deposits, forward contracts, swap maturities and *cash flow payment dates for all swaps*.

For a clear understanding, we show helpful Excel illustrations of boot swap rates. In particular, due to the use of the efficient vector process, enumeration of rows for swap cash flows is not necessary.

FIXED LEG

From the previous scenario, we already know the present value of the cash flow in the fixed leg as:

$$PV(CF_{t_i}^{fixed}) = DF(s, t_i) \,.\, R_{t=5Y}^{mkt} \cdot \frac{\tau(t_{i-1}, t_i)}{360} \,.\, NA$$

Summarize these results to the constant leg value. This process is illustrated in the following Excel calculations.

Date	Market Swap Rate	Interplated Zero Rate	t-spot	tau - Float	DF - Float	FWD - Float	tau - Fixed	DF - Fixed	sum of tau*forward rate*DF	sum of tau*swap rate*DF	squared error
2021-10-04		0.14775%	94	0.261	0.9996	0.1458%					
2022-01-04		0.14984%	186	0.256	0.9992	0.1499%	0.506	0.9992			
2022-04-04		0.16868%	276	0.250	0.9987	0.2048%					
2022-07-05		0.17986%	368	0.256	0.9982	0.2105%	0.503	0.9982			
2022-10-03		0.20009%	458	0.250	0.9975	0.2790%					
2023-01-03		0.23097%	550	0.256	0.9965	0.3796%	0.494	0.9965			
2023-04-03		0.23621%	640	0.250	0.9959	0.2647%					
2023-07-03	**0.32835%**	**0.10000%**	731	0.253	0.9980	-0.8453%	0.500	0.9980	20,007.36	65,630.37	**2.E+09**
2023-10-02		0.12493%	822	0.253	0.9972	0.3209%					
2024-01-02		0.15014%	914	0.256	0.9962	0.3704%	0.497	0.9962			
2024-04-02		0.17507%	1005	0.253	0.9952	0.4199%					
2024-07-02	**0.57105%**	**0.20000%**	1096	0.253	0.9940	0.4691%	0.500	0.9940	59,874.83	170,808.21	**1.E+10**
2024-10-02		0.22521%	1188	0.256	0.9927	0.5186%					
2025-01-02		0.25041%	1280	0.256	0.9913	0.5684%	0.500	0.9913			
2025-04-02		0.27507%	1370	0.250	0.9897	0.6177%					
2025-07-02	**0.79300%**	**0.30000%**	1461	0.253	0.9881	0.6667%	0.500	0.9881	119,364.08	=SUM(T18*$Z$3:$Z18*$AA$3:$AA18*$E$1)	
2025-10-02		0.32521%	1553	0.256	0.9863	0.7162%					
2026-01-02		0.35041%	1645	0.256	0.9843	0.7660%	0.500	0.9843			
2026-04-02		0.37507%	1735	0.250	0.9823	0.8153%					
2026-07-02	**0.96495%**	**0.40000%**	1826	0.253	0.9802	0.8643%	0.500	0.9802	198,120.69	478,909.06	**8.E+10**
									← 4 unknown equations		

FLOATING LEG

From the previous scenario, we already know the present value of the cash flow in the floating leg as follows:

$$PV(CF_{t_j}^{float}) = DF(s,t_i)\,.\,FD(s,t_{j-1},t_j)\,.\,\frac{\tau(t_{j-1},t_i)}{360}\,.\,NA$$

Summarize these results to the constant leg value. This process is illustrated in the following Excel calculations.

Date	Market Swap Rate	Interplated Zero Rate	t-spot	tau - Float	DF - Float	FWD - Float	tau - Fixed	DF - Fixed	sum of tau*forward rate*DF	sum of tau*swap rate*DF	squared error
2021-10-04		0.14775%	94	0.261	0.9996	0.1458%					
2022-01-04		0.14984%	186	0.256	0.9992	0.1499%	0.506	0.9992			
2022-04-04		0.16868%	276	0.250	0.9987	0.2048%					
2022-07-05		0.17986%	368	0.256	0.9982	0.2105%	0.503	0.9982			
2022-10-03		0.20009%	458	0.250	0.9975	0.2790%					
2023-01-03		0.23097%	550	0.256	0.9965	0.3796%	0.494	0.9965			
2023-04-03		0.23621%	640	0.250	0.9959	0.2647%					
2023-07-03	**0.32835%**	**0.10000%**	731	0.253	0.9980	-0.8453%	0.500	0.9980	20,007.36	65,630.37	**2.E+09**
2023-10-02		0.12493%	822	0.253	0.9972	0.3209%					
2024-01-02		0.15014%	914	0.256	0.9962	0.3704%	0.497	0.9962			
2024-04-02		0.17507%	1005	0.253	0.9952	0.4199%					
2024-07-02	**0.57105%**	**0.20000%**	1096	0.253	0.9940	0.4691%	0.500	0.9940	=SUM($W$3:$W14*$Y$3:$Y14*$X$3:$X14*$E$1)		
2024-10-02		0.22521%	1188	0.256	0.9927	0.5186%					
2025-01-02		0.25041%	1280	0.256	0.9913	0.5684%	0.500	0.9913			
2025-04-02		0.27507%	1370	0.250	0.9897	0.6177%					
2025-07-02	**0.79300%**	**0.30000%**	1461	0.253	0.9881	0.6667%	0.500	0.9881	119,364.08	315,676.31	**4.E+10**
2025-10-02		0.32521%	1553	0.256	0.9863	0.7162%					
2026-01-02		0.35041%	1645	0.256	0.9843	0.7660%	0.500	0.9843			
2026-04-02		0.37507%	1735	0.250	0.9823	0.8153%					
2026-07-02	**0.96495%**	**0.40000%**	1826	0.253	0.9802	0.8643%	0.500	0.9802	198,120.69	478,909.06	**8.E+10**
									← 4 unknown equations		

The formulas for the discount factor and forward rate are the same as in the previous scenario:

$$DF(s, t_i) = exp\Big(- R(s, t_i) \cdot \frac{t_i - s}{365} \Big)$$

$$FD(s, t_{j-1}, t_i) = \frac{365}{t_j - t_{j-1}} \cdot \Big(\frac{DF(s, t_{j-1})}{DF(s, t_j)} - 1 \Big)$$

OPTIMIZATION RESULT

From the legs above, 4 zero rates can be found numerically by making 2, 3, 4, 5 year swap rates all equal to zeros as shown in the last column of the following Excel illustration.

Date	Market Swap Rate	Interplated Zero Rate	t-spot	tau - Float	DF - Float	FWD - Float	tau - Fixed	DF - Fixed	sum of tau*forward rate*DF	sum of tau*swap rate*DF	squared error
2021-10-04		0.14775%	94	0.261	0.9996	0.1458%					
2022-01-04		0.14984%	186	0.256	0.9992	0.1499%	0.506	0.9992			
2022-04-04		0.16868%	276	0.250	0.9987	0.2048%					
2022-07-05		0.17986%	368	0.256	0.9982	0.2105%	0.503	0.9982			
2022-10-03		0.20009%	458	0.250	0.9975	0.2790%					
2023-01-03		0.23097%	550	0.256	0.9965	0.3796%	0.494	0.9965			
2023-04-03		0.27567%	640	0.250	0.9952	0.5417%					
2023-07-03	**0.32835%**	**0.32841%**	731	0.253	0.9934	0.6904%	0.500	0.9934	65,555.59	65,555.59	**7.E-10**
2023-10-02		0.38902%	822	0.253	0.9913	0.8649%					
2024-01-02		0.45030%	914	0.256	0.9888	0.9854%	0.497	0.9888			
2024-04-02		0.51092%	1005	0.253	0.9860	1.1059%					
2024-07-02	**0.57105%**	**0.57153%**	1096	0.253	0.9830	1.2258%	0.500	0.9830	170,151.47	170,151.47	**2.E-18**
2024-10-02		0.62798%	1188	0.256	0.9798	1.2848%					
2025-01-02		0.68443%	1280	0.256	0.9763	1.3965%	0.500	0.9763			
2025-04-02		0.73966%	1370	0.250	0.9726	1.5070%					
2025-07-02	**0.79300%**	**0.79550%**	1461	0.253	0.9687	1.6170%	0.500	0.9687	313,401.26	313,401.26	**3.E-16**
2025-10-02		0.83948%	1553	0.256	0.9649	1.5199%					
2026-01-02		0.88347%	1645	0.256	0.9610	1.6070%	0.500	0.9610			
2026-04-02		0.92650%	1735	0.250	0.9569	1.6931%					
2026-07-02	**0.96495%**	**0.97001%**	1826	0.253	0.9526	1.7789%	0.500	0.9526	473,683.84	473,683.84	**2.E-18**
									← 4 unknown equations		

Finally, we can compare the launched zero rates with market zero rates (Bloomberg) as follows. We can find that for the swap range, two zero rates are very similar.

Maturity Date	Market Rate	Zero Rate	Maturity Date	Zero Rate Bootstrapped	Discount Factor
2021-10-04	0.14575%	0.14775%	2021-10-04	0.14775%	0.9996
2021-12-15	0.13961%	0.14434%	2021-12-15	0.14505%	0.9993
2022-03-16	0.20384%	0.16639%	2022-03-16	0.16685%	0.9988
2022-06-15	0.19775%	0.17529%	2022-06-15	0.17563%	0.9983
2022-09-21	0.26625%	0.19607%	2022-09-21	0.19634%	0.9976
2022-12-21	0.35949%	0.22458%	2022-12-21	0.22480%	0.9967
2023-03-15	0.51260%	0.26446%	2023-03-15	0.26465%	0.9955
2023-07-03	**0.32835%**	**0.32841%**	2023-07-03	**0.32841%**	0.9934
2024-07-02	**0.57105%**	**0.57153%**	2024-07-02	**0.57153%**	0.9830
2025-07-02	**0.79300%**	**0.79550%**	2025-07-02	**0.79550%**	0.9687
2026-07-02	**0.96495%**	**0.97000%**	2026-07-02	**0.97001%**	0.9526

The following program (see Appendix E) applies the five-year LIBOR IRS zero-curve smoothing process with a curve 06-30-2021 and spot date 02-07-2021.

The result

The following results show the market zero rate curve (Bloomberg), the smoothed zero rate curve from sequential optimization, and the smoothed zero rate curve from global optimization with differences between them.

Except for the maturities of futures contracts, there are no significant differences between them. But even for the futures range, the differences between the market curves and the zero-run curves are not very large even though the convexity adjustment is not taken into account. Of course, when we know Bloomberg's approach to adjusting convex bias later, some adjustments will be made in the futures range.

```
Console  Terminal ×  Jobs ×
~/
> # to avoid redundant expressions of df.output$ ....
> df.output <- within(df.output, {
+     diff_seq = zero_mkt - zero_seq;
+     diff_glb = zero_mkt - zero_glb
+ })
>
> print("Comparison with Bloomberg Zero Curve")
[1] "Comparison with Bloomberg Zero Curve"
> df.output
         date    zero_mkt    zero_seq    zero_glb      diff_glb      diff_seq
1  2021-10-04 0.001477462 0.001477462 0.001477462 -1.084202e-18 -1.084202e-18
2  2021-12-15 0.001443378 0.001450496 0.001450496 -7.118815e-06 -7.118815e-06
3  2022-03-16 0.001663897 0.001668496 0.001668496 -4.598145e-06 -4.598145e-06
4  2022-06-15 0.001752948 0.001756344 0.001756344 -3.395756e-06 -3.395756e-06
5  2022-09-21 0.001960714 0.001963363 0.001963363 -2.649604e-06 -2.649604e-06
6  2022-12-21 0.002245825 0.002248026 0.002248026 -2.200602e-06 -2.200602e-06
7  2023-03-15 0.002644628 0.002646531 0.002646531 -1.902936e-06 -1.902936e-06
8  2023-07-03 0.003284080 0.003284072 0.003284072  8.045010e-09  8.044944e-09
9  2024-07-02 0.005715302 0.005715303 0.005715303 -1.505792e-09 -1.519486e-09
10 2025-07-02 0.007954963 0.007954985 0.007954985 -2.260751e-08 -2.262551e-08
11 2026-07-02 0.009700039 0.009700085 0.009700085 -4.653929e-08 -4.655490e-08
>
```

In this scenario, the zero curve of market swap rates was generated using smoothing. and implement smoothing as sequential or global optimization for unknown zero rates and we found no evidence of significant differences in the two approaches.

In fact, the reason behind covering this topic is that SIMM requires Greek market variants, not Greek zero. Greek market variants are calculated by multiplying market swap rates and re-quotes but zero from Greek by hitting the zero and re-quoting curve.

Section Five
Delta Sensitivity to the Interest Rate Swap[1]

This scenario explains how delta sensitivities to interest rate swaps are calculated, and delta can be calculated by the method of delta zero or market delta. A set of proposals from the Basel Committee on Banking Supervision for new capital requirements related to market risk for banks FRTB can use both methods but the International Swaps and Derivatives Association SIMM uses Greeks market variants, and both methods will be implemented in R.

Delta sensitivity to LIBOR swap

In the above scenarios, a 5Y Libor IRS swap is priced and a zero curve from market swap rates is generated using bootstrapping. Based on this, the variables are calculated for the IRS. Because the IRS does not have any optional features, the focus is on delta sensitivity. For convenience, the swap value is defined as (floating leg - fixed leg)[2].

delta sensitivity

ISDA SIMM uses the following definitions of delta of interest rate risk, (x) being a risk factor. There are, many versions of it but they are all basically the same.

---

[1] Sang-Heon Lee, Delta Sensitivity of Interest Rate Swap, R-bloggers, July 23, 2021, Link

[2] The floating rate in a swap contract is the part that depends on a variable level, such as an interest rate, a currency exchange rate, or an asset price. Most swaps involve a floating and fixed leg, although it is possible for both legs to be floating.

$$delta = V(x + 0.5bp) - V(x - 0.5bp)$$
$$delta = \frac{V(x + 1bp) - V(x - 1bp)}{2}$$

To simplify, we assume that:

$z(t), s(t)$ They denote the bootstrapped zero rate and (market supervisor) swap rate at time t respectively. There are two ways to calculate delta: (delta zero) and (delta market).

Delta Zero

The zero-delta approach calculates the delta sensitivities by raising or lowering the zero rates one by one in order. Once the zero curve is established: $z(t)$ is generated from market swap rates $s(t)$:

$$s(t) = \left([s(t_1), \ldots, s(t_i), \ldots, s(t_{ni}) \right)$$
$$z(t) = Bootstrap(s(t))$$
$$= \left(z(t_1), \ldots, z(t_i), \ldots, z(t_{ni} \right)$$

to move up: $z(t; t_i + 0.5bp)$

to move down: $z(t; t_i - 0.5bp)$

$delta(t_i)$ calculated, and this procedure applies to each t_i.

$$z(t; t_i + 0.5bp) = \left(z(t_1), \ldots, z(t_i) + 0.5bp, \ldots, z(t_{ni}) \right)$$
$$z(t; t_i - 0.5bp) = \left(z(t_1), \ldots, z(t_i) - 0.5bp, \ldots, z(t_{ni}) \right)$$
$$delta(t_i) = V(z(t; t_i + 0.5bp)) - V(z(t; t_i - 0.5bp))$$

whereas:

t_i ، $i = 1,2,\ldots,n_i$, are maturity dates or market swap rate dates on which the corresponding zero rates are smoothed.

Market Delta

The market-delta approach calculates delta sensitivities by raising or lowering market swap rates one by one in order. Unlike zero delta, every time we subtract one market swap rate for a specific rate, we have to run bootstrapping to find a new zero curve. Using the zero curve, we can calculate delta time sensitivity t_i as follows:

$$s(t; t_i + 0.5bp) = \left(s(t_1), \ldots, s(t_i) + 0.5bp, \ldots, s(t_{ni})\right)$$

$$s(t; t_i - 0.5bp) = \left(s(t_1), \ldots, s(t_i) - 0.5bp, \ldots, s(t_{ni})\right)$$

$$\begin{aligned} z(t)^{up} &= Bootstrap(s(t; t_i + 0.5bp)) \\ &= \left(z(t_1)^{up}, \ldots, z(t_i)^{up}, \ldots, z(t_{ni})^{up}\right) \end{aligned}$$

$$\begin{aligned} z(t)^{down} &= Bootstrap(s(t; t_i - 0.5bp)) \\ &= \left(z(t_1)^{down}, \ldots, z(t_i)^{down}, \ldots, z(t_{ni})^{down}\right) \end{aligned}$$

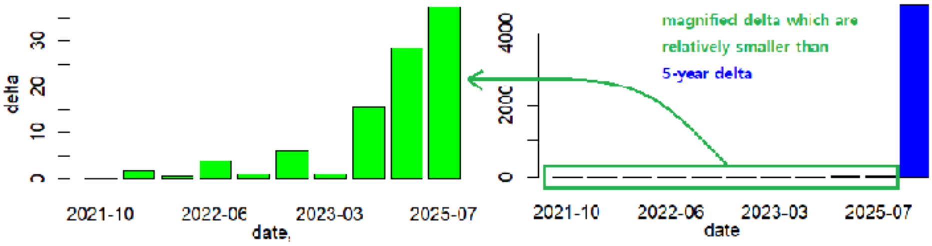
$$delta(t_i) = V(z(t)^{up}) - V(z(t)^{down})$$

The following R code (see Appendix F) calculates the delta sensitivities of the IRS using these two methods.

The result

Zero Delta: The following figure and table shows a vector delta zero along the maturity periods.

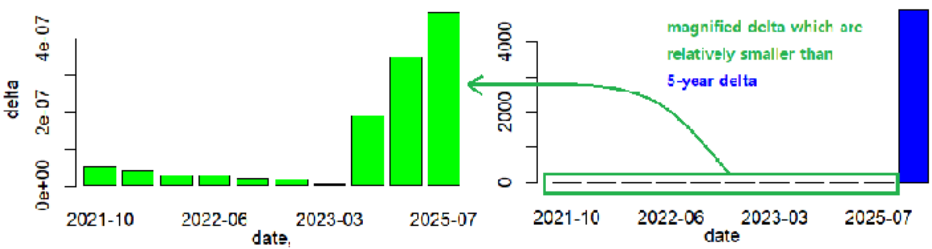
A meaningful delta value is only noticed at maturity because delta at maturities less than IRS maturity (3 years) is very small (10~30). But this pattern is not absolute and is subject to changing market environment because these days interest rates are showing very low.




```
> df.zr_delta
```

	d.date	swap rate	zero rate	DF	pr	pr dn	pr up	delta
1	2021-10-04	0.001457500	0.001477462	0.9996196	0.0007498704	7.498707e-04	7.498703e-04	2.037268e-10
2	2021-12-15	0.001396099	0.001450496	0.9993405	0.0007498704	-1.937402e+00	1.938824e+00	1.938113e+00
3	2022-03-16	0.002038386	0.001668496	0.9988259	0.0007498704	-5.452005e-01	5.466942e-01	5.459474e-01
4	2022-06-15	0.001977479	0.001756344	0.9983269	0.0007498704	-3.885532e+00	3.886719e+00	3.886126e+00
5	2022-09-21	0.002662493	0.001963363	0.9976038	0.0007498704	9.957028e-01	9.971821e-01	9.964424e-01
6	2022-12-21	0.003594909	0.002248026	0.9966981	0.0007498704	-6.055271e+00	6.055999e+00	6.055635e+00
7	2023-03-15	0.005126032	0.002646531	0.9955074	0.0007498704	-1.108041e+00	1.109515e+00	1.108778e+00
8	2023-07-03	0.003283550	0.003284072	0.9934444	0.0007498704	-1.552361e+01	1.552245e+01	1.552303e+01
9	2024-07-02	0.005710500	0.005715303	0.9829849	0.0007498704	2.839096e+01	2.838601e+01	2.838848e+01
10	2025-07-02	0.007930000	0.007954985	0.9686599	0.0007498704	3.740089e+01	3.739111e+01	3.739600e+01
11	2026-07-02	0.009649500	0.009700085	0.9526316	0.0007498704	-4.800494e+03	4.798097e+03	4.799296e+03

Market delta: The following figure and table shows the vector of market delta along the maturity periods. Like delta zero, a meaningful delta value is only noticed at maturity because delta at maturities less than IRS maturity (3 years) is considered zero. Like Delta Zero, this pattern is also not absolute and is subject to changing market environment for the same reason.

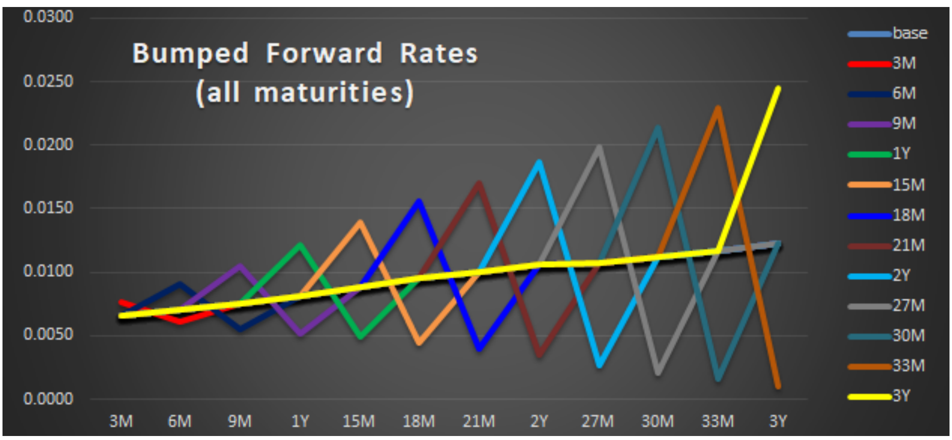


```
> df.mt_delta
        d.date   swap_rate   zero_rate        DF           pr        pr_dn        pr_up        delta
1  2021-10-04 0.001457500 0.001477462 0.9996196 0.0007498704  7.498247e-04 7.499192e-04 4.723552e-08
2  2021-12-15 0.001396099 0.001450496 0.9993405 0.0007498704  7.498335e-04 7.499079e-04 3.716559e-08
3  2022-03-16 0.002038386 0.001668496 0.9988259 0.0007498704  7.498431e-04 7.499008e-04 2.887100e-08
4  2022-06-15 0.001977479 0.001756344 0.9983269 0.0007498704  7.498421e-04 7.499001e-04 2.898742e-08
5  2022-09-21 0.002662493 0.001963363 0.9976038 0.0007498704  7.498544e-04 7.498898e-04 1.769513e-08
6  2022-12-21 0.003594909 0.002248026 0.9966981 0.0007498704  7.498610e-04 7.498909e-04 1.495937e-08
7  2023-03-15 0.005126032 0.002646531 0.9955074 0.0007498704  7.498665e-04 7.498744e-04 3.958121e-09
8  2023-07-03 0.003283550 0.003284072 0.9934444 0.0007498704  7.496835e-04 7.500611e-04 1.888257e-07
9  2024-07-02 0.005710500 0.005715303 0.9829849 0.0007498704  7.495243e-04 7.502238e-04 3.497407e-07
10 2025-07-02 0.007930000 0.007954985 0.9686599 0.0007498704  7.494038e-04 7.503417e-04 4.689209e-07
11 2026-07-02 0.009649500 0.009700085 0.9526316 0.0007498704 -4.909250e+03 4.908540e+03 4.908895e+03
```

The Intuition Behind Delta IRS

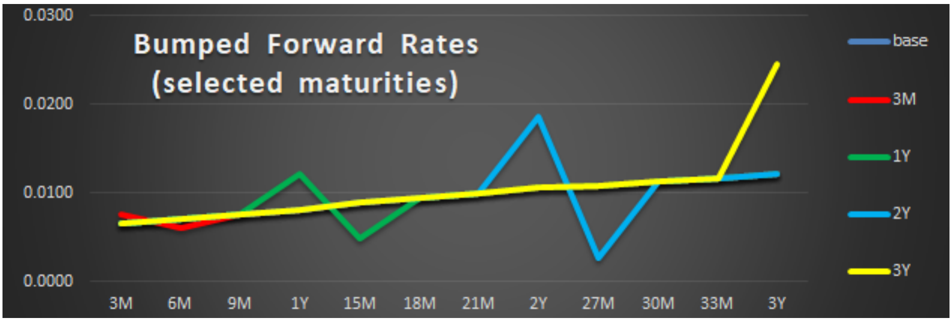
In both cases of zero delta and market delta of the IRS, we can observe peak delta as the IRS matures. An increase in the interest rate has two effects:

- A higher interest rate reduces the discount factor and increases the variable cash flow. These two effects have a comparison.
- Forward rates, which determine future cash flows, show the following pattern of up and down (*uses 25 basis points up for clear examination*), because the next swap rate is determined by market value, which matures after the impact maturity. So there are positive and negative effects on future cash flows at the time of vibration and the next.



But at maturity, there is only a positive effect on future cash flows because the cascading negative effect occurs after the IRS matures.

To be more specific, let's compare the Aqua and Yellow colored line, which represents the forward price curve with the swap rate rising 2-3 years in a row. We can note that due to the higher 2-year swap rate, the downward movement of the 2-year forward rate in time of 2.25 years follows the upward movement of it in 2-year time. But in the case of 3-year rallies, there is only an upward movement of the forward price on time for the 3-year period.



From this scenario, delta sensitivities for the IRS were calculated. In the example, the two methods do not show significant differences. This is not a general result because Greek in the market allows interaction between market variables, and Greek zero does not.

For example, in the case of a Libor 3x6 base swap, when the Libor3M swap rates are changed, the Libor6M zero curve is also changed. But there is little or no interaction effect in the absence of Greek. Therefore, it is advisable to investigate the full impact of a Greek account in many cases.

Chapter Three - MQAM 2003

The difference of the Islamic business environment from the traditional business environment requires searching for and excluding the sources of forbidden and suspicious things. Therefore, there is no objection to using the performance and efficiency measures that we mentioned earlier, provided that they do not depend on the usurious interest indicator as a basis for calculation or comparison. There are many indicators that do not depend on usurious indicators; As indicators of production and productivity, indicators of the financing structure, indicators of liquidity, payment and collection, indicators of operating efficiency and investment of funds in the economic unit such as the degree of manufacturing, the level of storage, the extent of energy utilization, capital turnover, sales ratios, and rentier indicators such as sales profitability, return on private funds and return on invested funds; These are indicators that do not depend on the interest rate.

Also, the recognition by Western economists of the shortcomings of interest as an indicator and as a misleading measure makes the pricing of deals or products based on it outside the market, in which case it is necessary to look for hidden elements in such deals; No one resorts to LIBOR pricing unless the risks are equal to LIBOR itself!

Suggested alternative methods

The Islamic Fiqh Council, by its resolution No. 59 (6/10), recommended the necessity of expediting the creation of tools and formulas to be used in the financial markets. The performance indicator is the proposed alternative to the usurious interest rate in determining the profit margin in transactions. As a result of the above, we suggest one of the following methods as an alternative indicator to the LIBOR index:

- It is possible to resort to the latest distributed profits (it is possible to resort to quarterly distributions) for eight Islamic banks or financial institutions by taking the average of the nearest two numbers, or by taking their arithmetic mean.
- Estimates of eight Islamic banks or financial institutions can be used and the nearest two numbers averaged.
- Find the appropriate sacrifice price for each business sector and consider the lowest opportunity cost.

Indicator is a form of pricing

Since the index is a form of pricing, the interest rate index is a guide that guides market operators in pricing their business of lending and borrowing, or in evaluating investments and comparing their returns and feasibility; Therefore, determining the interest rate is a form of pricing regardless of its legal content.

Ibn Taymiyyah sees the necessity of pricing when there is a fear of monopoly, saying: “If the owners of commodities refrain from selling them despite the people’s need for them except for an increase in the known value, then they must sell them for the value of the same“[1]. As for the mechanism to achieve this; Ibn Taymiyyah says, “The Governor should gather the faces of the people of the market for that thing, and attend others to memorize their sincerity, so he asks them how they buy and how they sell, so he brings them down to what is in it for them and for the public to pay until they are satisfied and they are not forced to price”[2] and satisfaction is an important factor in planting trust and tranquility among market members; Which means the prosperity and growth of swap and stability in prices, which leads to a commercial movement that revives incomes. As for the opposite, that is, forcing sellers to sell at a certain price without considering their costs, it leads to “corruption of prices, concealment of livelihoods and the destruction of people’s money”[3]. The stock market is currently resorting to similar matters to determine the swap rates. “As for the swap rates for foreign currencies, they are determined daily by brokers accepted or approved by the relevant stock exchange, i.e. banks, including

[1] Ibn Taymiyyah, Ahmad Al-Harrani Al-Dimashqi, Al-Hisbah in Islam, Dar Al-Bayan, Damascus, 1967. p. 23.

[2] IBID, Ibn Taymiyyah, p. 40.

[3] IBID, Ibn Taymiyyah, p. 40.

the Central Bank"[1]. Ibn Taymiyyah collected the faces of the people of the market and in the stock market the accepted brokers, and the Governor according to Ibn Taymiyyah was met by the banks, and Ibn Taymiyyah added when he determined the price by arguing, that is, bargaining without coercion.

Therefore, one of the three previous methods can be resorted to after the formation of a body of Islamic banks and financial institutions whose task is to prepare the standard, in addition to a supervisory committee composed of the Accounting and Auditing Organization for Islamic Financial Institutions, university professors, practitioners and experts with a reputation and fame in the investment world, which will reward the Governor with Ibn Taymiyyah Where the committee is used to the criterion calculated by one of the previously mentioned methods to meet the Islamic Banking and Financial Institutions Authority in arguing and bargaining in order to reach the satisfaction that achieves the interests of both parties without coercion.

Example:

Suppose the banks selected by the jury panel and charged with preparing the standard are M1, M2, M3, M4, M5, M6, M7, and M8. Its suggestions (or its distribution of profits for the fourth quarter) were as follows:

[1] Lotfy, Dr. Amer, The Stock Exchange and the Foundations of Investment and Employment, Dar Shuaa Publications, 1999, p. 31.

Table 2: MQAM(2003) calculation

Participating Bank	%
M1	15.20
M2	13.52
M3	**12.25**
M4	14.00
M5	13.25
M6	10.75
M7	**12.50**
M8	11.85

The rate is:

- The mean method: the arithmetic mean of the above eight distributions is 12.915%, and therefore the standard deviation of the above eight distributions is 1.29%, and since this is a prediction field to meet the global economic, financial and political conditions, the standard for measuring the performance of Islamic financial transactions is 12.915 ±1.29%.
- In an average way, the nearest two numbers are: (12.25 and 12.50), and accordingly, the standard for measuring the performance of Islamic financial transactions is equal to 12.375 percent.

Chapter Four - MQAM 2010

The (Ohaj-Kantakji) model stems from the idea of finding a fair price between the supply and demand of the parties to the financing process to determine the break-even point between them.

The owner of the money or the businessman has an economic point of view; You see him interested in the period of recovery of his capital or the rate of return that he will return to - it is possible to reach from the first to the second and vice versa -. Therefore, he is interested in what the investment is based on these determinants.

As for the second party or the financier; He must provide detailed data on the investment of funds to the first party to persuade him by presenting the expected cash flows and other financial indicators in the hope of obtaining financing.

According to the Mqam, it is possible to determine the target rate of return from financing an assumed project from the point of view of the financier through the expected cash flows from him and their ratios to the capital invested in it; Where the cash flows are supposed to take into account the good or bad economic conditions prevailing or that will prevail during the assumed life of the project, which reflects the size of the risks facing it.

The client who submits an economic feasibility study for his assumed project, showing the expected cash flows, in addition to other data and indicators. Then the financing party (the Islamic bank, for example) submits its approval to grant the necessary financing based on the results of applying the (Ohaj-Kantakji) model to the flows identified by the submitted feasibility study.

The focus on net cash flows (the difference between future cash inflows and current outflows) is not new; Rather, many studies evaluating investment decisions focused on it.

First, the NPV criterion, which seeks to discount cash flows at a predetermined discount rate; The cash outflows take place at the moment of purchasing the assets of the project to be established, and the expected cash inflows are the flows that will come in the future; Therefore, NPV calculates the difference between the current cash outflows and the expected future cash flows based on a current discount rate based on the money price or the so-called prevailing interest rate (LIBOR).

And despite the different times of the opposite cash flows, which require different interest rates because the price of money is affected by time; The NPV does not provide a scientific and objective distinction for this matter, although the decision taken on its basis leads to the establishment of the project or not!!

The net value of the project decreases with the increase in the discount rate associated with the applicable interest rate, and vice versa; Therefore, determining the interest rate is one of the problems facing the application of the NPV criterion.

Secondly, the internal rate of return (IRR) criterion is one of the most widely used criteria in judging the feasibility of investment decisions. Whereas, the NPV criterion seeks to calculate expected net flows at a predetermined discount rate; The IRR criterion looks for the discount rate that makes the NPV of the project equal to zero; Therefore, the two criteria are closely related to each other due to their dependence on the same equation with the inversion of hypotheses and results. The criterion of the internal rate of return (IRR) is computed by trial and error[1] at different discount rates in order to determine the best discount rate, in this case the net present value that is close to or equal to zero. The studied project is judged to be accepted if its internal rate of return is greater than the interest rate on long-term lending, or greater than the rate of return on the opportunity, such as investing in usurious government bonds, for example.

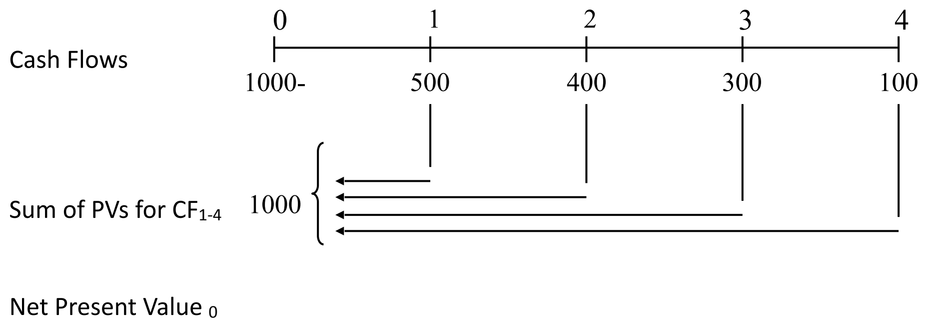
$$NPV = \sum_{i=1}^{n} \frac{CF_i}{(1+IRR)^i} = 0$$

The interrelationship between the two can be represented by the following statement[2], Figure No. (3):

$$-CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_n}{(1+IRR)^n} = 0$$

[1] Microsoft Excel and its counterparts offer formulas for calculating IRR directly with the same methodology.

[2] Eugene F. Brigham and Michael C. Ehrhardt, Financial Management Theory & Practice, Thompson, South Western, USA, 2005, P. 351- 355.



الشكل (3)

If we suppose that a project its cash flows in its five years of life are as follows: (1000), 500, 400, 300, 100; The following graph shows that the PV of the flows will be 1,000 and the net present value will be zero.

$$-1000+\frac{500}{(1+IRR)^1}+\frac{400}{(1+IRR)^2}+\frac{300}{(1+IRR)^3}+\frac{100}{(1+IRR)^4}=0$$

The Mqam is away from the internal rate of return, and from the internal rate of return, mIRR, as we will see later; It is lower than the internal rate of return of both types. This is illustrated by the two attached comparisons[1].

The three scales are based on grade; It combines the expected cash flows, and a Mqam is distinguished from them as:

- When determining the expected return, it is not affected by the shape of those flows; Rather, it depends on their totality, while the annual estimate in others is necessary, forcing the accountant to intervene in the estimate more; It has less objectivity and greater bias;

[1] View (Excel 120) and (Excel 121)

This increases the possibility of dispersion of those metrics.

- A Mqam does not need to estimate the annual interest rate that other metrics do, although it achieves the same goal.

The internal rate of return (IRR) is weakened by the necessity of observing four conditions for its use:

- It is not used when the net cash flow differs significantly from the investment curve (net cash outflows at the beginning, and net cash inflows at the end).
- It is not used to compare cash flows with very different features, even if they have similar investment curves.
- Do not explain the IRR when it differs materially from the true cost of capital and reinvestment rates.
- There is no point in finding the IRR when the net cash flow is either completely positive or completely negative. Because there is no IRR in such cases.

As for the application of the (Ohaj-Kantakji) model, it allows calculating a Mqam that enables the financier to determine the appropriate financing cost by calculating the expected return based on the expected project flows to assess the feasibility of investing in the project by accepting or rejecting its financing without relying entirely on the interest rate.

It also allows a Mqam to reach a rate of return through assumed cash flows similar to the internal rate of return, and helps in determining the net cash flows to be achieved at a pre-targeted return similar to the NPV standard without the need to average the interest rate, whether it is LIBOR or SAIBOR or other denominations based on interest.

Section One
Model Formulation

The model aims to determine the break-even point between the viewpoint of the financier with a macroeconomic view, and the viewpoint of the financier who is obliged to provide vital details of his use of funds. As for the advantages of using and applying Mqam, it brings the following benefits:

- Promoting the use of Islamic Mudaraba by helping to determine the profit distribution ratios between the owner of the money and the speculator worker based on the cash flows that will be achieved by that Mudaraba in the form of a mathematical formula, and not based on the negotiation of the parties to the financing process only.
- Supporting the credit studies that banks focus on to show the extent to which the assumed customer has achieved sufficient cash flows to pay the installments that he will be committed to.
- Protecting owner of the money, the speculator worker and society as a whole by relying on inferred indicators; From the cash flows that will be achieved in order to avoid the expected liquidity crises, especially after the recent financial crisis.
- Completely eliminating dependence on interest and avoiding it in all applications.

Form determinantions

The Mqam model assumes that the expected cash flows of the project, according to the economic feasibility study, match the actual cash flows at the end of the project, after deducting the financing burdens. This assumption is considered as an *efficiency condition* for the necessity of actually achieving the expected cash flows, and the efficiency is for the project to achieve cash flows equivalent to the cash flows allocated in the feasibility study after reinvesting those cash flows deducted by the same investment ratio. The assumed customer is considered responsible for the accuracy of the feasibility study's calculations in solidarity with the study company, which bears moral, technical and penal responsibility.

In addition to this, the availability of the following preferential determinants:

- The project generates annual cash flows; Whether they are equal or different flows, negative or positive.
- The term of the financing is considered to be five years; preferred period.
- The project reinvest its funds (received and resulting from cash inflows) at the discount rate resulting from the same Mqam model.

MODEL HYPOTHESES

- Are the determinants of the (Ohaj-Kantakji) model verifiable?

- Is the model suitable as a new tool in project evaluation or not?
- Based on the above, the model will be formulated in two opposite ways to demonstrate its flexibility and usability as follows:
  - *The first method:* calculating the target profit rate in terms of cash flows.
  - *The second method:* calculating cash flows in terms of the target profit rate.

In order to prove the hypotheses of the model to use it efficiently in proof of its objectives.

Section Two

Calculating the Target Profit Rate in Terms of Cash Flows

We will construct an equation whose result represents the meeting point of the interests of the financier and the financier, which can be considered as an alternative mechanism to borrowing with interest; The financier with his long-term economic view is looking for a total return that shows him the payback period, and the financier with his short-term financial and accounting view will support his view of estimating the cash flows during the life of the investment, seeking to achieve a match between the flows attached to the feasibility study and the actual cash flows of the project.

The break-even point can be established on a separate year basis; This makes the equation valid even for one year; Whether annual cash flows are equal or unequal.

The model assumes that the total cash flows are divided by the target return multiplied by the number of years the cash flows will accrue; Equivalent to the target return multiplied by the invested capital, Figure (4).

$$\frac{\sum_{i=1}^{n} (CF_i)}{R^n} = R \, . \, C$$

The financier's point of view, as the businessman has a comprehensive economic view

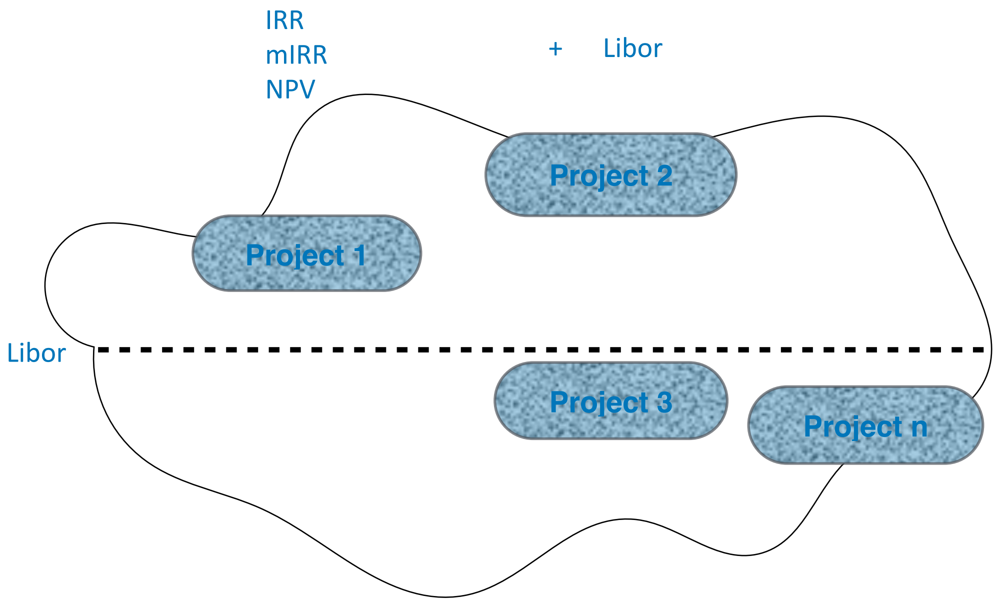
The financier's point of view provides vital details of his use of the funds

Figure (4)

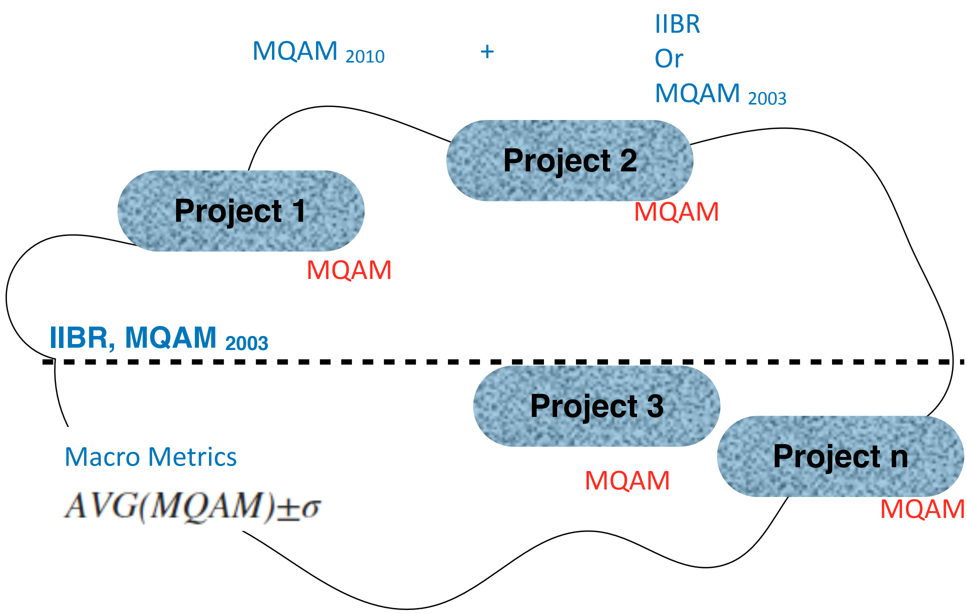
The Mqam of the break-even point, at which the negotiation between the financier and the financier begins, is an alternative to the interest indicator in a scientific and objective manner and by adopting estimates on the basis of the efficiency of each project separately, and not with the overall pricing technique for the entire market, where the confusion between the doable and the good of projects without distinguishing good from bad, figure (5).

At the level of macro-monetary policy; It is possible to calculate a Mqam for each project or sector and then calculate the arithmetic mean for all of them, and take the standard deviation to determine the acceptable range of total market pricing, or take the arithmetic mean of the two closest values to the Mqam, Figure (6).

Thus, the Mqam of the aggregate exceeds the Libor and IIBR scales, as it reflects the reality of the market in a scientific and objective manner.



الشكل (5)



الشكل (6)

Going back to the details of building Mqam; His hypothesis can be formulated by the following mathematical equation, equation (1):

Total Cash Flow ÷ (Target Discount Rate)^n = Target Discount Rate x Capital Invested

$$\frac{\sum_{i=1}^{n}(CF_i)}{R^n} = R \,.\, C \tag{1}$$

Whereas:

CFi Cash Flows per year i

R Target discount rate in year (n) corresponding to the assumed minimum modulus

n The number of years

C Invested Capital

Based on equation (1), the equation of total cash flows can be determined as follows, equation (2):

Total Cashflow = (Target Discount Rate)^n x Target Discount Rate x Invested Capital

$$\sum_{i=1}^{n} CF_i = (R)^n \,.\, R \,.\, C \tag{2}$$

And by dividing both sides of equation (2) by the invested capital C, equation (3):

Total Cashflow ÷ Capital Invested = (Target Discount Rate)^(N+1)

$$\frac{\sum_{i=1}^{n}(CF_i)}{C} = R^{(n+1)} \tag{3}$$

And by eliminating the root in equation (3), we get (target discount rate R), equation (4):

Target Discount Rate = (Total Cashflow ÷ Capital Invested)^(1/(n+1))

$$R = \left(\frac{\sum_{i=1}^{n} CF_i}{C}\right)^{\frac{1}{n+1}} \tag{4}$$

That is, the rate of the first year R1 is the same as R, equation (5):

$$R_1 = R \tag{5}$$

That is, the rate of the first year R1 is the target discount rate for the following years, equation (6): R itself, equation (5):

$$R_{(i)} = R^i \tag{6}$$

Accordingly, an indicator based on cash flows for several periods is calculated from the following equation, equation (7):

Mqam = (Total Cashflow ÷ Capital Invested)^(1/(n+1)) - 1

$$MQAM = \left(\frac{\sum_{i=1}^{n} CF_i}{C}\right)^{\frac{1}{n+1}} - 1 \tag{7}$$

But if we want to calculate a Mqam on the basis of a cash flow for one year, it is as follows, equation (8):

$$MQAM = \left(\frac{CF}{C}\right)^{\frac{1}{n+1}} - 1 \tag{8}$$

Taking into account the specificity of calculating successive years on an annual basis.

Thus, the Mqam is the break-even point at which negotiation begins between the financier and the financier, instead of using the usurious indicator.
We will illustrate this with a number of examples.

Section Three
Mqam Efficiency & Measurement of the Cashflows Quality

The cash flow generated by product sales; cash inflows, while the costs incurred to do so; cash outflows, and the difference between them is the net cash flow and these flows pertain to the operating activity CFO; The higher the net inflows, the more positive the efficiency of the financial product. Paying attention to net cash flows is important to distinguish between financial products.

What is the efficiency of Mqam as a measure of the quality of cash flows?

We will demonstrate the effectiveness of a Mqam by presenting a set of examples that address several financial aspects that the model can address or cover.

Equal annual cash flow

A request for an investment project from an Islamic bank for Mudaraba financing in the amount of 100,000 for a period of five years. The feasibility study indicated that the project will generate an annual cash flow of 100,000 annually until the end of the project. Proof required:

- The minimum return that the bank must accept.
- Minimum return.

- The extent to which the bank's credit policy has been achieved by targeting a return of 9.6% annually.

The solution:

Minimum return that a bank must accept:

We get the minimum that the bank must accept by applying equation (7), where we can build the following table (3):

Table 3

Accumulated reinvestment profits	Discounted annual cash flow + its accumulated investment	The accumulated amount reinvested at the rate of R_1	DCF Annual Cash Flow	Discount rate	annual cash flow	Year
$Share_2$	CFp		$Share_1$	R	CF	n
calculated 7	6 = 5+ 4	calculated 5	4=2/3	calculated 3	2	1
	100,000.00		76,472.5	1.3076	100000	1
	158,480.35		58,480.5	1.7098	100000	2
	251,959.86	207,238.0	44,721.6	2.2367	100000	3
	363,677.47	329,477.5	34,199.2	2.9242	100000	4
	501,719.86	475566.66	26,153.1	3.8232	100000	5
261,692.7	501,719.86		240,026	-	500000	مج

The source of current cash flows CF during the relevant financial period is cash sales and customer collections from forward sales; This represents the annual cash flow obtained during that period.

Mqam = (500,000 ÷ 100,000)^$^{(1 \div 6)}$ - 1 = 0.30766

It is the minimum acceptable to the Islamic bank to finance this Mudaraba, as the condition of reinvesting the money received during the same periods was taken into account, and the evidence for this in the second request is as follows.

Minimum Return or Break-even Point:

The break-even point is the minimum that must be accepted by the financier (ie, the bank in our case), and accordingly the bank will ask for an amount of 30,766 as a minimum return for the five years (according to the example).

To prove that this is true, we apply the following equation, equation (9):

Minimum Return (n) = Invested Capital x (n) Years ÷ Assumed Minimum Coefficient (n)

$$R = C \cdot \frac{n}{R^n} \qquad (9)$$

Where is the minimum rate per year (n) and is calculated from equation (6) as follows (column 3 of Table 3):

$$R^n = 1.30766^5 = 3.82362$$

Substituting in equation (9), we get the minimum return in the fifth year as follows:

Minimum return$_{\text{(for year 5)}}$ = (5 x 100,000) ÷ 3.82 = 130766

The cash flow CF in the first year of (100,000) its value discounted in the year of study - that is, the year of estimating the flows - is (76,472.45), in the second year its value is (58,480.35), and so on (column 4 of Table 3).

Total annual flows deducted by Mqam:

The $Share_1$ amount is 240026: the total annual DCF, or the equivalent of the total operating profits at the end of each financial period in addition to the principal invested money, and this can be formulated as follows, equation (10):

$$Share_1 = \sum_{i=1}^{n} \frac{CF_i}{R_i} \qquad (10)$$

Net operating profit:

By subtracting the invested capital from the total annual DCF, we get the net operating profit of 140026 (according to the example), as follows, equation (11):

$$Profits_1 = \sum_{i=1}^{n} \frac{CF_i}{R_i} - C \qquad (11)$$

Or calculated as follows, equation (12):

$$Profits_1 = Share_1 - C \qquad (12)$$

$$Profits_1 = 240026 - 100000 = 140026$$

So the cumulative amount reinvested in R_1 proportion is the sum of the DCF invested in R_1 proportion that starts accumulating from the third period CF_{p_i} and is $CF_{p_{(i-1)}}$.

So, the money received in previous periods with its investments must be reinvested at a rate of R_1.

This is a condition of competence in Mqam.

Total discounted cash flow reinvested:

The total discounted cash flow reinvested CFp annually can be calculated as follows, equation (13):

$$CF_{p_1} = CF_1 + \frac{CF_2}{R_2} + \sum_{i=1}^{n} \frac{CF_{(p_{i-1})}}{R_i} \quad (13)$$

Equation (13) can also be written as follows, equation (14):

$$CF_{p_n} = CF_{(n-1)} + \frac{CF_n}{R_n} . R_1 \quad (14)$$

The explanation for that is as follows:

$$Year_1 = \frac{100000}{R_1} . R_1 = 100000$$

$$Year_2 = Year_1 + \frac{100000}{R_2} . R_1 = 158480$$

$$Year_3 = Year_2 + \frac{100000}{R_3} . R_1 = 251959$$

$$Year_4 = Year_3 + \frac{100000}{R_4} . R_1 = 363677$$

$$Year_5 = Year_4 + \frac{100000}{R_5} . R_1 = 501719$$

It is noted that the last year we did not invest in R_1 due to the expiry of the investment period.

Total cash flow:

The total cash flows are calculated as follows, equation (15):

Total Cashflow = Invested Capital + Operating Profit + Reinvestment Profit

$$\sum_{i=1}^{n} CF = C + Profits + Share_2 \quad (15)$$

According to the example = 100,000 + 140026 + 261,692 = 500,000

The sum of the flows can also be calculated as follows, equation (16):

$$\sum_{i=1}^{n} CF = Share_1 + Share_2 \qquad (16)$$

This is (approximately) the total balance (501,719).

Reinvestment Profits:

The $Share_2$ amount (261692) represents the reinvestment profit, which is equivalent to the lost opportunity cost if the bank did not reinvest the money received during the financial periods in the same proportion as Mqam.

From the foregoing, we conclude that the reinvestment profits are calculated as follows:

Reinvestment Profit = Total Outflows Generated - (Operating Profit and Capital Invested)

This is represented mathematically as follows, equation (17):

$$Share2 = CF_{p_n} - Share_1 \qquad (17)$$

By substitution, we find that:

$$Share_2 = 501719 - 240026 = 261692$$

Assuming that the return of the minimum Mqam is reduced to the limit of 20% instead of the percentage set by the Mqam of 30.76%; For a decrease in annual cash flow, for example, from 100,000 to 60,962; The reinvested funds, 289,469 will be less than the total project cash flows 304,810.

This means that the financing decision will be directed towards refusing to finance this Mudaraba in order to ward off risks. *The project will operate with low efficiency, because the reinvested funds are less than the total cash flows of the project.*

The question is:

Where does the quality of investment efficiency lie?

The *efficiency condition* is that the total expected cash flows CF equal the total discounted cash flows reinvested CFp as follows, equation (18):

$$\sum_{i=1}^{n} CF = \sum_{i=3}^{n} CF_p \qquad (18)$$

Since the discounted cash flow $Share_1$ represents the capital invested and the discounted cash flow; The operating profit appears after deducting the invested capital from the discounted cash flows according to the previous equation (11) as follows:

$$\sum_{i=3}^{n} \frac{CF_i}{R_i} - C$$

And the total annual cash flows are as follows, equation (19):

$$\sum_{i=3}^{n} CF_i = C + \sum_{i=j}^{n} \left(\frac{CF_j}{R_i} - C \right) + Share_2 \qquad (19)$$

So the efficiency condition is when the project recovers its invested capital, operating profit and reinvested profit - as *a lost opportunity cost - all equal to the expected total cash flows (CFi).*

According to the previous example, the following can be concluded:

Table 4

Capital target cash flow ratio C	capital C	Targeted cash flow CF	Efficiency
97.75%	100000	97750	100%
61.30%	100000	61300	95%

Accordingly, it is:

(1) Quality of Efficiency as a Function of Expected Flow:

The 100% efficiency requirement is met when a cash flow of 97,750 is achieved i.e. 97.75% of the invested capital. The minimum efficiency is considered[1] to be 95% when a cash flow of 61,300 is achieved as the decision becomes closer to the rejection area, i.e. when it reaches 61.30% of the invested capital.

(2) Quality of efficiency in terms of profit:

The $Share_2$ result of reinvestment $Share_1$, whenever its ratio $Share_1$ is approximately one (increase or decrease), the efficiency condition is met, equation (20):

$$\frac{Share_2}{Share_1} \cong 1 \tag{20}$$

[1] The ratio of the total calculated cash flows to the total expected cash flows, and the ratios were obtained empirically on a case model calculated with denominator by substitution of assumed flows as in Table 5.

That is, the quality of the efficiency of the reinvested profits $Share_2$ begins to decrease after $Share_2$ it achieves its full efficiency of 100%[1].

Table: 5

Quality Reinvestment Efficiency	$Share_2 \div Share_1$	Project Efficiency	Assumed cash flow
106.36%	236846 ÷ 251901	100%	97750
99.46%	227382 ÷ 228607	99.13%	92000
99.08%	226039 ÷ 228144	99.08%	91680
97.04%	227382 ÷ 228607	98.83%	90000
60.67%	181233 ÷ 291180	95.00%	61300

Demonstration of Mqam as a tool for measuring the bank's achievement of its credit policy:

The percentage of total operating income is calculated as follows, equation (21):

Gross Operating Income Ratio = Total Operating Income ÷ Total Reinvested Cash Flow

$$Share_{1ratio} = \frac{Share_1}{\sum_{i=3}^{n} CF_i} \tag{21}$$

By example; It is equal to: 240026 ÷ 500,000 = 48%

to obtain its annual percentage; We divide the total percentage by the number of years, as follows, equation (22):

$$AnnualShare_{1ratio} = \frac{Share_{1ratio}}{n} \tag{22}$$

[1] Share1 to Share2 ratio, ratios obtained empirically on a case model computed with (Mqam)

It is equal to: 48% ÷ 5 = 9.6%

In comparison with the bank's target credit policy (according to the text of the issue), it can be said that the financier achieved his desired credit policy, with a target annual return rate of 9.6%.

Variable annual cash flow

By repeating the same previous example with different cash flows such as random, increasing or decreasing; The results will be as follows:

Table: 6

Accumulated reinvestment profits	Discounted annual cash flow + its accumulated investment	The accumulated amount reinvested at the rate of R1	DCF Annual Cash Flow	Discount rate	Annual cash flow	Year
$Share_2$	CFp		$Share_1$	R	CF	n
7	6 = 5 + 4	5	4 = 2÷ 3	3	2	1
	60,000		45,883	1.30766	60,000	1
	130,176		70,176	1.70998	120,000	2
	214,947	170,226	44,721	2.23607	100,000	3
	320,408	281,078	39,329	2.92402	115,000	4
	446,446	418,985	27,460	3.82362	105,000	5
218,874	446,446		227,571		500,000	Total

The value of Mqam remains the same; That is: 1.30766 because the total cash flows have not changed. While the total discounted cash flow decreases and the operating profit decreases to 127,571 and the reinvestment profit drops to 218874; Due to the concentration of large cash flows in recent years; What negatively affected the reinvestment.

If the flows are increasing: 60,000, 80,000, 100,000, 120,000, and 140,000; The operating profit will decrease to 115,043 and the reinvestment profit will decrease to 190,486 for the same previous reasons.

But if it were decreasing: 140,000, 120,000, 100,000, 80,000, and 60,000, the operating profit would have risen to 165,000, and the reinvestment profit would have risen to 332,899 due to the increase in cash flows in the first periods.

Section Four
Relationship of Annual Cashflows to Profit Distribution Ratios

To study the relationship of annual cash flows compared to the profit distribution ratios between the financing bank and the financing client using Mqam, we present the following example:

Assuming that a project with a capital of 1200 achieved during its five years of life different cash flows totaling 17,000 as follows: 1200, 2400, 3600, 4800, 5000, and using a Mqam model, the following results are:

Table 7

Annual cash flow cf	Profit distribution ratio for the bank Share1	Borrower's dividend payout ratio Share2
1200	0	0
2400	71%	29%
3600	57%	43%
4800	50%	50%
5000	45%	55%
17000	31%	69%

Representing this graphically, we get Figure (7):

The analysis of the relationship (through the graph, Figure 7) shows that there is an inverse relationship between what the financing bank achieves and the borrower or

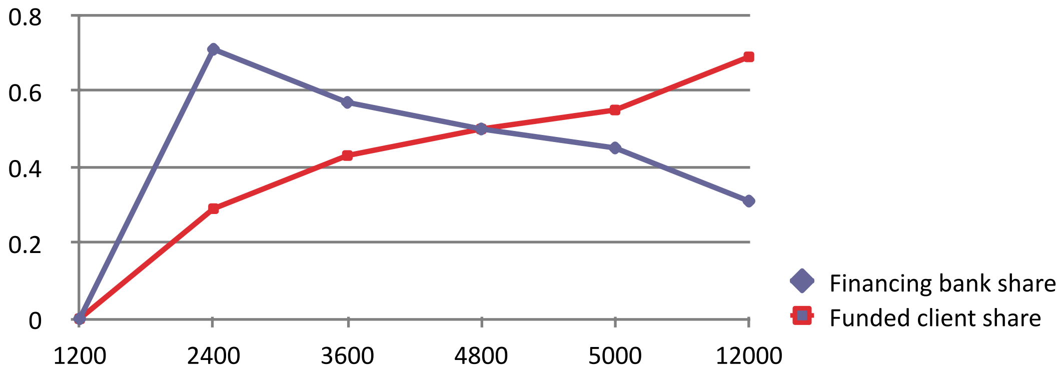


Figure (7)

financier, as follows:

- When the project generates cash flow equal to the principal of the loan, the dividend payout ratios are zero.
- When the project generates cash flow higher than the principal of the loan up to a certain point, the profit ratios of the financing bank are greater than the profit ratios of the borrower financier.
- When the project achieves a cash flow four times the principal of the loan, the profit distribution ratios are equal between the financing bank and the financing borrower, or in other words, the total amount obtained by the bank and the borrower is equal.
- When the project generates cash flow of more than four times the principal of the loan here the profits of the financier begin to decrease compared to the profits of the financier begin to increase.

The graph illustrates the following assumptions, assuming that the project's capital is equal to 1200 by applying Mqam:

- If the project generates cash flow of 1200, the discount rate is zero.
- If the project has a cash flow of 2,400, then the discount rate is 41.4% at the end of the period.
- If the project generates 4800 cash flow then the discount rate is 100%.

This relationship varies according to the form of cash flows that occur; Because of Mqam impact.

Section Five
Calculating Cashflows in Terms of a Target Profit Rate

The objective of calculating the minimum expected cash flows from the project to be financed aims to reduce and hedge risks before issuing the financing decision.

The employer's flows represent the minimum return of r% per annum, the amount of the basic financing and the return that he wants to achieve, and this can be done by the following formula, equation (23):

The Cashflow to be Achieved = Financier's Capital After Investment + Mudarib Capital After Investment

$$CF_p = Share_1 + Share_2 \tag{23}$$

To calculate $Share_1$ we find:

financier's capital after investment = invested capital + (invested capital x expected return)

Hence, equation (24):

Financier's Capital After Investment = Invested Capital X (1 + Expected Return)

$$Share_1 = C.(1 + r) \tag{24}$$

whereas:

r The target rate to be achieved according to the financier's investment policy

C invested capital

$Share_1$ Funded capital after investing it

For the calculation $Share_2$, we find that:

Mudarib's Capital After Investment = Financier's Capital After Investment + Financier's Capital After Investment x Expected Return

Hence, equation (25):

Mudarib's Capital After Investment = Financier's Capital After Investment x (1 + Expected Return)

$$Share_2 = Share_1 \, . \, (1 + r) \qquad (25)$$

As it $Share_2$ is the Mudarib's capital after investing the investor's money and achieving a return that belongs to him. Substituting equation (24) into equation (25), we get the following:

Mudarib Capital After Investment = Invested Capital x (1 + Expected Return) x (1 + Expected Return)

From it we get the Mudarib's capital after investment, equation (26):

Mudarib's Capital After Investment = Invested Capital x (1 + Expected Return)^2

$$Share_2 = C \, . \, (1 + r)^2 \qquad (26)$$

By substituting equations (24 and 25) into equation (23), the cash flow can be represented by the following equation (27):

$$CF_p = C \, . \, (1 + r) \, . \, (2 + r) \qquad (27)$$

That is, the total cash flows for the investment years can be represented by the following equation, equation (28):

$$CFp_n = C\,.\,(1+r)\,.\,(2+r) + \sum_{i=1}^{n}\left(Share_{2i}\,.\,(1+r)\,.\,(2+r)\right) \tag{28}$$

Example:

Suppose an investment project requested a Mudaraba financing bank for $100,000 for a period of five years, and suppose that the credit department wants to achieve an annual return of 9.6%. What is required:

1. The statement of cash flows that should be clarified by the project feasibility study.
2. A statement of the minimum return accepted by the Islamic bank as a financier.

The solution:

The target r is 9.6% annually, so the results for the first year will be as follows:

The financier's capital $Share_1$ after investment according to equation (24) = 100,000 x (1,096) = 109,600

Mudarib capital after investment $Share_2$ according to equation (25) = 100,000 x (1,096) 2 = 120,122

Cash flow CFp according to equation (27) = 100,000 x 1,096 x 2,096 = 2,29722

Applying the previous equations, the total cash flows CFp_n for the investment years = 478,284

Table (8) summarizes the previous results for the specified investment years as follows:

Table 8

Year n	Cash Flow CF	Minimum return r	Bank share SHARE1	Share of the Mudarib SHARE2	Gross discounted and reinvested flows CFp
1	100,000	1.096	109,600	120,122	229,722
2	120,122	1.096	131,653	144,292	275,945
3	144,292	1.096	158,144	173,326	331,470
4	173,326	1.096	189,965	208,202	398,167
5	208,202	1.096	228,189	250,095	478,284

To verify the previous results, we can calculate the Mqam as in the following table (9):

Table 9

Year n	Cash Flow CF	Discount rate R	Bank share SHARE1	Gross discounted and reinvested flows CFp	Share of the Mudarib SHARE2
1	95,657	1.29802	73,694.59	95,657.00	
2	95,657	1.68485	56,774.65	152,431.65	
3	95,657	2.18697	43,739.46	241,598.68	
4	95,657	2.83873	33,697.08	347,296.81	
5	95,657	3.68473	25,960.38	476,758.32	
مجموع	478,285		233,866.17	476,758.32	242,892.15

The differences between the shares of the financier and the Mudarib between tables (8 and 9) are caused by the assumption that the annual cash flow is the same; Because we divided the total cash flows by the number of years of investment; The objective of formula (28) is to determine the total cash flows, not their items; To make it computationally impossible. As for the Mqam, it represents the minimum return that a bank must accept as a financier, and is equal to: 29.80%.

Section Six
Comparison of Using Two Different Tools Using Mqam

A project borrowed 1,000 pounds for a year, and the annual cash flows were as follows:
Vogue status: 1300 cash flow and 10% market interest rate.
Depression status: cash flow 1050 and market interest rate of 2.50%.

Which of the two methods is better: MQAM or usurious interest?

The solution:
First, Vogue status:
By using (interest rate):
The share of the money owner $Share_1$ = 1.10 x 1000 = 1100
The share of the Mudarib worker $Share_2$ = 1300-1100 = 200 = 200 ÷ 1000 = 20%
By using Mqam:
Discount rate r = (1300÷1000)^(1÷2) = 1.14
The share of the money owner $Share_1$ = 1000 x 1.14 = 1140
The share of the Mudarib worker $Share_2$ = 1300 - 1140 = 160 = 160 ÷ 1000 = 16%
Interpretation of the result:
The owner of the money, according to the Mqam, obtained an additional percentage: 20% - 16% = 4%, due to his risk

taking, while the share of the Mudarib decreased by the same percentage.

Secondly, Depression status:

Bu using the interest rate:

The share of the money owner $Share_1$ = 1000 x 1.025 = 1025

The share of the Mudarib $Share_2$ = 1050 - 1025 = 25

= 25 ÷ 1000 = 2.5%

By using Mqam:

Discount rate r= (1050÷ 1000)^(1÷2) = 1.025

The share of money owner $Share_1$ = 1000 x 1.025 = 1025

The share of the Mudarib $Share_2$= 1050 - 1025 = 25

= 25 ÷ 1000 = 2.5%

Interpretation of the result:

The owner of the money obtained the same percentage, both in the case of the Mqam and the case (usury interest). In the event of a recession, the interest rate represents the highest price accepted by the money owner, otherwise he will keep his money; Therefore, financiers using usury formulas are reluctant to inject and lend their money in situations of depression, causing severe damage to the economy by increasing its contraction (Fig. 1). While the partnership formulas enjoy flexibility because the money owner contributes to bearing the burdens with the Mudarib in their business; Which speeds up the revival of depression cases, Table (10).

Table 10

statment	vogue status		depression status	
	Interest	Mqam	Interest	Mqam
Money Owner	1100	1140	1025	1025
Mudarib	200	160	25	25

Section Seven
Capital Preservation

A Mqam can be used to preserve capital; By looking for the minimum return.

If we assume that the investor has to pay zakat on his money at a rate of (2.5%) and that he aims to achieve a return of (7%) as a minimum.

Minimum Return r = Target Return + Zakat Rate (Cost of Capital)

So the target return r = 7% + 2.5% = 9.5%

If the capital is (1000); What is the minimum return that the investor should demand to preserve his capital?

Capital after investment = 1000 x 1.095 = 1095

Therefore, the required cash flow is:

1095 = x ÷ 1.095

x = 1095 x 1.095 = 1200

If the cash flow of the offered investment is less than that, the decision is to refuse the financing.

Section Eighth
Sukuk Treatment Using Mqam

An investment company issued 5,000 Mudaraba Sukuk at a price of 100 per one, i.e. at a value of 500,000. The available distribution policies were as follows:

Policy 1: Not to distribute the profits of the Sukuk for reinvestment; Some large projects do not like to distribute their profits if their cash flows are less than their subscribed capital.

Policy 2: Dividends are distributed annually.

Policy 3: Selling the Sukuk at their face value in addition to the value of the undistributed profits.

Assuming the following hypotheses are met:

1. The company generated 400,000 cash flows in the first year.
2. In the second year, the company achieved cash flows of 1,000,000.
3. 50% of the holders of the subscribed Sukuk decided not to spend their profits due in the second year of their investment in the company.
4. The company generated cash flows of 1,300,000 in the third year.
5. The owners of 1,000 Sukuk decided to sell their Sukuk as follows:

- 250 checks from the owners of the distributed profits.

- 750 Sukuk from undistributed profits holders.

Required by using Mqam:

1. Proving that the Sukuk holders are deprived of profits in case the company achieves a cash flow below the value of the subscribed Sukuk.
2. How are profits distributed?
3. How are the bonds of undistributed profits holders calculated?
4. How to price the sold Sukuk?

The solution:

The first request: The proposed first distribution policy: Proving that the Sukuk holders are deprived of profits in the event that the company achieves a cash flow below the value of the subscribed Sukuk:

First Hypothesis: In the first year, the company generated cash flows of 400,000:

Mqam = $(400,000 \div 500,000)^{\wedge(1\div2)}$ = 89%

The share of the Sukuk owner in this case = 89% x 100 = 89

So we have a loss of 20%, for example, (because the project is in its start) if some Sukuk holders sold their Sukuk in the market at their face value as if they had made an undeserved profit.

The second hypothesis: In the second year, the company generated a cash flow of 1,000,000:

Mqam = $(1,000,000 \div 500,000)^{\wedge(1\div2)}$ = 1.41

The share of the Sukuk owner = 1.41 x 100 = 141

Profits per one of Sukuk = 141 - 100 = 41

The third hypothesis: The case of the decision of the holders of half of the subscribed Sukuk not to spend their profits in the second year and invest them:

Total profit of the issued Sukuk: 41 profit of each one of Sukuk x 5,000 = 205,000

Dividend share = 205,000 x 50% = 102,500

Undistributed profit share = 205,000 x 50% = 102,500

Fourth Hypothesis: The company achieved cash flows of 1,300,000 in the third year

Capital Invested = Value of the Subscribed Bonds + Undistributed Profits

Capital invested = 500,000 + 102,500 = 602,500

Third year inflows = 1,300,000

Mqam = $(1,300,000 \div (602,500))^{\wedge(1\div 2)}$ = 1.47

The share of the Sukuk owner (the owners of the distributed profits) = 1.47 x 100 = 147

Profit of each One of Sukuk (for dividend holders) = 147 - 100 = 47

Total dividends = 47 x 2500 one = 117500

The share of the Sukuk owner (the owners of the undistributed profits) = 1.47 x 141 = 207

Profit of the Sukuk (for owners of undistributed profits) = 207 - 100 = 107

Total undistributed and invested profits = 107 x 2500 = 267,500

Fifth Hypothesis: Selling Sukuk 1000:

Sukuk of the owners of the dividends = 250 x 100 = 25,000

The Sukuk of undistributed Profits Holders = 750 x (Undistributed Profits ÷ Number of Invested Sukuks) + Nominal Value of the Sukuk

Bonds of undistributed profit holders = 750 x (267,500 ÷ 2,500) + 100 = 750 x 207 = 155,250

Section Nine
Determining the Wages of Islamic Insurance Company

The Mqam method is parallel to the loss rate ratio method; Because it proceeds from its own computational principles, and is distinguished from it as a modifiable modeling method.

Loss rate method[1]

It is summarized by collecting statistical data on the values of the property that suffered losses in the past due to a certain risk and the values of these losses, and by dividing the amount of losses by the property values, the loss rate is produced.

Example: Suppose we are in the process of estimating the loss rate due to a fire, and the following data are available, Table No. (11):

Table 11

Loss rate per thousand	Estimate the losses caused by the fire	The value of the property that was burned	Year
3.0	15000	5000000	1960
2.3	10500	4500000	1961
1.7	6000	3500000	1962
2.5	15000	6000000	1963
1.0	2000	2000000	1964

[1] Consider our book Takaful Insurance Accounting

3.0	12000	4000000	1965
3.3	10000	3000000	1966
3.6	14500	4000000	1967
2.6	85000	32000000	المجموع

If a person wants to insure his property against fire at a value of 100,000 dollars, the net premium is: 100,000 x 2.6 per thousand = 260 dollars, then a specific percentage is added to him against the general and administrative expenses of the insurance business, as well as the profit to be achieved to reach the commercial premium.

So let's add 23% against expenses, 18% for agents' commission, 5% for shareholders' profits, and 2% for reserves. Assuming that the loss rate on which the net premium is calculated is 3% of the property value; The commercial premium is equal to the result of solving the following equation:

y = 0.23 y + 0.18 y + 0.05 y + 0.02 y + 0.03

y = 0.48 y + 0.03

This is equivalent to (1 - 0.48) y = 0.03

And from it: 0.52 p = 0.03

Thus: y = $\frac{3}{52}$

where y is the value of the property.

If the value of the property is $104,000, then:

Commercial Installment = $6000 = $104000.\frac{3}{52}$

Net premium = $3120 = $104000.\frac{3}{100}$

The difference between them equals 2,880 profit, reserves, and insurance agents' commission.

The same idea applies to all insurances that are subject to the principle of compensation.

By studying the detailed data of Rajhi Takaful Company from its financial statements for the years 2011-2012-2013 in addition to other details of the company; We have set the following table (12):

Table 12

Insurance portfolio and agency fees								
Statement	Different types of insurance					Total	insurance healthy	Total
	vehicles	Charge	Property	geometric	general			
ium after reinsurance	376,205	9,287	2,282	346	3,040	391,160	54,992	446,152
ons and bills received	1,448	3,343	2,549	6,687	492	14,519	0	14,519
commissions paid	(11,017)	(2,604	(1,512)	(3,265)	(570)	(18,968)	(4,978)	(23,946)
supervision fee	(1,893)	(97)	(54)	(163)	(21)	(2,228)	(1,682)	(3,910)
Total	**364,743**	**9,929**	**3,265**	**3,605**	**2,941**	**384,483**	**48,332**	**432,815**
Agency fee rate	40%	40%	40%	40%	40%	40%	30%	
Agency fees	**145,897**	**3,972**	**1,306**	**1,442**	**1,176**	**153,793**	**14,500**	**168,293**
Loaded in 12 months	62,748	1,708	562	620	506	66,144	6,236	72,380
							deficit	95,913
		The deficit in the subscriber's fund						
	Statement		Total	registered	unregistered		calculate	38.88%
	deficit 2010		75,401	75,401	0		registere	16.72%
	deficit 2011		121,420	121,420	0			
	deficit 2012		168,291	72,380	95,911			
	Total		365,112	269,201	95,911			

The previous table shows that the percentage of management's wages on book was 16.72%, or about 17%, while the assumed (calculated) percentage amounted to 38.88%, or about 39%.

Therefore, based on the data of the previous example, the following table can be depicted:

Table 13: Insurance portfolio and agency fees in Mqam

Year	Vehicles that have been involved in accidents	Value the losses that occurred due to accidents	Commercial Installment	Mqam rate	perationa fees	net premium	Percentage		
							Commercial Installment	perationa fees	net premium
1960	5,000,000	15,000	39,271	1.61804	24,271	15000	0.0079	0.0049	0.0030
1961	4,500,000	10,500	27,490	1.61805	16,990	10500	0.0061	0.0038	0.0023
1962	3,500,000	6,000	15,709	1.61807	9,708	6001	0.0045	0.0028	0.0017
1963	6,000,000	15,000	39,273	1.61808	24,271	15001	0.0065	0.0040	0.0025
1964	2,000,000	2,000	5,236	1.61808	3,236	2000	0.0026	0.0016	0.0010
1965	4,000,000	12,000	31,418	1.61808	19,417	12001	0.0079	0.0049	0.0030
1966	3,000,000	10,000	26,182	1.61808	16,181	10001	0.0087	0.0054	0.0033

It is possible to construct an arithmetic mean that takes into account the ratios of the past periods, and for negotiation, its standard deviation can be calculated to reach a negotiating margin.

The arithmetic equations are calculated as follows:

Trade Premium = Mqam^2 x Loss Values

Administrative & Operational Fees = Commercial Installment ÷ Mqam Rate

Net Premium = Commercial Premium - Administrative and Operational Fees

The average Mqam is 1.6180441, which is derived as an average from Table (4), which is affected by the given statistic data.

Mqam = (Commercial Premiums ÷ Values of Losses that Occurred Due to Accidents)^$^{(1+2)}$

Mqam = (39271÷15000)^(1+2) = 1.6180441

Commercial Installment = (1.6180441)^2 x 15000 = 39,271

Administrative and operational fees = 39,271 ÷ 1.6180441 = 24271

Net premium = 39271 - 24271 = 15,000

The values have been converted into percentages to be a tariff based on calculating the insurance contract fees and its allowances.

If the cost of a vehicle reaches 100,000, the commercial insurance premium, net premium and operating expenses are calculated as follows:

Net insurance premium = 100,000 x 0.003 = 300.00

Operating expenses = 100,000 x 0.004854 = 485.40

Commercial insurance premium = 100,000 x 0.0078542 = 785.42

In our opinion, linking the agency wages in Islamic insurance companies to the loss rate is a control that achieves justice and does not lead to the inability of the policyholders fund.

Chapter Five - MQAM Sensitivity Analysis

The (Ohaj-Kantakji) model assumes that the minimum return on Mudaraba funds is the starting point for studying the sensitivity of cash flows to investment projects for the purposes of better selection; Mudaraba is one of the forms of participation, in which the partners do what they can to achieve the best possible profits.

Sensitivity analysis is used in financial measurements to determine the extent of the project's response to surrounding changes, whether fixed costs or variable costs change, revenues change or all change in different proportions, and this is called the worst scenario.

The net cash flow is an arithmetic summation of the above because it expresses the cash flow after covering the project cost; It results from adding fixed costs as a periodic cash outflow, with variable costs as periodic cash outflows, and subtracting this from periodic revenue.

Therefore, cash flows are the best comparison criterion, after deducting the minimum return on Mudaraba funds.

Section One
Sensitivity Modulus

The developers of Mqam model tried to find the sensitivity coefficient for a Mqam by trial and error[1] method before they reached a mathematical formula for a function.

Sensitivity Modulus = (Average Cash Flows) x Sum(P+1)^(n-i) ÷ (C x (P+1)^n)

Whereas:

P: represents Mqam

C: represents the cost of the project

and whereas:

Mqam = Mqam + 1

then:

$$R = Mqam + 1$$

Therefore, the sensitivity coefficient equation can be written as follows, equation (29):

$$SensPara = \frac{CF}{n} \cdot \frac{\sum_{i=1}^{n} R^{(n-i)}}{C \cdot R^{n}} \qquad (29)$$

[1] Calculation by trial and error: the sum of the denominator rates for investment periods multiplied by the cash flow for a given period (one of the flows if they are equal or the average of the flows if they are different).
The return on the speculative capital for example (A) is 11.20%.
344406 =)31428.57) × ((1.112) + (1.2371) + (1.37596) + (1.53041) + (1.7022) + (1.89327) + (2.1057))
The return on the speculative capital for example (B) is 12.43%
361288 =)31428.57) × ((1.1243) + (1.26405) + (1.42117) + (1.5978) + (1.7964) + (2.0197) + (2.2707))

Section Two
MQAM Sensitivity

To calculate Mqam sensitivity, the sum of cash flows discounted by a Mqam will be divided by the Mqam sensitivity modulus specified above.

Mqam Sensitivity = Sum of the Project's Deducted Flows at a Mqam ÷ Sensitivity Modulus

Equation (30) shows the Mqam sensitivity equation:

$$MQAMsensitivity = \frac{CFp}{SensPara} \tag{30}$$

Whereas:

CFp It is the sum of cash flows discounted at a Mqam rate,

$SensPara$ is the Mqam sensitivity coefficient,

Mqam has means that help in evaluating investment projects, just like the internal return and other measures.

Therefore, after determining the sensitivity of the studied projects; The project with the lowest sensitivity is the one that has the greatest value and is considered in comparison.

If the sensitivity of the two studied projects is respectively 229600 and 215791; The first is better than the second because its sensitivity value is greater. This may be achieved although the return of the second is greater in some cases, as the following examples will show.

Results:

- A project with less sensitivity is better because it is less sensitive to the volatility of cash flows; Therefore, it is preferred over others.
- When the output approaches the capital of the project, the semi-regular cash flows have minimal risks.
- When the project generates equal cash flows; The Mqam rate is equal to the return on the Mudaraba capital, but if it is different, the return on the Mudaraba capital may be less than the Mqam rate if the flows were of the largest size in recent years, and it would be greater than the Mqam rate if the cash flows were of the largest size in the early years.

In what follows, we will present a set of illustrative examples.

Example 1:

Two projects (A) and (B) that have the same capital and number of years of operation, differ from each other by the size of the annual net cash flow, as project (B) has a total of 538,500 cash flows and project (A) 451,000.

Table: 11

Case 1			Case 2		
R	-220,000	DCF	R	-220,000	DCF
1.09388	64,429	58,899.18	1.11840	76,929	68,784.76
1.19657	64,429	53,844.34	1.25081	76,929	61,503.07
1.30890	64,429	49,223.31	1.39890	76,929	54,992.24
1.43178	64,429	44,998.87	1.56452	76,929	49,170.65
1.56620	64,429	41,136.97	1.74975	76,929	43,965.35

[1] View (Excel file 130)

1.71323	64,429	37,606.52	1.95692	76,929	39,311.09
1.87406	64,429	34,379.05	2.18861	76,929	35,149.74
10.18463	451,000	320,088.24		538,500	352,876.92
MQAM	9.39%		MQAM	11.84%	
IRR	22.01%		IRR	29.13%	
MIRR	11.52%		MIRR	14.38%	
Sum(p+1)^(n-i)	9.311		Sum(p+1)^(n-i)	10.039	
SensPara	1.4549		SensPara	1.6040	
MQAMsensitivity	220,000		MQAMsensitivity	220,000	

The decision:

Project B outperforms Project A in all respects with a Mqam, internal rate of return, and adjusted internal rate of return, and they are similar in their sensitivity of 220,000 each.

So Project B is better than Project A.

By standardizing the total cash flows of the two projects and the number of years of investment in them by introducing the ROI measure, considering the investment of the received funds at the same Mqam rate, the results will differ according to the following three examples[1].

Example 2:

In the following example, the annual flow is constant in (A) and decreasing in (B).

[1] View (Excel file 131)

Table 15

الحالة (أ)				الحالة (ب)			
Mqam	CF cash flow	The flow deducted by a Mqam	reinvested cash flow	Mqam	CF cash flow	The flow deducted by a Mqam	reinvested cash flow
R	-220,000	DCF	CFp	R	-220,000	DCF	CFp
1.09403	64,500	82,276.02	156,870.18	1.09388	120,000	71,531.05	118,220.46
1.19690	64,500	66,857.71	225,100.61	1.19657	100,000	39,974.15	178,285.96
1.30945	64,500	53,479.87	288,871.16	1.30890	71,000	48,967.11	246,157.10
1.43258	64,500	42,604.25	354,343.20	1.43178	70,000	51,133.85	320,701.86
1.56728	64,500	38,309.38	416,846.89	1.56620	58,000	51,435.81	401,909.79
1.71465	64,500	29,184.66	477,387.14	1.71323	10,000	51,100.80	471,624.45
1.87588	64,500	21,343.98		1.87406	22,000	31,983.82	
	451,500	334,055.86			451,000	346,126.60	
MQAM	9.40%		2.17	MQAM	9.39%		2.14
IRR	22.05%	Yield of yea	1.17	IRR	32.47%	Yield of year	1.14
MIRR	11.53%	annual retu	16.7%	MIRR	11.77%	annual retur	16.3%
Sum(p+1)^	9.315			Sum(p+1)^(n-	9.311		
SensPara	1.4558			SensPara	1.4549		
MQAM sensitivity	229,462			MQAM sensitivity	237,896		

The decision:

Project A is better in terms of annual return and Mqam rate.

Project B is better in terms of internal rate of return and adjusted internal rate of return.

The sensitivity of Project A is less than that of Project B.

Therefore, Project A is better than Project B in terms of the quality of its cash flows.

Example 3:

In the following example, we take the same previous assumptions, considering that project flows (A) are decreasing and project flows (B) are increasing.

Table: 16 -

الحالة (أ)				الحالة (ب)			
Mqam	CF cash flow	The flow deducted by a Mqam	reinvested cash flow	Mqam	CF cash flow	The flow deducted by a Mqam	reinvested cash flow
R	-220,000	**DCF**	**CFp**	**R**	-220,000	**DCF**	**CFp**
1.09388	120,000	109,701.36	203,572.14	1.09388	21,000	19,197.74	29,357.21
1.19657	100,000	83,572.14	291,443.10	1.19657	10,000	8,357.21	55,033.18
1.30890	90,000	68,759.83	374,677.87	1.30890	30,000	22,919.94	116,074.06
1.43178	80,000	55,874.42	429,006.89	1.43178	80,000	55,874.42	184,435.02
1.56620	30,000	19,154.69	475,118.50	1.56620	90,000	57,464.07	260,118.89
1.71323	10,000	5,836.93	530,927.68	1.71323	100,000	58,369.32	348,570.49
1.87406	21,000	11,205.59		1.87406	120,000	64,031.93	
	451,000	354,104.97			451,000	286,214.64	
MQAM	9.39%		2.41	MQAM	9.39%		1.58
IRR	33.68%	Yield of yea	1.41	IRR	15.47%	Yield of year	0.58
MIRR	11.80%	annual retu	20.2%	MIRR	11.23%	annual retur	8.3%
Sum(p+1)^	9.311			Sum(p+1)^(n-	9.311		
SensPara	1.4549			SensPara	1.4549		
MQAM sensitivity	243,380			MQAM sensitivity	196,718		

<u>The decision:</u>

Project A is better in terms of annualized return, internal rate of return and adjusted internal rate of return. The two projects are equal in Mqam rate.

The sensitivity of Project B is lower than that of Project A. Therefore, Project B is better than Project A in terms of the quality of its cash flows.

Example 4:

In the following example, we take the same previous assumptions, taking into account that project (a) flows are concentrated in the first two periods only, and project (b) flows are increasing.

Table: 17 -

الحالة (أ)				الحالة (ب)			
Mqam	CF cash flow	The flow deducted by a Mqam	reinvested cash flow	Mqam	CF cash flow	The flow deducted by a Mqam	reinveste d cash flow
R	-220,000	**DCF**	**CFp**	**R**	-220,000	**DCF**	**CFp**
1.09388	225,500	206,147.14	413,955.18	1.09388	21,000	19,197.74	46,071.64
1.19657	225,500	188,455.18	452,816.82	1.19657	30,000	25,071.64	73,316.74
1.30890	0	0.00	495,326.76	1.30890	30,000	22,919.94	136,074.06
1.43178	0	0.00	541,827.47	1.43178	80,000	55,874.42	206,312.60
1.56620	0	0.00	592,693.62	1.56620	90,000	57,464.07	284,050.31
1.71323	0	0.00	648,335.03	1.71323	100,000	58,369.32	364,076.58
1.87406	0	0.00		1.87406	100,000	53,359.94	
	451,000	394,602.32			451,000	292,257.07	
MQAM	9.39%		2.95	MQAM	9.39%		1.65
IRR	64.72%	Yield of year	1.95	IRR	16.36%	Yield of yea	0.65
MIRR	12.10%	annual retur	27.8%	MIRR	11.28%	annual retu	9.4%
Sum(p+1)^(r	9.311			Sum(p+1)^(n-	9.311		
SensPara	1.4549			SensPara	1.4549		
MQAM sensitivity	271,214			MQAM sensitivity	200,871		

<u>The decision:</u>

Project A is better in terms of annualized return, internal rate of return and adjusted internal rate of return. The two projects are equal in Mqam rate.

The sensitivity of Project B is lower than that of Project A.

Therefore, Project B is better than Project A in terms of the quality of its cash flows.

Chapter Six - Comparison between Investment Decisions

The markets attach clear importance to the element of liquidity. It is one of the five components of the credit rating in the markets as international rating companies. The rating is a well-known source for measuring risks, and liquidity risk has acquired a corner that cannot be ignored after the succession of global financial crises.

The two researchers (Ohaj-Kantakji) developed their model as a tool for measuring the performance of Islamic financial transactions with techniques that keep pace with the development of financial engineering without the need for usurious tools. To avoid usury that God Almighty commanded us to stay away from. In confirmation of their theory; They are developing practical examples to facilitate the use of a position between researchers and practitioners alike, in an effort to remove the sin of a war on people who have no energy; For He, the Most High, says: (2:279) but if you do not do so, then you are warned of the declaration of war against you by Allah and His Messenger.

The research compares investment decisions using financial mathematics for sales and Islamic financing formulas; To be a flexible and easy tool, especially as it is supported by exercises designed on calculation programs such as Excel and Numbers, and this helps in programming it within information systems because the model's algorithms are indicated and explained.

Cash Flow is the arteries of liquidity from the body for all establishments of all kinds without exception. The importance of the cash flow statement has increased among financial reports for its effective role in measuring liquidity and sensing its increase or decrease. This allows the financial management to manage the expected deficit or direct the surplus in order to prevent damage to its rates of return and reduce its efficiencies if this happened.

The financial and economic events are the controllers of the data and vocabulary of those monetary events; Cash sales policies increase cash flows, while credit sales policies reschedule those flows; This makes it imperative for the senior management to formulate its investment policies in coordination between its departments, especially the financial department responsible for managing liquidity, and the investment department that controls the policy of granting credit. Marketing management is the spearhead in any economic institution as it is a market sensor. It senses the needs of the market and the movements of its pioneers and probes the tendencies towards cash or forward purchase and the duration of that term.

The provision of financial and mathematical tools to decision makers helps them in rationalizing their investment decisions, whether they are buyers or sellers. The prevalence of the correct financial culture among market members raises financial awareness, improves market performance, and increases confidence in it, its leaders and their decisions. It stands as a mathematical and financial tool that can be applied when making an investment decision and can also be applied to business results, Figure (8).

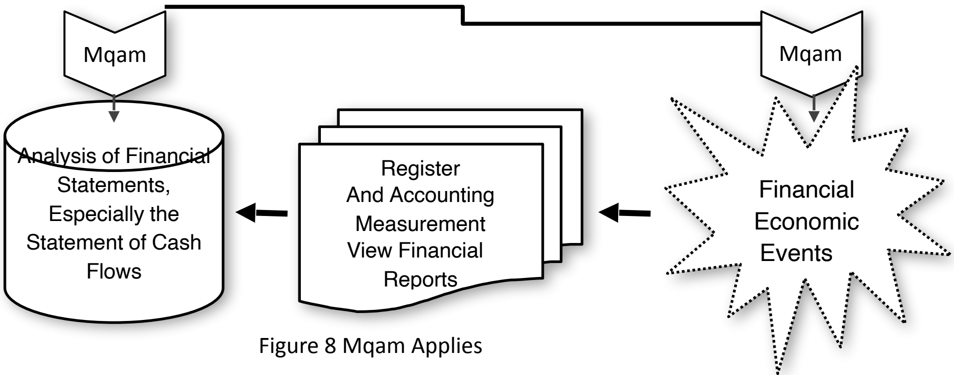


Figure 8 Mqam Applies

Therefore, financial and Math tools are a scientific method that helps in achieving justice between the parties to the swap transactions. It helps in clarifying the fair price and then leaves the freedom to negotiate to determine the price. This prevents unfairness and monopoly and spreads disclosure and transparency in the market. The parties to the swap process may be unable to achieve the (honesty and explanation) which he, may God's prayers and peace be upon him, urged for technical reasons; Which refers the responsibility to the market accountant as its observer and responsible (regardless of his name), in order to avoid the consequences of dishonesty and data silencing in the market.

Section One
Cashflow, Spot & Forward Selling Policies

A developer of an established model seeks to develop measurement tools that depend on cash flows and their movement, without usurious suspicions; To add serenity to Islamic financial transactions in rational markets in order to achieve the blessing and prosperity of the markets, and to avoid the destruction of their blessing and stagnation, in accordance with the Prophet of guidance, peace be upon him, who defined in a great Hadith the cornerstone of any market; He began with its smallest units, the seller and the buyer, and their negotiating board, and ended with drawing the fate of the market if one of the two behaviors specified in the text of the Hadith spread. He, peace be upon him, said:

(The two sales are by choice, so long as they do not separate. If they are truthful and we explain, it is blessed for them to sell them, and if they lie and conceal, the blessing of their sale will be annihilated).

It should be noted the greatness of this Hadith, as it began with honesty and clarification or what is known as disclosure and transparency, and this is a correct sequence. As for the opposite, it was in concealment and lying, and the peace and blessings of God be upon him reversed their order because the original was the disappearance of clarification, explanation and transparency, then followed by the disappearance of honesty to replace it with lies.

The market depends in its work on buying and selling operations; If the swap of the two prices takes place in the meeting of the contract, the sale is for cash immediately, and if the time of delivery of the price is far from the time of delivery of the commodity, the sale is forward. If the price is delivered first and the commodity later, it is Salam, and if the commodity is delivered first and then the price later, it is a forward sale as is customary. If the price is paid in several forward payments, then it is a forward sale in installments, in relation to the payment of installments at the beginning of each lunar month, so the wording is linked to it.

The elements of the cash sale are the cost (or the first purchase price), the selling price, and between them the profit or loss achieved by the increase of the second over the first, or vice versa. As long as the swap of the two prices or the commodity and its price takes place in the contract council, there is no credit or debt in the cash sale, and therefore does not have the capacity of financing because both parties to the swap will give up an asset in swap for an asset with the other with their consent.

As for the forward sale, the financing is clear; The party that paid the least; What he took is funded; In installment sale the buyer finances, and in Salam and Istisna sales the seller finances.

The components of forward selling consist of four components, which are:

- Cost (or first purchase price).
- Selling value (or selling price).
- The down payment (or the margin or the down payment in Murabaha sales).
- The financing amount is equal to the cost minus the down payment.

Determining the outcome of the swap process, whether it is profit or loss or without them (i.e. with capital) is a mathematical achievement because determining the buying and selling prices means showing the outcome of the swap process. Cost and profit, or sales price and profit, all of which achieve the same money.

Based on the foregoing, and based on the (Ohaj-Kantakji) model known as Mqam, we can study the policies of cash sales and forward sales depending on the cash flows resulting or expected from them, as the Mqam tracks the behavior of cash flows and draws alternative or lost investment opportunities or to be achieved if the management is well done. Investing that liquidity with the same behavior resulting from its first investment decision, at the very least. And all the equations are derived from the mentioned model (and explained in the previous chapters).

Equations derived from the search:

Mqam = [(Sales Price ÷ Basic Cost)^ ((1÷ (n+1))] - 1

Where (n = 1) if the transaction represents a cash sale, and (n) is greater than one in the case of forward financing, and in the forward sale, the cash sale return must be achieved as a minimum, equation (31).

$$MQAM = \left(\frac{SellPrice}{CostPrice}\right)^{\frac{1}{n+1}} - 1 \qquad (31)$$

Forward Sale Rate = (Mqam x 2) ÷ Financing period

$$ForwardSellingRate = \frac{2.MQAM}{FinancePeriod} \qquad (32)$$

The number (1) is added to equation (2) because it represents the cost, equation (33):

Modulus = [(Forward Selling Rate+1)^1+... +(Forward Selling Rate +1)^ (n-1)] +1

$$Parameter = \sum_{i=1}^{n-1}\left(ForwardSellingRate + 1\right)^{i} \qquad (33)$$

Cash Sale Amount = (Forward Sale Rate + 1)^N x Base Cost

This can be represented by equation (34) as follows:

$$CashAmount = (ForwardSaleRate + 1)^{n}\,.\,Cost \qquad (34)$$

Installment = Cash Sale Amount ÷ Coefficient

This can be represented by equation (35) as follows:

$$Installment = \frac{CashAmount}{Parameter} \qquad (35)$$

Total Installments = Installment x Finance Period

This can be represented by equation (36) as follows:

$$TotalInstallments = Installment \, . \, FinancePeriod \quad (36)$$

Net Cost = Total Premiums ÷ (Term Sale Rate +1)^(N+1)

This can be represented by equation (37) as follows:

$$NetCost = \frac{TotalInstallments}{(ForwardSaleRate + 1)^{(n+1)})} \quad (37)$$

Prepaid = Base Cost - Net Cost

This can be represented by equation (38) as follows:

$$DownPayment = Cost - NetCost \quad (38)$$

Example:

Suppose the purchase price of a machine is 4500, its cash sale price is 5000, and its financing period is five months if it is sold in installments; The bank wishes to study selling it in installments; To obtain a return similar to the cash return available in the market. What is required:

- determine the down payment,
- Installment Amount (Monthly Flow),
- The best financing amount.

The pricing on the basis of the shadow price is one of the entrances used in pricing policies, and in our case, the cash sale price represents the shadow price that you will be familiar with the pricing policy in our example.

First: The cash return on which the bank wishes to formulate its sales policy is calculated on the basis of:

Cash Sale Rate = Cash Sale Price ÷ Cost

Cash sale rate = 5000 ÷ 4500 = 11.11%

Mqam rate = [(5000 ÷ 4500)^(1÷2)] - 1 = 0.054093
Forward Selling Rate = (0.054093 x 2) ÷ 5 months = 0.02163 = 2.16%
We add the number (1) because it represents the cost:
Forward selling rate = 0.0216372 + 1 = 1.0216372
Modulus = [(1.0216372) + (1.0216372)^2 + (1.0216372)^3 + (1.0216372)^4] +1 = 5.221103
Cash sale price = (1,0216,372)^5 x 4,500 = 5008
Installment = 5008 ÷ 5.22103 = 959
The forward sale price or total installments = 959 x 5 = 4795
Net cost = 4795 ÷ (1.0216372)^(5 + 1) = 4217
Down payment = 4500 - 4217 = 283
Second: Installment sale calculation using Mqam directly:
After determining the installments, down payment and net cost, a Mqam can be applied to obtain the installment sale amount due:

$$MQAM = \left(\frac{CF_i}{C}\right)^{\frac{1}{(n+1)}} - 1$$

Whereas:
Cash Flow = Total Installments
Cost = Net Cost

$$MQAM = \left(\frac{4796.27}{4217.1}\right)^{\frac{1}{(6)}} - 1 = 0.02168015$$

Then the table of accounts is prepared, Table (18):

Table: 18 -

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DFC	CFp
1	1.02168015	959.254	938.899	20.355
2	1.04383032	959.254	918.976	40.278
3	1.06646071	959.254	899.475	40.779
4	1.08958174	959.254	880.388	78.866
5	1.11320403	959.254	861.706	97.548
		4796.27	4499.445	296.825

The discounted flow results from dividing the cash flow by the Mqam of the same period, which means that the cash flow of 959.25 is equal to the end of the first period 938.89 and at the end of the second period equals 918.97 and so on, and the discount rate is calculated based on the investment of the cash flow in calculated operating ratios of the cash flows for the studied period as an opportunity cost.

Therefore, the operating premium for the first period should be 20.355 and the second 40.278, while the total reinvested flows should equal 296.82.

Section Two
Comparison Between Spot & Forward Sale

We suppose that the financier is used to the money market price in drawing his pricing policy for the sale of installments, and he helps to achieve such a policy, and the following example illustrates the following[1]:

- A study of installment financing and cash sales, assuming that the cash sale process is repeated once during the financing period.
- A study of installment financing and cash sales, assuming that the cash sale process is repeated five times during the financing period.

Assuming the following data, Table (19):

Table: 19 -

Period	Paid	Down Payment	Cost	Sale Price
5	4220	280	4500	5000

The cost from the point of view of the financier is considered an outgoing cash flow, and since the advance payment will be paid by the financier, it represents an incoming cash flow to the financier; Accordingly, the net outflow of cash paid by the financier will be 4,220.

This will be discussed in the following cases:

First: Installment financing and repeating the cash sale process once during the financing period.

[1] View (Excel file 102)

Second: Installment financing and repeating the cash sale process five times during the financing period.

Then we will go through the case of selling in installments with or without down payment.

Installment financing and repeat cash sales once during the financing period

Installment case, represented by Table (20):

Table: 20 -

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.02151801	959	938.7989	20.20108
2	1.04349904	959	919.0234	39.97663
3	1.06595306	959	899.6644	59.33562
4	1.08889024	959	880.7132	78.28681
5	1.11232099	959	862.1612	96.83880
		4795	4500.3611	294.63895

The case of cash sale, represented by Table (21):

Table: 21 -

Units	Cost price	Sale Price
10	450	500
10	4500	5000

Based on the previous assumptions, Table (20) shows that the commodity sold in installments over (5) periods achieves a profit of:

4795 installments + 294 investment received + 280 (down payment) = 5369 total received

5369 - 4500 = 869 profit from one-time installment sale
While table (21) shows that the cash profit is:
5000 - 4500 = 500 profit from the one-time sale of the commodity for cash.

The result:

Installment sale is more profitable in terms of return; If the bank is able to increase the sale price of the installment - if market conditions allow it to increase - then the installment will be more beneficial. It is possible to compare the ratios of the profit of cash and forward sales to make a comparison between them:

Installment sale rate of return = (5369 - 4500) ÷ 4500 = 19.30%

So, the rate of return of the profit of the cash sale when the capital turns once is 11.11%, and from it we conclude that this rate will be double that when turning twice, and therefore it is in the interest of the bank to implement two installment sales (approximately) for one cash sale.

The decision will differ as to whether the pricing policy is based on the construction of the forward selling price without consulting the cash selling prices prevailing in the market, and this happens in conditions other than perfect or perfect competition market; This is when market conditions allow the seller to formulate his pricing policies with the power of a monopoly or a quasi-monopoly.

Installment financing and repeating the cash sale process five times during the financing period

Installment status, summarized in table (22):

Table: 22 -

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.11111111	1175	1057.5000	117.5000
2	1.23456790	1175	951.7500	223.2500
3	1.37174211	1175	856.5750	318.4250
4	1.52415790	1175	770.9175	404.0825
5	1.69350878	1175	693.8258	481.1743
		5875	4330.5683	1544.4318

The case of cash sale, summarized in Table (23):

Table: 23 -

No.	Units	Cost price	Sale Price
	10	450	500
1	10	4500	5000
2	11.1111111	5000	5555.5556
3	12.3456790	5555.555556	6172.8395
4	13.7174211	6172.839506	6858.7106
5	15.2415790	6858.710562	7620.7895

Table (22) is built on the basis of reinvesting the amount and its cumulative profit.

Based on the previous assumptions, table (24) shows that the profit of the commodity sold in installments over (5) periods is:

Table 24 -

installments	5875
Invest what has been received	1544
Down Paiment	280
Total Receivable	7699

7699 - 4500 = 3199 the profit realized from the case of the installment sale.

While Table (20) shows that the cash profit is:

7620 - 4500 = 3120 in the case of selling the commodity five times for cash.

The result:

That if the cash sale turnover increases to five times in the study period, the installment sale price must rise to 1175 so that it can be considered preferred; This depends on market conditions and condition.

Sale in installments with or without down payment

Assuming that the data of the previous example is repeated, it is required to help the bank in differentiating between the following two options:

1. Request an advance payment of 280 with a monthly installment of 960.
2. Financing the entire process in return for a monthly installment of 1000.

Solution: The following tables (25 and 26) show the solution data[1]:

Table: 25 -

4500	Cost
280	Down Payment

First Choice

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.0216955	960	939.6146	20.3853
2	1.0438616	960	919.6621	40.3378
3	1.0665087	960	900.1333	59.8666
4	1.0896471	960	881.0192	78.9807
5	1.1132875	960	862.3109	97.6890
		4800	4502.7402	297.2597

Table: 26 -

4500	Cost
0	Down Payment

Second Choice

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.0177152	1000	982.5931	17.4068061
2	1.0357442	1000	965.4893	34.5106154
3	1.0540926	1000	948.6832	51.3167019
4	1.0727660	1000	932.1697	67.8302482
5	1.0917702	1000	915.9436	84.0563464
		5000	4744.8792	255.1207181

To improve the comparison, we will calculate the internal

[1] View (Excel file 101)

rate of return (IRR) and the rate of return on investment (ROI). Table (27) summarizes the results as follows:

Table: 27 -

Second Choice		First Choice	
ROI	IRR	ROI	IRR
	- 4500		- 4220
	1000		960
	1000		960
	1000		960
	1000		960
	1000		960
%11.11	%3.62	%7.11	%4.45

The results of tables (24, 25 and 26) can be grouped into the following table, table (28):

Table: 28 -

Statement	Choice 1	Choice 2
ROI	7.11%	☑ 11.11%
IRR	☑ 4.45%	3.62%
MQAM	☑ 2.16%	1.77%

- Choosing on the basis of the internal rate of return means that the bank prefers the *first option*.
- Choosing on the basis of a Mqam rate means that the bank will prefer the *first option*.
- Choosing on the basis of the rate of return on investment means that the bank will prefer the *second option*.

So the first option is the best solution in terms of internal rates of return and Mqam; That is, a forward sale (whether in installments or not) with an down payment is better than without a down payment; Because the down payment reduces the amount of financing.

Note: The down payment has been subtracted from the cost in all rate calculations.

Example:

Suppose that a property has a purchase cost of 1,500,000 and its market price is 1,567620, and a bank wants to sell it in installments for a period of 60 months. A detailed account statement is required using a Mqam to make the right investment decision.

Solution method:

We will use the studied case data in making the initial calculations in preparation for calculating the Mqam, and then we will develop a table of detailed calculations.

We divide the selling price by the cost price within the following equation from the equations of the (Ohaj - Kantakji) model in order to build on it the calculations that will follow.

Mqam = ({(Selling Price ÷ Cost)^1÷2} -1) x (2 ÷ Cost Price)

Mqam= ((1567620÷1500000)^1÷2-1)×(2 ÷1500000) = 1.0007431

Then we calculate the Mqam sequence by raising the following years as a cup for the Mqam of the first year[1].

By multiplying the Mqam of the year (n) by the cost, we are in front of the total amount after investing its monthly payments.

Total Amount after Investment = Mqam of the year (n) x cost

Total amount after investment = 1.0007431 x 1500000 = 1568361.8

Coefficient = (Sum of Mqam for years (1)... (n - 1)) + 1

And by dividing the total amount after investment by the coefficient, we get the due premium.

Monthly Installment = 1568361.8 ÷ 61.3342965 = 25570.71

Total installments = 25570.71 x 60 months = 1534242.89

To arrive at the financing value, we divide the total installments by the Mqam of the entire period:

$MQAM^{(n+1)}$

Total Financing Amount = Total Installments ÷ Mqam^(N+1)

Total Financing Amount = 1534242.89 ÷ 1.0463515 = 1466278.73

Down Payment = Cost - Finance Amount

Down payment = 1,500,000 - 1,466,278.73 = 3,3721.26

Then we can prepare detailed accounts tables (Table 29) to enable the decision maker to study the cases of the model by changing its basic variables to be his negotiation tool as

[1] View (Excel file 104)

market conditions allow. In order to rationalize the investment decision.

The bank is advised (in our example) to take a down payment of 33721 so the amount it will pay is: 150,000 - 33721 = 1466,279.

The decision maker can improve his solution by improving his returns by negotiating with his client to raise the value of the monthly installment or the advance payment if that is possible.

Institutions with central administration in making their decisions can use the outputs of the model within their (automated) information system to be in front of institutional work that strays away from subjective decisions, as well as personal bias; due to compliance with the controls of the automated information system; This enhances the application of governance and reduces the waiting lines experienced by the credit departments in those departments; Because of her central decision-making style.

Table: 29 -

Year	Mqam	Cashflow	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.00074305	25,571	25,551.7286	18.9862
2	1.00148666	25,571	25,532.7564	37.9584
3	1.00223081	25,571	25,513.7984	56.9165
4	1.00297552	25,571	25,494.8544	75.8605
5	1.00372078	25,571	25,475.9245	94.7904

6	1.00446660	25,571	25,457.0086	113.7062
7	1.00521297	25,571	25,438.1068	132.6081
8	1.00595989	25,571	25,419.2190	151.4959
9	1.00670737	25,571	25,400.3452	170.3696
10	1.00745541	25,571	25,381.4855	189.2294
11	1.00820400	25,571	25,362.6397	208.0751
12	1.00895315	25,571	25,343.8080	226.9069
13	1.00970285	25,571	25,324.9902	245.7246
14	1.01045311	25,571	25,306.1864	264.5284
15	1.01120393	25,571	25,287.3966	283.3183
16	1.01195531	25,571	25,268.6207	302.0942
17	1.01270724	25,571	25,249.8587	320.8561
18	1.01345974	25,571	25,231.1107	339.6041
19	1.01421279	25,571	25,212.3766	358.3382
20	1.01496640	25,571	25,193.6565	377.0584
21	1.01572057	25,571	25,174.9502	395.7647
22	1.01647531	25,571	25,156.2578	414.4571
23	1.01723060	25,571	25,137.5793	433.1356
24	1.01798646	25,571	25,118.9146	451.8002
25	1.01874287	25,571	25,100.2638	470.4510
26	1.01949985	25,571	25,081.6269	489.0880
27	1.02025739	25,571	25,063.0038	507.7111
28	1.02101549	25,571	25,044.3945	526.3203
29	1.02177416	25,571	25,025.7991	544.9158
30	1.02253339	25,571	25,007.2174	563.4974
31	1.02329319	25,571	24,988.6496	582.0653
32	1.02405355	25,571	24,970.0955	600.6194
33	1.02481447	25,571	24,951.5552	619.1596

34	1.02557596	25,571	24,933.0287	637.6862
35	1.02633802	25,571	24,914.5159	656.1989
36	1.02710064	25,571	24,896.0169	674.6980
37	1.02786383	25,571	24,877.5316	693.1832
38	1.02862758	25,571	24,859.0600	711.6548
39	1.02939191	25,571	24,840.6022	730.1126
40	1.03015680	25,571	24,822.1581	748.5568
41	1.03092226	25,571	24,803.7276	766.9872
42	1.03168829	25,571	24,785.3109	785.4040
43	1.03245488	25,571	24,766.9078	803.8071
44	1.03322205	25,571	24,748.5183	822.1965
45	1.03398979	25,571	24,730.1426	840.5723
46	1.03475809	25,571	24,711.7805	858.9344
47	1.03552697	25,571	24,693.4320	877.2829
48	1.03629642	25,571	24,675.0971	895.6178
49	1.03706644	25,571	24,656.7758	913.9390
50	1.03783704	25,571	24,638.4682	932.2467
51	1.03860820	25,571	24,620.1741	950.5407
52	1.03937994	25,571	24,601.8937	968.8212
53	1.04015226	25,571	24,583.6268	987.0881
54	1.04092514	25,571	24,565.3734	1,005.3414
55	1.04169860	25,571	24,547.1336	1,023.5812
56	1.04247264	25,571	24,528.9074	1,041.8074
57	1.04324725	25,571	24,510.6947	1,060.0202
58	1.04402244	25,571	24,492.4955	1,078.2193
59	1.04479820	25,571	24,474.3098	1,096.4050
60	1.04557454	25,571	24,456.1377	1,114.5772
		1,534,243	1,500,000.0000	34,242.8909

Section Three
Comparison for Choosing Optimal Selling Price

Suppose a property costs 1,500,000 and the owners want to comparison its selling price to make the best option. The displayed prices were as follows, Table (30):

Table: 30 -

Cash Sale Price	Forward Selling Price
2000000	2003200
1800000	1812102
1750000	1762371
2200000	2183265

The third option, which is forward selling, is initially considered to be the best among the previous offers due to it achieving the largest return according to table (31).

Table: 31 -

Cash Sale Price	Forward Selling Price	The Formalism Return Difference
2000000	2003200	3200
1800000	1812102	12102
1750000	1762371	12371
2200000	2183265	(16735)

The solution using a Maqm[1] is summarized by the

[1] View (Excel file 105: page without down payment)

following matrix of results (Table 32) after compensating the forward selling price for each case[1].

Table: 32 -

Period	Cash Sale Price	Forward Selling Price	Cash Sale Profit	Forward Selling Profit
1	2,000,000	2,003,200	500,000	768014
2	1,800,000	1,812,102	300,000	473512
3	1,750,000	1,762,371	250,000	397399
4	2,200,000	2,183,265	700,000	1048157

The cash gain results from subtracting the cost 1,500,000 from the quoted cash sale price. As for the forward sale profit, it results from the sum of the investment of the collected premiums and the increase in the forward selling price over its cost[2].

The result:

That the fourth case, which is the decision to sell in installments, is the best.

As for the solution using the Mqam[3] and the summary in Table (33), it is as follows:

Table: 33 -

Period	Cash Sale Price	Forward Selling Price	Cash Sale Profit	Forward Selling Profit	Down Payment for Solution Improvement
1	2,000,000	2,003,20	500,000	537,12	237,597
2	1,800,000	1,812,12	300,000	336,76	155,652

[1] View (the referenced excel file)

[2] See (Excel file, cell G19)

[3] View (Excel file 105: page with cash payment)

3	1,750,000	1,762,31	250,000	283,87	132,805
4	2,200,000	2,183,25	700,000	722,51	307,329

It is noticed that the forward profit decreased by 69%, although it remains the largest profit that can be achieved in return for the financier receiving an advance payment, and this improves his liquidity to increase the cash inflow for him. As for the comparison between achieving a greater profit or obtaining a greater cash flow, it is the responsibility of the decision maker, according to the financial position of his institution and its efficiency.

Section Four
Comparison for Choosing Optimal Investment Period

Assuming a machine whose selling price is 54575 and its purchase cost is 37,000, a bank wants to sell it on a forward basis for periods of 10, 8 or 4 years and wants to make a comparison between those decisions.

Table (34) summarizes the results[1] of the solution as the cash flows were distributed over the selected investment periods.

Result: It is noted that the return ratios are almost identical.

Table: 34 -

Investment Period	Profit	Return Ratio
10	26,981.8989	49.44%
8	26,993.3627	49.46%
4	27,043.78	49.55%

But if the bank wishes to maintain the equal value of the installment and collect the rest by increasing the last installment, the results of table (35) summarize the results as follows[2]:

[1] View (Excel 106 file)

[2] View (Excel file 107)

Table: 35 -

Investment Period	Profit	Return Ratio
10	26,981.8989	49.44%
8	28,301.9820	51.86%
4	30,116.91	55.18%

The result:

It is noted that the rates of return for the shorter periods are greater to converge the cash flow more. Therefore, it can be said that the more a financial institution can shorten the financing period, the more it improves its liquidity and increases its returns, or at least maintains them.

Session Five
Determining Down Payment in Terms of Market Prices

The cost of financing decreases whenever the financier increases the down payment (or the one who provides the seriousness or the margin of the seriousness), but he cannot increase it at all, otherwise the sale would be in cash, and placing the down payment arbitrarily or randomly harms the institutional work, especially in light of central decisions.

The mathematical solution considering the market conditions or the prevailing price level provides the most appropriate solution and helps in determining the size of the down payment or the margin of seriousness in an economical way.

Suppose a client desires a lease-to-own for fifteen years; How does the bank determine the value of the offer of seriousness? Although the cost of the property is 1,500,000 and the current market price for annual rent is 120,000[1]:

After preparing the initial accounts, the following table can be prepared, Table (36):

Table: 36 -

Period	Cash Sale Price	Forward Selling Price	Cash Sale Profit	Forward Selling Profit
n	MQAM	CF	DCF	CFp

[1] View (Excel 109)

1	1.0127262	120,000	118,492.0681	1,507.9319
2	1.0256138	120,000	117,003.0851	2,996.9149
3	1.0386656	120,000	115,532.8127	4,467.1873
4	1.0518844	120,000	114,081.0160	5,918.9840
5	1.0652703	120,000	112,647.4626	7,352.5374
6	1.0788268	120,000	111,231.9235	8,768.0765
7	1.0925565	120,000	109,834.1721	10,165.8279
8	1.1064603	120,000	108,453.9850	11,546.0150
9	1.1205406	120,000	107,091.1415	12,908.8585
10	1.1348008	120,000	105,745.4236	14,254.5764
11	1.1492428	120,000	104,416.6162	15,583.3838
12	1.1638675	120,000	103,104.5066	16,895.4934
13	1.1786795	120,000	101,808.8852	18,191.1148
14	1.1936784	120,000	100,529.5447	19,470.4553
15	1.2088691	120,000	99,266.2805	20,733.7195
		1,800,000	1,629,238.35	170,761.0765

The table shows that the realized profit is 470,761 without down payment based on 120,000 monthly installments. If we applied the results of the initial calculations to the table, the monthly installment would be 110,481 and the realized profit would be 324079 with a down payment of 146246 at a rate of 9.76% of the cost; We therefore find that the rate of profit is directly proportional to the cash flow.

If the client wishes to own the property after five years; How does the bank determine the seriousness?

It is assuming that the property cost 500,000 and the current market price for annual rent is 120,000. The following table (37) can be constructed:

Table: 37 -

Period	Cash Sale Price	Forward Selling Price	Cash Sale Profit	Forward Selling Profit
n	MQAM	CF	DCF	CFp
1	1.0381785	120,000	115,587.110	4,412.8900
2	1.0256138	120,000	117,003.081	2,996.9149
3	1.0386656	120,000	115,532.817	4,467.1873
4	1.0518844	120,000	114,081.010	5,918.9840
5	1.0652703	120,000	112,647.466	7,352.5374
		600,000	574,851.484	25,148.5136

The table shows that the realized profit is 125,148 without down payment, with a monthly installment of 120000. By applying the results of the preliminary calculations to the table, the monthly installment becomes 103337 and the realized profit is 122556, with a forward payment of 87,336 at a rate of 17.47% of the cost.

Section Six
Comparison of Two Annual Financings & More Than One Year

CASE OF CASH FLOW VARIANCE

Assuming that a project whose capital is in pounds $C = 1200$, will be liquidated annually $n = 1$, or after five years $n = 5$, and the same different cash flows CF in both cases; So what filters do you recommend using a Mqam model?

The first case: We apply the Mqam equation (8) for one-year flows, and to calculate the minimum rate of return we use equation (9), table (38):

Table: 38 -

Statement	n	Cash Flow CF	Discount rate per annum R	Operating Profit Share1	Reinvestment Profit Share2
Annual return + Capital	1	1,800	1.2247	1,469.6938	
Annual return + Capital	1	3,600	1.7320	2,078.4609	
Annual return + Capital	1	2,400	1.4142	1,697.0562	
Annual return + Capital	1	3,600	1.7320	2,078.4609	
Annual return + Capital	1	3,300	1.6583	1,989.9748	
Total				9,313.6469	
Total after deducting the calculated capital		14,700		4,513.6469	10186.6

According to equation (8), the annual discount rate is equivalent to:

$$R = \sum_{i=1}^{n} \left(\frac{CF}{C}\right)^{\frac{1}{i+1}}$$

$$R_1 = \sum_{i=1}^{5} \left(\frac{1800}{1200}\right)^{\frac{1}{2}} = 1.2247$$

$$R_2 = \sum_{i=1}^{5} \left(\frac{3600}{1200}\right)^{\frac{1}{2}} = 1.7320$$

$$R_3 = \sum_{i=1}^{5} \left(\frac{2400}{1200}\right)^{\frac{1}{2}} = 1.4142$$

$$R_4 = \sum_{i=1}^{5} \left(\frac{3600}{1200}\right)^{\frac{1}{2}} = 1.7320$$

$$R_5 = \sum_{i=1}^{5} \left(\frac{1200}{1200}\right)^{\frac{1}{2}} = 1.6583$$

According to equation (9), the Mqam for each year is equal to:

$$R = \sum_{i=1}^{n} \left(\frac{CF}{C}\right)^{\frac{1}{i+1}}$$

$$R_1 = \left(\frac{3600}{1200}\right)^{\frac{1}{2}} - 1 = 0.7320$$

$$R_2 = \left(\frac{3600}{1200}\right)^{\frac{1}{2}} - 1 = 0.7320$$

$$R_3 = \left(\frac{2400}{1200}\right)^{\frac{1}{2}} - 1 = 0.4124$$

$$R_4 = \left(\frac{3600}{1200}\right)^{\frac{1}{2}} - 1 = 0.7320$$

$$R_5 = \left(\frac{3300}{1200}\right)^{\frac{1}{2}} - 1 = 0.6583$$

To calculate the operating profit, we apply equation (10) as follows:

$$Share_1 = \sum_{i=0}^{n} \frac{CF_i}{R_i} = 9.3136469$$

Excluding the calculated capital[1] (Corresponding to 4 years x 1200), the net operating profit is:

$$Profits_i = 9313.6 - 4800 = 4513.6$$

The second case, table (39):

Table: 39 -

Statment	n	Cash Flow CF	Five-year discount rate R	$Share_1$ بعد n	$Share_2$
Return after 5 years + capital	5	1,800	1.5182	1,185.5407	
Return after 5 years + capital	5	3,600	2.30521	1,561.6743	
Return after 5 years + capital	5	2,400	3.50000	685.7142	
Return after 5 years + capital	5	3,600	5.31403	677.4518	
Return after 5 years + capital	5	3,300	8.06826	409.0099	
Total		14,700		4,519.3911	9280.61

The second case assumes that the target return Mqam = 51.82%, and according to equation (4) the annual discount rate is:

$$R = \left(\frac{\sum_{i=1}^{n} CF_i}{C}\right)^{\frac{1}{n+1}}$$

$$R = \left(\frac{\sum_{i=1}^{5} 14700}{1200}\right)^{\frac{1}{6}} = 1.5182$$

[1] The nominal capital is 1200 Pounds x 4 years = 4800 liras; That is, the equivalent of one year's capital remained.

Therefore, the Mqam according to equation (7):

$$MQAM = 1 - R = 0.5182$$

The operating profit is according to equation (10):

$$Share_1 = \sum_{i=0}^{n} \frac{CF_i}{R_i} = 4519.3911$$

The result in the case of different cash flows:

Operating profit: by comparing $Share_1$ the first case and the second case, it becomes clear that the second case is better; No liquidation after five years.

Reinvestment profits: By comparing $Share_2$ the first case and the second case, it becomes clear that the first case is better, i.e. the annual liquidation, where the difference is: 10186 - 9280 = 905

THE CASE OF SYMMETRY OF EQUAL FLOWS

Assuming that a project whose capital is $C = 1200$ in pounds, will be liquidated annually $n = 1$, or after five years $n = 5$, and the same different cash flows CF in both cases; So what filters do you recommend using a Mqam model?

The first case, table (40):

Table: 40 -

Statment	n	Cash Flow CF	Five-year discount rate R	$Share_1$	$Share_2$
Return after 5 years + capital	1	3,731	1.7632	2,115.9395	
Return after 5 years + capital	1	3,731	1.7632	2,115.9395	
Return after 5 years + capital	1	3,731	1.7632	2,115.9395	
Return after 5 years + capital	1	3,731	1.7632	2,115.9395	

Return after 5 years + capital	1	3,731	1.7632	2,115.9395	
Total				10,579.6975	
Total after deducting the calculated capital		18,655		5,779.6975	12,875

The second case, table (41):

Table: 41 -

Statment	n	Cash Flow CF	Five-year discount rate R	$Share_1$	$Share_2$
Return after 5 years + capital	5	3,731	1.3076	2,853.1870	
Return after 5 years + capital	5	3,731	1.7099	2,181.9020	
Return after 5 years + capital	5	3,731	2.2360	1,668.5539	
Return after 5 years + capital	5	3,731	2.9240	1,275.9840	
Return after 5 years + capital	5	3,731	3.8236	975.7762	
Total		18,655		8,955.4033	9,700

The result in the case of equal cash flows:

Operating profit: By comparing $Share_1$ the first case and the second case, it turns out that the second case is better, i.e. liquidation after five years, where the difference is: 8955 - 5779 = 3176

Reinvestment profits: by comparing $Share_2$ in the first case and in the second case, it becomes clear that the first case is better, i.e. the annual liquidation, where the difference is equal to: 12875 - 9700 = 3175

CASE OF INCREASED FLOWS

Assuming that a project whose capital is in $C = 1200$ pounds, will be liquidated annually $n = 1$, or after five years $n = 5$, and the upwardly increasing cash flows CF are the same in both cases; So what filters do you recommend using a Mqam model?

The first case, table (42):

Table: 42 -

Statment	n	Cash Flow CF	Five-year discount rate R	Share₁	Share₂
Return after 5 years + capital	1	1,200	1.0000	1,200.0000	
Return after 5 years + capital	1	2,400	1.4141	1,697.0562	
Return after 5 years + capital	1	3,600	1.7320	2,078.4609	
Return after 5 years + capital	1	4,800	2.0000	2,400.0000	
Return after 5 years + capital	1	5,000	2.0412	2,449.4897	
Total				9,825.0069	
Total after deducting the calculated capital		17,000		5,025.0069	11,975

The second case, table (43):

Table: 43 -

Statment	n	Cash Flow CF	Five-year discount rate R	Share₁	Share₂
Return after 5 years + capital	5	1,200	1.5555	771.4420	
Return after 5 years + capital	5	2,400	2.4196	991.8713	
Return after 5 years + capital	5	3,600	3.7638	956.4640	
Return after 5 years + capital	5	4,800	5.8547	819.8406	
Return after 5 years + capital	5	5,000	9.10730	549.0100	
Total		17,000		4,088.6281	12,12911

The result in the case of increased cash flows:

Operating profit: By comparing $Share_1$ in the first case and in the second case, it turns out that the first case is better, i.e. the annual liquidation, where the difference is equal to: 5025 - 4088 = | 937 |

Reinvestment Profits: By comparing $Share_2$ in the first case and in the second case, it becomes clear that the second case is better, i.e. liquidation after five years, where the difference is equal to: 11975 - 12911 = | 936 |

The case of diminishing flows

Assuming that a project whose capital is $C = 1200$ in pounds, will be liquidated annually $n = 1$, or after five years $n = 5$, and the decreasing cash flows CF will be the same in both cases; So what filters do you recommend using a Mqam model?

The first case, table (44):

Table: 44 -

Statment	n	Cash Flow CF	Five-year discount rate R	$Share_1$	$Share_2$
Return after 5 years + capital	1	5,000	2.0412	2,449.4897	
Return after 5 years + capital	1	4,800	2.0000	2,400.0000	
Return after 5 years + capital	1	3,600	1.73205	2,078.4609	
Return after 5 years + capital	1	2,400	1.4142	1,697.0562	
Return after 5 years + capital	1	1,200	1.0000	1,200.0000	
Total				9,825.0069	
Total after deducting the calculated capital		17,000		5,025.0069	11,975

The second case, table (45):

Table: 45 -

Statment	n	Cash Flow CF	Five-year discount rate R	$Share_1$	$Share_2$
Return after 5 years + capital	5	5,000	1.5555	3,214.3418	
Return after 5 years + capital	5	4,800	2.4196	1,983.7427	
Return after 5 years + capital	5	3,600	3.7638	956.4640	
Return after 5 years + capital	5	2,400	5.8547	409.9203	
Return after 5 years + capital	5	1,200	9.1073	131.7624	
Total		17,000		6,696.2313	10,304

The result in the case of diminishing cash flows:

Operating profit: By comparing $Share_1$ the first case and the second case, it turns out that the second case is better, i.e. liquidation after five years, where the difference is: 6696 - 5025 = 1671

Reinvestment profits: By comparing $Share_2$ in the first case and in the second case, it becomes clear that the first case is better, i.e. the annual liquidation, where the difference is equal to: 11975 - 10304 = 1671

Table (46) depicts the results: cash flow form

Table: 46 -

cash flow form	filter shape	$Share_1$	$Sahre_2$
Different	Annual	4513	10186
	After n year	4519	9280
Equal	Annual	5779	12875
	After n year	8955	9700
Increase	Annual	5025	11975
	After n year	4088	12911

Decrease	Annual	5025	11975
	After n year	6696	10304

The table shows that operating profits are better in cases of liquidation at the end of the investment period in cases of different, equal and diminishing flows, while reinvestment profits are best in cases of annual liquidation with the same mentioned flows. Whereas the preferential solution is inverse in the case of increased cash flows.

Therefore, in the case of increased flows, the focus should be on reinvested profits, while the focus should be on operating profits in case the flows are equal or diminishing.

Section Seven
Calculating Reward for Early Payment Using Mqam

Dubai Islamic Bank adopts a special policy in calculating early settlement bonus procedures. The terms of the bank's credit policy are summarized as follows:

- The number of unpaid installments is 13, and the remaining profits after deduction of 6 months are less than one thousand Dirhams, and in this case (there is due) the scheduled early payment bonus.
- The number of installments not due for 10 months, and the remaining profits after deducting 6 months is more than one thousand Dirhams, and in this case (there is due) the scheduled early payment reward.
- No profits are calculated for the month in which the application is submitted.
- Unpaid installments are those whose due date has not yet come, and it depends on the date of the installments recorded in the Murabaha contract.
- Late installments: its checks were returned from the bank because of the customer.

Example:

On 25/11/2002, a customer submitted a service request to pay the vehicle's Murabaha in full, and the Murabaha details were as follows: Murabaha total on the date of contracting 171,600 Dirhams.

- The Murabaha balance on the order date is 128,700 Dirhams.
- Total profits 28,600 Dirhams.
- The number of Murabaha installments is 48 monthly installments.
- The remaining installments are 36 monthly installments.
- Regular in the payment of installments to be paid on the same due dates.
- He does not have forward installments or arrears for other Murabahas.
- The Murabaha contract was held on 11/1/2001.
- The Murabaha was paid on 27/11/2002.

Calculation of Remaining Earnings:

- The profits of the month of 11/2002 are not included in the remaining profits.
- Deduction of 6-month profits as follows:
  (1) Earnings: 1 month 12/2002
  (2) Dividends: 5 months of 2003 profits
- The 2003 profit of 7,150 dirhams is divided into 12 months.
- Each month's share of profits 7150 ÷ 12 = 595.83 Dirhams to deduct 5 months of the profits of the year 2003.
- Profits of 5 months from the profits of the year 2003 = 595.83 x 5 = 2,979 Dirhams.
- Remaining profits from 2003 = 7150 - 2979 = 4171 Dirhams.

- The remaining profits, from which the customer will be awarded a reward, are:
  The remainder of: 2003 profits are 7,150 Dirhams
  The profits for the year 2004 are 7,150 Dirhams
  The profits for the year 2005 are 5,958 Dirhams
  Total Remaining Profit 17,279 AED
- The reward to be given to the customer is 17,279 x 95% = 16,415 Dirhams
- Pay the balance after deducting the bonus: 128700 - 16415 = 112285 Dirhams.

The solution in a Mqam way[1]:

If the selling price is 128,600 Dirhams and the profit is 28,600 Dirhams, then the cost price is 143,000 Dirhams; Table (47) shows the following:

Table: 47 -

Period	Mqam	Cash Flows	Cash flow after discount	Return on investment
n	MQAM	CF	DCF	CFp
1	1.003	3,575	3,561.7227	13.2773
2	1.0074	3,575	3,548.4947	26.5053
3	1.0112	3,575	3,535.3158	39.6842
4	1.0149	3,575	3,522.1859	52.8141
5	1.0187	3,575	3,509.1047	65.8953
6	1.0225	3,575	3,496.0721	78.9279
7	1.0263	3,575	3,483.0879	91.9121
8	1.0302	3,575	3,470.1520	104.8480

[1] يُنظر (ملف الإكسل 111)

9	1.0340	3,575	3,457.2641	117.7359
10	1.0379	3,575	3,444.4240	130.5760
11	1.0417	3,575	3,431.6316	143.3684
12	1.0456	3,575	3,418.8868	156.1132
13	1.0495	3,575	3,406.1893	168.8107
14	1.0534	3,575	3,393.5389	181.4611
15	1.0573	3,575	3,380.9355	194.0645
16	1.0613	3,575	3,368.3790	206.6210
17	1.0652	3,575	3,355.8690	219.1310
18	1.0692	3,575	3,343.4055	231.5945
19	1.0732	3,575	3,330.9884	244.0116
20	1.0772	3,575	3,318.6173	256.3827
21	1.0812	3,575	3,306.2922	268.7078
22	1.0853	3,575	3,294.0128	280.9872
23	1.0893	3,575	3,281.7791	293.2209
24	1.0934	3,575	3,269.5907	305.4093
25	1.0974	3,575	3,257.4477	317.5523
26	1.1015	3,575	3,245.3498	329.6502
27	1.1056	3,575	3,233.2967	341.7033
28	1.1098	3,575	3,221.2885	353.7115
29	1.1139	3,575	3,209.3248	365.6752
30	1.1180	3,575	3,197.4056	377.5944
31	1.1222	3,575	3,185.5307	389.4693
32	1.1264	3,575	3,173.6998	401.3002
33	1.1306	3,575	3,161.9129	413.0871
34	1.1348	3,575	3,150.1698	424.8302
35	1.1390	3,575	3,138.4702	436.5298
36	1.1433	3,575	3,126.8142	448.1858

37	1.1475	3,575	3,115.2014	459.7986
38	1.1518	3,575	3,103.6317	471.3683
39	1.1561	3,575	3,092.1050	482.8950
40	1.1604	3,575	3,080.6212	494.3788
41	1.1648	3,575	3,069.1799	505.8201
42	1.1691	3,575	3,057.7812	517.2188
43	1.1735	3,575	3,046.4248	528.5752
44	1.1778	3,575	3,035.1106	539.8894
45	1.1822	3,575	3,023.8384	551.1616
46	1.1866	3,575	3,012.6080	562.3920
47	1.1911	3,575	3,001.4194	573.5806
48	1.1955	3,575	2,990.2723	584.7277
		171,600	156,856.8445	14,743.1555

The solution in the way of Dubai Islamic Bank in application of its credit policy is:

128,700 (total remaining premiums) - 16,415 (bonus) = 112285

The solution in a Mqam method is:

128,700 (Total Remaining Premium) - 13721 (Total Return on Investment) = 114,979

Assuming that the client applied in the middle of the period, i.e. in the 24th month, the solution would be as follows:

Dubai Islamic Bank method:

85,800 (total remaining premiums) - 10,530 (bonus) = **75,270**

The solution is in a Mqam method:

85,800 (Total Remaining Premium) - 10871 (Total Return on Investment) = 74929

We believe that the Mqam method is easier, more accurate and more objective because it gives the bank the profits (ie the return resulting from investing the cash flows) as it represents a missed opportunity for the client's request to liquidate the Murabaha on a date to be determined.

Section Eighth
Comparison in Decision-Making & Equilibrium Point of Cost Financing

Later, we will discuss the pricing of liquidity using a Mqam at the aggregate level, and the way we will present it depends on a Mqam as well, where we will set a fair price for financing between the financier and the financier as a negotiating point between them. This will be assuming that the cash flow is the only variable, then we will search for the monthly rate of return using the experimental method, leading to the development of measuring equations that achieve the intended goal.

Monthly Rate of Return = [Annual Cash Flow ÷ (Finance Amount + Finance Cost)]^$^{(1 \div \text{Period})}$

Whereas, the amount of financing is what the financier will pay and is equivalent to the cost of purchasing the asset that is the subject of the financing. As for the cost of financing, it is what the financier will add of profit and the like to his cost in order to determine its selling price to the financier.

By rearranging the previous equation to determine the cost of financing in terms of return, it becomes as follows[1]:

Finance Cost = (Annual Cash Flow - Finance Amount x Rate of Return^$^{\text{Period}}$) ÷ Rate of Return^$^{\text{Period}}$

[1] View (Excel file 112)

Example:

A machine that financed a 12-month Murabaha amount of 100 pounds and the annual cash flow was 300 pounds. It is required to determine the cost at which the customer's internal rate of return is achieved using a Mqam by calculating:

1. Annual financing cost.
2. Murabaha monthly rate of return.

The solution:

Finance cost = (300 - 100 x 1.043^12) ÷ 1.043^12 = 73.55

Rate of return = [300 ÷ (100 + 73.55)]^(1/12) = 1.043

Verify the fairness of pricing with a Mqam:

Funder's Monthly Rate of Return = [(Annual Cash Flow ÷ (Finance Amount + Financing Cost))]$^{[1/(N+1)]}$

The financier's monthly rate of return = [(300÷ (100 + 73.55)^(1÷13) = 1.043 i.e. Mqam = 4.3%

Financier's Monthly Rate of Return = [(((Finance Amount + Finance Cost) ÷ Finance Amount)]$^{[1/(n+1)]]}$

The financier's monthly rate of return = [(100 + 73.55) ÷ 100]^(1 ÷ 13) = 1.043, meaning that the Mqam = 4.3%

Accordingly, if the financier adds 73.55 as a monthly profit or adds a rate of 4.3%, then it is the point of balance between him and the financier.

Example:

A client offers to purchase a machine that costs 20,000 Murabaha for 12 months, with a serious margin of 40%, with a Murabaha of 1300 Pounds. The financial study of the customer shows that his annual cash flow is 14740. It is required to determine the cost at which the customer's internal rate of return is achieved using a Mqam by calculating:

1. Annual financing cost.
2. Murabaha monthly rate of return.

The solution:

Finance cost = (14740 - 12000 x 1.0079^12) ÷ 1.0079^12 = 1306

Rate of return = [14740 ÷ (12000+1300)]^(1/12) = 1.0079

Verify the fairness of pricing with a Mqam:

The financier's monthly rate of return = [(14740÷ (12000 + 1300)^(1÷13) = 1.0079, meaning that the Mqam = 0.79%

The financier's monthly rate of return = [(12,000 + 1300) ÷ 12000]^(1 ÷ 13) = 1.0079, meaning that the Mqam = 0.80%

If the financier adds 1300 as a monthly profit or adds a rate of 0.79%, it is the balancing point between him and the financier.

Section Nine
Comparison Between the NPV & Mqam

The net present value[1] is the equivalent value in the present time for a group of sums of money that will be paid in different periods in the future, and a Mqam shares with the net present value that they take into account the expected cash flows in the differentiation between projects or between investment decisions to choose a project or to rationalize a decision through the profitability criterion. For cash flows. They differ in that the net present value is taken as the time value of money through the specified interest rate, while the Mqam of the lost opportunity from investing the cash flows received (if not invested) is considered through a Mqam for the same period; Therefore, we find a shrine that is more related to reality and the studied case, and it can be considered more suitable for Islamic financial engineering to avoid usury and its tools.

Example:

Suppose the financial manager is faced with a decision to purchase a machine, and he has three offers, Table (48):

Table: 48 -

Annual Cash Flow	The initial cost	Machine life / year
2,000	6,075	4
2,292	7,000	4
2,370	7,200	4

[1] Ct cash flow for each of the years r annual interest rate: t year

The most appropriate decision is required[1].

Solution by NPV method:

The net cash flows at a 10% interest rate are summarized in Table (49):

Table 49: NPV, 10%

Machine	Annual cash flow	FVIF(10%,4)	Cash flow after discount	The initial cost	Net Cash Flow
1	2,000	3.169	6,338.00	6,075	263.00
2	2,292	3.169	7,263.35	7,000	263.35
3	2,370	3.169	7,510.53	7,200	310.53

Where the present value rate at an interest rate of 10% for four years is extracted from the present values table (Appendix A)[2], which is equal to 3.169 and by adding the annual cash flow at the present value rate, we get the cash flow discounted, and by subtracting the cost of the machine from it, we are in front of the net present value .

The selection is based on:

In the case of comparison between several projects, the project that achieves the highest net present value is selected.

In the case of one project, the project is accepted if the NPV is greater than zero.

So in our case; The third machine is the best.

As for the Mqam solution, Table (50) shows the results of applying the model as follows:

[1] View (Excel file 108)

[2] Future value interest modulus of $1 per period at 10% for 4 periods, Present value page.

Table 50: MQAM

MQAM1: 6.075

Period	Mqam	Annual Cash Flows	Cash flow after discount	Return on investment	Net Cash Flow
1	1.0565955	2,000	1,892.8720	107.13	
2	1.1163940	2,000	1,791.4823	208.52	
3	1.1795768	2,000	1,695.5233	304.48	
4	1.2463355	2,000	1,604.7044	395.30	
		8,000	6,984.5820	1,015.42	909.58

MQAM2: 7.000

Period	Mqam	Annual Cash Flows	Cash flow after discount	Return on investment	Net Cash Flow
1	1.0554443	2,292	2171.5973	120.40	
2	1.1139626	2,292	2057.5196	234.48	
3	1.1757255	2,292	1949.4346	342.57	
4	1.2409128	2,292	1847.0275	444.97	
		9,168	8025.5791	1,142.42	1,025.58

MQAM3: 7.200

Period	Mqam	Annual Cash Flows	Cash flow after discount	Return on investment	Net Cash Flow
1	1.0565624	2,370	2,243.1235	126.88	
2	1.1163242	2,370	2,123.0392	360.62	
3	1.1794662	2,370	2,009.3835	468.19	
4	1.2461797	2,370	1,901.8124	1,202.64	
		9,480	8,277.3586	2,158.32	1,077.36

The net present value was calculated by subtracting the cost of purchasing the machine from the sum of the discounted cash flows. In our opinion, adding the return on investment of the cash flows received compensates for the opportunity to invest them and at least equals the change in the time value of money.

Table (51) summarizes the previous results:

Table: 51 -

Macine	Mqam%	Cost	Annual Cash Flows	Net Cash Flow NPV	Net Cash Flow Mqam	Net Flow in Mqam Considering flow investment
1	5.66%	6,075	8,000	263.00	909.5820	2,940.42
2	5.66%	7,000	9,168	263.34	1,025.5791	3,310.42
3	5.54%	7,200	9,480	310.53	1,077.3586	4,438.32

The choice of the third machine is compatible between the two financial instruments (NPV, MQAM). In our opinion, Mqam reflects a clearer and more accurate picture of the choice and the results show this, especially considering the investment of cash flow received at each period of operation of the machine; The net present value does not take into account the difference in the cost of the project, while the Mqam separates the various costs and cash flows.

Note: The previous comparison is a financial comparison, but by entering other variables, the decision may change[1].

It is necessary to address the situation currently prevailing - which we referred to in the first chapter - where the interest has become negative, which makes the NPV method and similar measures useless and not capable of providing any solution.

---

[1] For more, see our book, Rationalizing Maintenance Operations by Quantitative Methods, (Chapter Two, Section Two, Paragraph 2- 4), 2000.

Example:

Table: 52 -

Rate	Annual Cash Flow	Cash flow after discount	Installment	Balances	Reinvested Balances
1.07	- 13,000,000	- 12,149,532		- 12,149,532	
1.14	- 13,000,000	- 11,354,703		- 11,354,703	
1.22	- 13,000,000	- 10,611,872		- 10,611,872	
1.31	166,000,000	126,640,605		126,640,605	
1.40	250,000,000	178,246,544	200,000,000	- 21,753,455	
1.50	250,000,000	166,585,555	200,000,000	- 33,414,444	
1.60	250,000,000	155,687,435	200,000,000	- 44,312,564	
1.71	250,000,000	145,502,276	200,000,000	- 54,497,726	
1.83	250,000,000	135,983,435	200,000,000	- 64,016,564	
1.96	250,000,000	127,087,323		127,087,323	
	1627000000	1,001,617,067	1,000,000,000	1,617,067	1,232,371

Table: 53 -

	NPV	NPV
Interest Rate	10%	10%-
Invested Amount	-100,000	-100,000
Cash Flow 1	60,000	60,000
Cash Flow 2	60,000	60,000
Cash Flow 3	60,000	60,000
Cash Flow 4	60,000	60,000
Cash Flow 5	60,000	60,000
CF sum	300,000	300,000
NPV	115,861	
FV	-241,886	

If negative interest rates are applied; Soon the accounts will stop.

Section Ten
Comparison Between Participation and Usurious Financing

Suppose a company asks[1] a bank to enter into one of its industrial projects in the form of partnership with a share of 70% for the bank and 30% for the customer. The following data was available[2]:

The size of the financing is one billion dollars (the financing that the bank will provide if approved).

The production capacity of the plant is expected to be as follows: 60% at the end of the fourth year, and 90% at the end of the fifth year.

The buildings will be completed at the end of the third year.

All machines will be imported from abroad.

If we know that:

Sale of project production is guaranteed for 10 years due to availability of supply orders.

Raw materials are 90% locally available and 10% imported.

The client enjoys credibility and good reputation and has real estate guarantees at twice the value of the project.

As the Finance Manager of the requesting company, please answer the following:

Do you recommend the formula of a diminishing company, in which the bank exits after 10 years from the beginning of the

[1] An issue proposed by His Eminence Dr. Samir Al-Sheikh, may God have mercy on him, according to his disposition.

[2] View (Excel 113 file)

agreement, or in the form of a fixed and continuous company? What is the expected return?

Assuming that the customer has the opportunity to finance a loan with interest for a period of 10 years, he pays 20% of the loan in addition to the interest of 7% annually starting from the end of the fifth year from the date of obtaining the loan; Why do you advise him?

Undoubtedly, interest-based financing is absolutely forbidden, especially with the availability of permissible financing formulas, and the following solution is to explain the answer with mathematical foundations because it contains a satisfactory statement for some and convincing for others, as it helps to improve the financing decision, as it will appear from the solution.

First: Financing using the usurious interest rate formula

An interest rate of 7% results in the ten-year interest being 423690205 and the cash flows have been set assuming the cost of capital equals the project's internal rate of return. This table (54) shows the following:

The table of reinvested balances is shown in the following table:

Table: 54 -

Reinvested Balances	
- 13,000,000	- 24,354,703
- 26,059,533	- 36,671,405
- 39,238,403	87,402,202
93,520,356	71,766,901

76,790,584	43,376,140
46,412,470	2,099,905
2,246,898	- 52,250,826
- 55,908,383	- 119,924,948
- 128,319,694	- 1,232,371

Second: Financing in the form of diminishing partnership

The Mqam is 2.06%, so:

The Islamic bank's share of financing in addition to its capital = 172,005,324

Investor's share of investment = 51,378,214

Table (55) shows this:

Table: 55 -

Mqam	Annualash Flow	Cash flow after discount	Installments	Balances	Reinvested Balances
1.02	- 13,000,000	- 12,737,605		- 12,737,605	
1.04	- 13,000,000	- 12,480,506		- 12,480,506	
1.06	- 13,000,000	- 12,228,597		- 12,228,597	
1.08	166,000,000	152,998,027		152,998,027	
1.10	250,000,000	225,767,897	200,000,000	25,767,897	
1.13	250,000,000	221,210,951	200,000,000	21,210,951	
1.15	250,000,000	216,745,984	200,000,000	16,745,984	
1.17	250,000,000	212,371,139	200,000,000	12,371,139	
1.20	250,000,000	208,084,596	200,000,000	8,084,596	
1.22	250,000,000	203,884,574		203,884,574	
	1627000000	1403616461	1000000000	403616461	423180878

The table of reinvested balances is shown in the following table:

Table: 56 -

Reinvested Balances	
- 13,000,000	- 25,480,507
- 26,005,405	- 38,234,003
- 39,021,624	113,976,404
116,324,318	142,092,216
145,019,315	166,230,267
169,654,611	186,400,595
190,240,448	202,611,587
206,785,385	214,869,982
219,296,304	423,180,878

Third: Financing in the form of continuous partnership

The Mqam is equal to 4.52% and according to Table (57); then:

The share of the Islamic bank = 553,350,675

Investor's share = 237,150,289

Table: 57 -

Mqam	Annual Cash Flow	Cash flow after discount	Install ments	Balances	Reinvested Balances
1.045	- 13,000,000	- 12,437,810.95		- 12,437,810.95	
1.092	- 13,000,000	- 11,899,933.93		- 11,899,933.93	
1.141	- 13,000,000	- 11,385,317.58		- 11,385,317.58	
1.193	166,000,000	139,094,668.51		139,094,668.51	
1.247	250,000,000	200,420,897.87		200,420,897.87	
1.303	250,000,000	191,753,633.63		191,753,633.63	
1.362	250,000,000	183,461,187.93		183,461,187.93	
1.424	250,000,000	175,527,351.64		175,527,351.64	

1.488	250,000,000	167,936,616.57		167,936,616.57	
1.555	250,000,000	160,674,145.21		160,674,145.21	
	1627000000	1,183,145,438		1,183,145,438	1346646403

The table of reinvested balances is shown in the following table:

Table: 58 -

Reinvested Balances	
- 13,000,000	- 24,899,934
- 26,025,411	- 37,410,729
- 39,101,693	99,992,975
104,512,658	304,933,555
318,716,552	510,470,186
533,543,438	717,004,626
749,413,235	924,940,587
966,747,901	1,134,684,518
1,185,972,258	1,346,646,403

The results of the solution can be summarized in the following table:

Table: 59 -

Formulla	Bank Share			
Loans	Traditional Bank = Amount / Rate * 10 Years	1,000,000,000	7.00	423,690,205
Diminishing Partnership	Islamic Bank	223,383,538	0.77	172,005,324
Continues Partnership	Islamic Bank	790,500,965	0.70	553,350,676

The financing in the continuous partnership format has achieved the best results (according to the assumptions), since the demand for the project's products is equal to the products it offers (according to the issue); Therefore, if the capital remains under investment, it will support sales and finance its movement; Which will reflect positively on the results of both the bank and the investor together significantly. Then the financing is followed by the interest-based loan and then the diminishing company.

As for the reason for the decline in the benefits of the diminishing company formula, it is the decrease in the invested capital due to the bank’s temporary exit from the partnership. Otherwise, the results of participation would have exceeded the benefits of financing with an interest-based loan (we speak mathematically), and this is what justifies the high returns of the continuous participation.

If we assume that the investor will compensate for the capital decrease resulting from the bank’s exit and exit, the investor’s benefits will be maximized by collecting his benefits and the bank’s benefits together (resulting from the exit); This makes financing in the diminishing company better for the investor and less beneficial for the bank.

Bringing other elements into the discussion, we find that:

- Participation of both types leads to the parties to the contract bearing the risks, while the borrower bears them in the case of an interest-based loan only.
- Both types of participation motivate both parties to make the best effort to make the work successful (microeconomic); Which is reflected positively on the

stability of the economic situation in general (macroeconomic), so participation achieves real development in the country and establishes the construction that God has commanded us.

Section Eleven
Comparison Between Daily Cashflow Businesses

A Mqam can be used to determine the rate of return for everyday service business owners. The following examples illustrate this.

Example:

A merchant buys a bus for 25,000 Pounds and is expected to generate a daily net income of 30 Pounds; If we consider that the days of the month are 28 days, and the estimated useful life of the bus is five years (without waste value), that is, its value at the end of the fifth year will be zero; What is the annual rate of return for this investment?

The solution:

Total cash flow = 28 days x 30 Pounds x 12 months x 5 years = 50,400

Bus cost = 25000

Mqam = (50400 ÷ 25000) ^ (1 ÷ 6) = 1.12395

Mqam Rate or Annual Return = 1.12395 - 1 = 0.12395 = 12.4%

Example:

A merchant bought a bus for 11,000 Pounds and expects to generate a daily net income of 15 Pounds; If we consider that:

The days of the month are 28 days.

The estimated useful life of the bus is five years (without waste value); That is, its value by the end of the fifth year will be zero,

What is the annual rate of return for this investment?

The solution:

Total cash flow = 28 days x 15 Pounds x 12 months x 5 years = 25,200

Bus cost = 11,000

Mqam = (25,200 ÷ 11000)^(1 ÷ 6) = 1.1482

Mqam Rate or Annual Rate of Return = 1.1482 - 1 = 14.82%

Therefore, based on the foregoing; The research presented a comparison between investment decisions using pure financial mathematics without any usurious tools, in a manner appropriate to Islamic financing formulas.

Mqam is the lost opportunity from investing the cash flows received (if not invested) at rates determined by a Mqam for the same period, which makes it a more relevant tool for reality, and more suitable for Islamic financial engineering to avoid usury and its tools.

Chapter Seven - Pricing of Financial Products

Pricing issues are important and vital. This includes the pricing of market liquidity and the pricing of financial products and services as well. Perhaps the pricing of Islamic financial products is something new in the financial literature, especially as it relies on a Mqam without the well-known usurious techniques.

This needs more tuning and calibration in order to achieve justice.

Section One
The Triple; Price, Thaman and Value

The price is said, the worth is said, and the value is said; What are the differences between these terms, and how did the scholars view them?

Ibn Abidin distinguished between Thaman (worth) and value, saying[1]: "The price is what the two contracting parties have agreed upon, whether it increases or decreases in value.

The first is; That is, the price is with the consent of both parties, and it is possible for one of the parties to be oppressed and satisfied because of his need, and this may reflect a monopolistic market.

As for the second value, it represents the standard consideration according to the supply and demand factors in a perfectly competitive market.

Abu Jaafar al-Dimashqi (d. 327 AH = 939 AD) mentioned the mechanism of determining the average value and changing the price names according to its degree, and he referred to a technique that included the question of experts, and this is in each country separately, taking into account the concentration or dispersion of the price series, then taking into account the overall indicators the economy from boom, depression, war conditions, and the like, in order to reach a fair price; He said[2]: "The face in identifying the average value:

---

[1] Ibn Abdin, Hashiyat Ibn Abdin, vol. 4, p. 575.

[2] IBID, Al-Dimashqi, p. 22.

- To ask trustworthy experts about the price of that in their country,
- As usual the most continuous times,
- The usual increase in it and the usual decrease in it.
- rare increase and rare decrease,
- Measuring some of that with others in addition to the proportion of the conditions they are in, such as fear or security, abundance, abundance or imbalance.

And you extract with your slice of that thing an average value or use it from those with experience, knowledge and honesty among them; For every commodity and everything that can be sold has an average value known to those who have experience with it. Whatever exceeds it is called by different names according to its height.

...

...

…

…

So the price expresses the Thaman and value, so that the price is with the consent of the two parties as a result of market bargaining and one of the parties may be oppressed and satisfied because of his need, and this may reflect the situation of a monopolistic market. As for the value, the consideration represents the standard according to the factors of supply and demand in a perfectly competitive market, and the concept of cost is taken into consideration.

Accordingly, the fair price is the same price at the measurement date. The pricing of services does not differ much from the pricing of products and is often subject to the same limitations.

Pricing Strategies

Undoubtedly, it is the supply and demand components of any market that determine the price; The market is a place where supply and demand meet, and based on the size of each of them, the fair price is determined, provided that the circumstances of either of them are not distorted.

Pricing in the traditional macro monetary policy includes setting a price for cash with names such as LIBOR, SIBOR, and the like; Depending on the market in which the pricing takes place, then that pricing applies to the financial institutions in the market that is its sub-units; Where that price is its guide, the basis of its cost, and on it the prices of its usurious interests are based.

As for sound monetary policy, it stays away from those usurious indicators and builds its prices based on sound supply and demand factors, and this is what we are dealing with.

Section Two
Needed Data to Make & Rationalize Pricing Decisions; Salam Sale Model

The sale of peace achieves a fair distribution among its parties. None of them have a fixed return; Rather, it depends on the soundness of the decision taken by them, each for his own benefit, and according to the risks he sees and estimates from his perspective. Among these risks are the risks of inflation, as commodity prices rise and the value of liquid money decreases; Which loses its purchasing power, and thus monetary capital loses part of its value, and this is a risk that affects the recipient of the money, and not if the price is a good or service.

The costs of the Salam can be calculated as follows:

Salam Costs = Straight Cost + Indirect Cost

The direct costs are: the purchase cost, the transportation costs, and the related costs. As for *the indirect costs*, they are: the costs of potential risks, including: delayed delivery, late payment, economic inflation, ..etc.

The accounting profit can be calculated as follows:

Accounting Profit = Selling Price - (Direct Cost + Indirect Cost) + Internal Operating Profit of the Remaining Amounts with the Salam seller

In order to demonstrate the efficiency of the Salam business management and for the purposes of comparison and judgment, a distinction must be made between: the profit of the first purchase, the profit of the sale.

The first is the difference between the purchase price when contracting and the purchase price upon delivery, and the second is the difference between the selling price and the purchase price upon delivery. Determining this data helps to distinguish between profit from higher market prices (yield or accidental profits) and profit from organization and management; Appropriate data helps judge the soundness of purchasing decisions, and is the basis for organizational profit calculations that are useful in studying future decisions.

The probabilistic nature of the expected return of the Salam makes the historical accounting data based on historical cost and its commitment to applying the rules of caution and careful fall short of assisting in making sound pricing decisions, and it is necessary to use appropriate tools that help the decision maker and maintain the legal integrity of him away from usurious indicators.

Financing return (buyer) <0 the purchase price > replacement price, and the condition is a loss
Financing return (buyer) >0, the purchase price < replacement price, and the condition is profit
Financing return (buyer) = 0, then purchase price = replacement price, case opportunity cost loss

Can the risk be canceled or reduced in selling the Salam to make the return more certain?

If this condition can be guaranteed, then the return to the financier can be achieved with certainty; However, since the return on the sale of Salam is not achieved for the financier unless the price of the commodity at the time of payment is higher than its price on the future; Economic profit can be formulated as follows:

Economic Profit = | Replacement Price - Purchase Price |

Mqam helps in studying probabilistic cases and studying available opportunities based on measuring the situation itself through its data such as expected cash flows, purchase price and selling price. Since most Islamic financial institutions tend to parallel Salam, we will focus on this type in some detail with examples.

Example:

Suppose a financial institution needs wheat that it bought at a Salam from a farmer at a price of 250,000 and then sold it at a parallel Salam for five months at a profit of 27.62%, i.e. at a price of 319050.

We can use the Mqam to put the following table:

First choice:

Table: 60 -

		Sale Price	319,050	
		Cost	250,000	
		Period / Year	5	
Year	Mqam	Cash Flows	Cash flow after discount	Reinested Return
1	1.041485	69,050	66299.5468	2,750.4532

2	1.084691	69,050	63658.6517	5,391.3483
3	1.129690	69,050	61122.9509	7,927.0491
4	1.176555	69,050	58688.2540	10,361.7460
5	1.225365	69,050	56350.5379	12,699.4621
			306119.9413	39,130.0587

Gross Profit = Direct Profit + Profit from Investment

Gross profit = 69,050 + 39,130 = 108,180 (43.27%).

The institution will receive 319,050 and pay 250,000, which represents the first cash inflow, and the second cash outflow. The difference is a direct profit that will remain in the foundation's fund, which it invests with its money throughout the five-month period, i.e. the Salam period. By calculating the Mqam based on the previous data, the internal operating return will be 39,130, which is an indirect profit achieved by the institution. Thus, the total profit achieved is 108,180 by 43.27%.

The size of the indirect profit is directly proportional to the duration of the Salam; If the institution occupies funds for investors as a speculator, then the distribution of profit using a Mqam is as follows:

Table: 61 -

Distribution of direct Salam profits and internal operating return after the end of the parallel Salam				
1	1.0414	108180	103870.89	4309.11
2	1.0846	108180	99733.42	8446.58
3	1.1296	108180	95760.77	12419.23
4	1.1765	108180	91946.35	16233.65

5	1.2253	108180	88283.87	19896.13
				61304.70
	Profit	43.27%	108180	
	Money Owner Share	24.52%	61304	
	Bank Share	18.75%	46876	

The realized profit of 43.27% will be distributed to the owners of money, 24.52% and 18.75% to the Mudarib, and the financier's study of his pricing decision will benefit from this, as he determines exactly his total and net profit related to it as well. This chapter helps in improving and evaluating the quality of decisions.

Assuming that the institution did not contract immediately with the farmer, waiting for them and waiting for the best price of wheat, the cash outflow would be delayed and the liquidity in its fund would remain invested with its money, achieving an indirect return added to the Salam returns, but in this case it will bear additional risks that must be taken into account and its costs as well.

Example:

A farmer requested financing with a Salam contract in the amount of 250,000 in swap for 500 bags of corn for a five-month financing period. The bank has the following two options[1]:

- Selling the commodity with a return of 27.62%.
- Selling the item after receiving it for 270000.

[1] View (Excel 110)

Under the Salam contract, the bank will pay 250,000 to the farmer at the contract and will receive 500 bags of corn from him at the end of the five months, where he will be able to sell and receive the value,

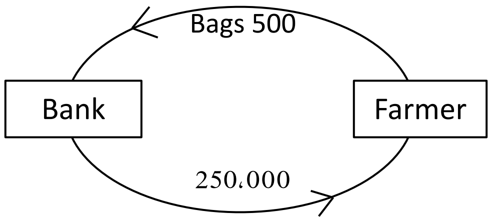


Figure (9) -SALAM

The expectation of selling the corn when it is received is the controller of the bank's return and its cash flow. The profit will be the product of subtracting what he will pay by a Salam (ie 250,000) from the actual selling price of the corn product received, and in our example the first case is better than the second.

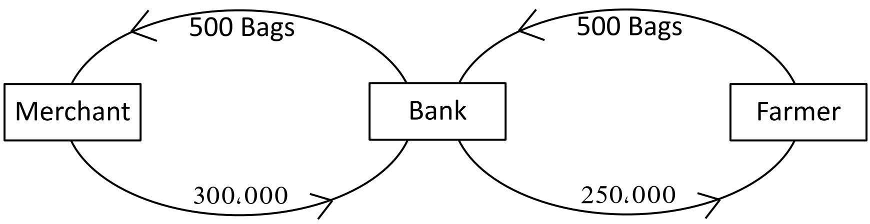


Figure (10) Parallel Salam

But if the Salam is a parallel Salam, Figure (10), where the bank receives the sale price first and then pays the value of the Salam in it to the farmer, and he has the surplus, which represents his profit throughout the period of the Salam.

The following tables illustrate the solution, as the investment of the surplus and its return in successive periods were considered:

Table: 62 -

Period	Mqam	Annual Cash Flow	Cash flow after discount	Reinvestment Return
n	MQAM	CF	DCF	CFp
1	1.0414852	69,050	66,299.5468	2,750.4532
2	1.0846915	69,050	63,658.6517	5,391.3483
3	1.1296902	69,050	61,122.9509	7,927.0491
4	1.1765557	69,050	58,688.2540	10,361.7460
5	1.2253654	69,050	56,350.5379	12,699.4621
				39,130.0587

Period	Mqam	Annual Cash Flow	Cash flow after discount	Reinvestment Return
n	MQAM	CF	DCF	CFp
1	1.0129057	20,000	19,745.1015	254.8985
2	1.0259868	20,000	19,493.4516	506.5484
3	1.0392385	20,000	19,245.0090	754.9910
4	1.0526486	20,000	18,999.7327	1,000.2673
5	1.0662379	20,000	18,757.5825	1,242.4175
				3,759.1227

The bank's return is the result of the difference in the selling price (parallel Salam) from the purchase price (the Salam), in addition to the opportunities to operate this profit only.

Therefore, the return in the first option of the table (62):

69,050 + 58,678 = 108,180 with a return rate of 43.27%.

While the return in the second option of the table (62):
20,000 + 3759 = 23,759 at a rate of return of 9.50%.
Therefore, the first option is the best.

Appropriate data for Salam pricing

Development and innovation are among the catalysts for the survival of institutions in the market; The introduction of new products requires following up on their information returned from the market to re-use them in a useful way to modify the product and re-present it in a better way in order to achieve the best efficiency.

Selling Salam, in both its regular and parallel parts, achieves competitive advantages for financial institutions because it represents financing for them. As well as its broad developmental role in the economy.

The accounting problems of the Salam are one of the important development tools, but sometimes it is a tool in reinventing it if it is better to use its data.

Salam by its nature involves financing from the buyer (the deliverer) who pays the price to the seller (the deliverer) who undertakes to repay the commodity after a certain time. It is suitable for financing fixed and working capital. The Islamic Development Bank has recommended that the financing period in this method should not exceed 18 months, according to the type of commodity, which is often an intermediate or consumer commodity.

The Salam trade cycle consists of two stages, the stage of paying the price, and then the stage of delivering the commodity later. Accordingly, the documentary cycle of the Salam consists of the stage of paying the capital and receiving the commodity after a specified period.

Since the Salam combines debt and investment, the condition of the buyer must be examined before contracting to find out the extent of his ability to deliver the Salam in it, as well as study the commodity under contract to determine its legality, measure its risks and study its profitability.

The entrance to determining the profit is the best entrance for the financial manager, where he can impose his conditions, not impose on him.

The problem of setting profit target is not a simple matter; If the price set is higher than market prices without competitive advantages, the decision maker may miss feasible opportunities, albeit less; What is prevalent in the market may lose a profit, and in both cases, the reputational risk may take the loyalty of customers away from the institution.

On the other hand, the target profit plays a major role in determining the price before production, which affects the target quantities, up to the total capital of the Salam.

The successful Salam depends on buying at the lowest price in the market during the Salam period, without being less than the price at the time of delivery.

Accounting data provide important historical data that helps in extrapolating past events; Cost accounting helps track the costs of production centers that have occurred, while trading accounts, profits and losses, or what has become known as the income statement, help in determining the expenses and revenues related to sales that occurred in the relevant financial period. By following a data series for several years, it is possible to predict the general trend line, anticipate future events, and formulate policies for the development of work. However, the historical data provided by accounting through its financial reports is not considered sufficient to predict future events, as history may not repeat itself; Therefore, it has developed a secondary accounting that helps the administration in making its future decisions. It is called management accounting, and it has benefited from administrative and financial mathematics and quantitative economic consequences. To give more objectivity and science to management decisions to achieve success and development.

Accountability is affected by legislation and laws, so it operates within its framework and does not depart from it, and since Islamic Sharia is the governing law; Therefore, accounting must operate within Shariah controls and standards; Accountability is the shadow of actions that move with their movement, and selling Salam is one of the Islamic formulas that does not deviate from what has been previously explained; Salam has the meaning of indebtedness or credit, so its nature is that it is a debt to which its provisions and controls apply unless all of its operations are completed.

Therefore, the Mqam is considered a mathematical tool that helps in pricing the Salam and targeting certain profit rates that are in line with the general financial policy of the institutions that practice the sale of Salam.

LIQUIDATION OR EXIT DECISION

The decision to exit a company or to liquidate a specific Murabaha or the like is a vital decision that needs study that determines the advantages or disadvantages of that decision; The basic principle in Murabaha, for example, is that the two parties continue to Murabaha until the date specified in it. If one of the parties wishes to liquidate the Murabaha before that, the other party may accept or refuse; What is the criterion governing their decisions?

Mqam helps in determining the best decision by studying the possible alternatives to the decision, through the expected cash flows, and determining the return on the basis of which one decision is preferred over another.

Section Three
Liquidity Pricing

Banks generally seek to attract liquidity from the market in the form of deposits; whether savings or investment deposits; It offers its clients portfolios and products of various durations and returns to suit the nature and needs of each of them. Deposit holders are given preference among the opportunities offered in the market to invest their savings for periods that they can dispense with for the best returns.

The monetary policy in an Islamic economy in the pricing of liquidity is subject to the laws of supply and demand, just like others. of things that are priced; If the chances of supply absorbing the investment of liquidity decrease, the ratios of its returns decrease due to the disruption and accumulation of liquidity, and the same is said if the money supply to be operated increases without the increase in demand and vice versa.

Whereas the monetary policy in a non-Islamic economy in pricing liquidity is subject to the usurious interest rate set by the administrations of central banks (or the like in some countries); The central bank intervenes in determining the volume of liquidity by raising the interest rate when it wants to absorb it or reduce its volume in the market, and lowers the interest rate when it wants to pump it into the market, controlling the market movement with an unclean float policy. The interest rate offered between banks in London (or its sisters) is considered the basic interest rate, so interest-based banks (or as some call them commercial banks) use it to price what is deposited with them, as well as price their granted loans with a specific increase on them. Unfortunately, Islamic banks use it to price their business as well.

The Index of Islamic Banking Profit (IIBR)[1] was released while we were preparing this research, in a joint effort between Thomson Reuters[2], the Accounting and Auditing Organization for Islamic Financial Institutions (AAIOFI)[3] and some members of the Authority's Sharia Board, according to which the 16 largest Islamic banks will present a daily rate of average Murabaha rates. offered to them; Each undertakes to provide accurate information each business morning - as he sees fit - and Thomson Reuters takes care of the technical issues in the index statement. The proposed index (IIBR) is similar in its methodology to what we proposed in 2003 with the difference that what we proposed is based on building the measurement standard on the basis of the average profit distributed for the relevant financial period for 15 Islamic banks. In our opinion, this depicts the reality of the market and actually reflects its condition, while the proposal of the relevant banks in the (IIBR) index remains based on expectations and estimates that mimic what the eight British banks do in preparing the (LIBOR)[4] index.

---

[1] IIBR: Islamic Interbank Benchmark Rate.

[2] http://thomsonreuters.com

[3] AAOIFI: www.aaoifi.com

[4] LIBOR: London Interbank Offered Rate.

The approach to pricing liquidity in a positioned manner, does not mean ignoring the rest of the factors affecting the price determination, such as political and economic factors and trends in the behavior of the partial units that represent the elements of the market, but it is an important entry in determining an **indicator that shows the price equilibrium point**.

Our following example focuses on the pricing of liquidity without the need for interest (or LIBOR and its sisters), and it is suitable for considering it an important mathematical tool in reaching the (IIBR) index objectively, away from personal judgment and bias. He will keep the Islamic financial market away from the sharp fluctuations that may occur as a result of estimation errors.

The following example assumes that a bank offers portfolios and products with the aim of attracting customer deposits for specific periods and at expected rates of return (historically or as a result of standard studies), and it seeks to achieve a drawn investment policy.

On the other hand, deposit holders choose between investing their surpluses and savings by depositing them in banks or operating them with other available opportunities, and they also seek to achieve their investment policies.

Thus, we are faced with a situation of supply and demand that must be combined with a fair price, then there is no problem in any negotiation between the parties to supply and demand, which may result in the price inclination to one party without another as long as satisfaction is achieved between the concerned parties, and this is what we referred to in the previous price-value trilogy mentioned.

Example:

Assuming that the composition of the funds invested in a bank was as follows, according to the financing periods, Table (63):

Table: 63 -

Average (3) = (2) × (1)	target rate ROI (2)	Target Fund Ratio (1)	year / period (investment portfolios)
0.625%	6.25 %	10 %	5
1.400%	7.00 %	20 %	10
2.000 %	8.00 %	25 %	15
4.320 %	9.60 %	45 %	20
8.345 %	-	100 %	Covered medium

Assuming the amount the company is willing to deposit for investment is 1,500,000 for a period of 20 years.

The solution:

Any financial or credit analyst can come up with a total average covered bank return that is equivalent to the internal rate of return from the range presented as follows:

8.345 x 2 where the bank invests its money back from the finances as monthly payments = 16.69%

The bank usually seeks to achieve this internal rate of return (which may be a hypothetical rate) in order to achieve its established investment policy.

The amount deposited in the bank of 1,500,000 represents cash inflows.

Accordingly, the total amount of the target period:

= 1,500,000 + (1,500,000 x 12.50% x 20 years) = 5,250,000

Assuming that the annual payments that the bank will pay to the investor represent cash outflows, they are equal to:

Annual cash flow = 5,250,000 ÷ 20 years = 262,500

This is assuming the application of a fixed distribution policy, and it can be assumed otherwise, then a Mqam will be directly affected by those changing cash flows in his accounts.

By calculating the internal rate of return (IRR)[1], we find that it is equal to 16.7% (Table 64).

Table: 64 -

Year	Target internal bank return
0	+ 1500000
1	(262500)
2	(262500)
3	(262500)
4	(262500)
5	(262500)
6	(262500)
7	(262500)
8	(262500)
9	(262500)
10	(262500)
11	(262500)
12	(262500)
13	(262500)

[1] Internal Rate of Return, for details please follow the link: http://en.wikipedia.org/wiki/Internal_rate_of_return

14	(262500)
15	(262500)
16	(262500)
17	(262500)
18	(262500)
19	(262500)
20	(262500)
IRR	16,70%

As for the company, it targets a return of at least 12.50%[1], and less than that means that its investment will be futile, and if it chooses to target a return greater than that, this reflects its competitiveness and the opportunities available to it in the market in which it operates.

What we will do in our next treatment is to meet the desire of the supply (investors) and the demand holders (the bank in our example) by applying a Mqam function, where we will deduct the expected cash flows using a Mqam based on the internal rate of return targeted by the bank, which is 16.7% in the hope of achieving a match between supply and demand to arrive at a common investment policy expressed by the prevailing market price.

Accordingly, the results using a Mqam function where the calculations start with an initial value of the internal rate of return targeted by the bank itself, which is 0.1670, can be depicted in the following table:

[1] (Excel file based on an assumption in a previous example that was published in the name of the rate of return on the basis of distributing zakat to eight banks to equal the cost of capital, as this number may be Assumed. 110)

Table: 65 -

The present value of the flows up to the amount assumed 1500000 (3)	Annual cash flow 20 ÷ 5250000 (2)	based on % The Mqam of the IRR targeted by the bank (1)	Year
224935.7326	262500	1.1670000	1
192746.9860	262500	1.3618900	2
165164.5120	262500	1.5893200	3
141529.1450	262500	1.8547400	4
121276.0456	262500	2.1644800	5
103921.2044	262500	2.5259500	6
89049.8950	262500	2.9477900	7
76306.6626	262500	3.4400700	8
65387.0287	262500	4.0145600	9
56030.0161	262500	4.6849900	10
48012.0103	262500	5.4673800	11
41141.3970	262500	6.3804300	12
35253.9800	262500	7.4459700	13
30209.0677	262500	8.6894400	14
25886.0900	262500	10.1405800	15
22181.7400	262500	11.8000000	16
19007.4890	262500	13.8103457	17
16287.4801	262500	16.1166735	18
13956.7096	262500	18.8081580	19
11959.4769	262500	21.9491204	20
1500242.6500	5250000		

Explanation of the table:

The source of the column (1) is caused by the application of the Mqam function, as the second and subsequent years are caused by raising the rate of the base year (1.1670) to the exponent, which is equivalent to the number of the studied year, and so on according to the Mqam technique. Thus, the calculations proceed from the internal rate of return that the bank plans (requesting party) to target it.

Column (2) is caused by dividing the total amount of the target period by the same 20-year period as mentioned earlier.

Column (3) is the result of dividing column (2) by column (1).

Interpretation of the results of the table:

The decline in the value of money has become a given for many reasons, and inflation remains the biggest cause, in addition to other reasons (not now to be mentioned). One of the most important causes of inflation is the prevalence and application of usury; The prevailing usurious interest represents the lowest level of inflation prevailing in the market, and it is also a (continuously fueling inflation stove) as it works to reduce the value of money over time and raises real prices in return.

Therefore, the cash flow at the end of the first year of 262,500 equals 224,935 and at the end of the second year it equals 192,746 and so on until the twentieth year where it becomes 11,959.

Accordingly, the saying of the Scholars: that the current cash is better than the deferred, is matched - as an example -: that it is fair for the installment price to be more than the cash price to compensate the owner of the money for what he will lose as a result of the decrease in the value of the cash that will come to him in the future, whose real value will differ from its cash value according to the different periods of its holding .

Explanation of the table:

The sum of column (3) is equivalent to the principal amount invested, and by subtracting it from the sum of column (2), we get the amount of return that the investor has achieved and is equal to:

5,250,000 - 1,500,242.65 = 3,749,757.347

Dividing this return by the principal amount invested, we get the total internal rate of return for the entire period:

3,749,757 ÷ 1,500,000 = 2,4998

By dividing the total internal rate of return for the entire period by the number of years of investment, we get the same internal rate of return that the company is targeting:

2.4998 ÷ 20 years = 12.50%.

Table: 66 -

Year	Mqam%	Annual Cash Flow ÷ 5250000 20	The present value of the flows Up to the assumed amount of 1500000	The company's target return	Target internal bank return
1	1.167	262,500	224,935.733		1,500,000
2	1.361	262,500	192,746.986		262,500-
3	1.589	262,500	165,164.512		262,500-
4	1.854	262,500	141,529.145		262,500-
5	2.164	262,500	121,276.046		262,500-

6	2.525	262,500	103,921.204		262,500-
7	2.947	262,500	89,049.875		262,500-
8	3.440	262,500	76,306.663		262,500-
9	4.014	262,500	65,387.029		262,500-
10	4.684	262,500	56,030.016		262,500-
11	5.467	262,500	48,012.010		262,500-
12	6.380	262,500	41,141.397		262,500-
13	7.445	262,500	35,253.982		262,500-
14	8.689	262,500	30,209.068		262,500-
15	10.140	262,500	25,886.091		262,500-
16	11.834	262,500	22,181.740		262,500-
17	13.810	262,500	19,007.489		262,500-
18	16.116	262,500	16,287.480		262,500-
19	18.808	262,500	13,956.710		262,500-
20	21.949	262,500	11,959.477		262,500-
		5,250,000	1,500,242.653	3,749,757.34	262,500-
				2.4998	
				12.50%	16.70%

To clarify the understanding of the company's point of view (the depositor or the owner of liquidity), and the point of view of the bank (the attractor of liquidity), we present the following examples:

Company viewpoint (depositor or owner of liquidity)

The company has set its minimum target internal rate of return at 12.50%, and has received an annual investment rate (ROI) by a bank of 9.60% (Schedule A) for twenty years.

If the company accepts the offer, its internal rate of return will be 9.44% as it appears from Table (D), and in order to achieve its goal, it must seek an annual return (ROI) of 12.65% for the same amount and duration, Table (67).

Table: 67 -

The company's internal revenue When ROI investment rate = 9.60%	*The company's internal revenue When ROI investment rate = 12.65%*
(1,500,000)	(1,500,000)
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750
144,000	189,750

1,500,000	1,500,000
IRR = 9.44%	IRR = 12.50%

The bank's viewpoint (the polarizer for liquidity)

The bank planned to achieve an internal rate of return of 16.70%, while the company whose liquidity is targeted by the bank (liquidity prepared for investment) planned an internal rate of return of (greater or equal to) 12.50%.

If we assume that the bank has only this deposit, then this means that it must invest it at the rate of 16.81% in order to achieve an internal return of 16.70%, according to the following table:

Table 68 -

Internal Bank Return: At ROI = 16.81%
1,500,000
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)

(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(252,150)
(1,500,000)
IRR = 16.70%

Accordingly; It is in the interest of the bank to offer an ROI of 12.65% to its supposed customer so that the customer achieves its goal while the bank has achieved a saving of 16.70% - 12.65% = 4.05% over its targets, where this saving remains as Margin of negotiation for him in front of the opportunities of other clients.

The application of Mqam will provide the bank with the shortest way to determine the highest rates of return on investment (ROI) that it can put in the market in return for attracting the necessary liquidity while maintaining the internal rate of return targeted by its investment policy.

Thus, the administration will set a ceiling for the credit and marketing departments to expand the scope of their negotiation towards multiple customer segments, within the framework of the investment policy.

Conversely, if we assume that the company is an investment management company; It will also resort to setting up its own assortment in the manner followed by the bank itself; If its investment plans seek to achieve an internal rate of return of 22.7%; This is according to the composition of its funds planned to be invested according to the following financing periods, table (69):

Table 69 -

Avarege (3) = (2) × (1)	Target rate ROI (2)	Target Fund Ratio (1)	year / period (investment portfolios)
4.9689 %	11.042 %	45%	5
2.8075 %	11.230 %	25%	10
2.3720 %	11.860 %	20%	15
1.2500 %	12.500 %	10%	20
11.3984 %		100%	Covered Average

The company's total average hedged return is as follows:
11.3984% x 2 = 22.7968%
Where the company invests its money returned from investment profits.
The company will seek to achieve this internal return (which may be a hypothetical rate) in order to achieve its established investment policy. Applying the same previous solution rules, Mqam matrix is as follows:

Table 70 -

The present value of the flows (3)	Annual cash flow (2)	Mqam of target IRR % (1)	Year
	(1,500,000)		0

283,114.13331	347,650	1.2279500	1
230,558.35605	347,650	1.5078612	2
187,758.74918	347,650	1.8515782	3
152,904.22996	347,650	2.2736454	4
124,519.91527	347,650	2.7919229	5
101,404.71132	347,650	3.4283417	6
82,580.48888	347,650	4.2098322	7
67,250.69334	347,650	5.1694634	8
54,766.63817	347,650	6.3478426	9
44,600.05551	347,650	7.7948333	10
36,320.74230	347,650	9.5716656	11
29,578.35604	347,650	11.7535268	12
24,087.58992	347,650	14.4327432	13
19,616.09994	347,650	17.7226870	14
15,974.67319	347,650	21.7625735	15
13,009.22121	347,650	26.7233522	16
10,594.25971	347,650	32.8149403	17
8,627.59861	347,650	40.2951059	18
7,026.01784	347,650	49.4803754	19
5,721.74587	347,650	60.7594269	20
1,500,014.27	6,953,000		
	IRR 22.79500%		

Explanation of the table:

The sum of column (3) is equivalent to the principal amount invested, and by subtracting it from the sum of column (2) we get the amount of return that has been achieved and is equal to:

6,953,000 - 1,500,014.27 = 5,452,985,724

Dividing this return by the principal amount invested, we get the total internal rate of return for the entire period:

5,452,985,724 ÷ 1,500,000 = 3,6353

And dividing the total internal rate of return for the entire period on the number of years of investment we get the internal rate of return target:

3,6353 ÷ 20 years = 18.20%.

Thus, the company must adjust its target rates (according to the table) to achieve its set investment policy, of course if the market conditions allow it to do so, and this is the case of the prudent investor in the market.

Session Four
Targeting Murabaha Return in Terms of Mudaraba Funds

The model (targeting the return on Murabaha in terms of Mudaraba funds)[1] is based on calculating a Mqam through the expected cash flows for the studied period of Mudaraba funds, then distributing the Mudaraba capital over the studied period to calculate a minimum return using a Mqam to reach the calculated capital balance, which is the *money available for investment*.

If we assume that the invested funds are all directed to Murabaha, and accordingly, we will calculate the return on Murabaha executed with the available capital in Mqam ratios, and by adding the total returns of the financial period to the capital asset, and then distributing it over the studied period in preparation for its deduction at a Mqam rate, the size of the reinvested funds can be determined.

The revenue that will be realized will be due to two reasons:

- Murabaha return resulting from direct investment of available funds.
- The return received from the Murabaha installments and reinvested for the same percentage at least, which is considered an internal return, and this is one of the Mqam assumptions that are similar to the assumptions of the

[1] See (Excel file 122).

internal rate of return and the adjusted internal rate of return.

Based on the foregoing; then:

Total Murabaha Funds = Mudaraba Capital + Reinvested Murabaha Returns

Profit of Mudaraba operations = Mudaraba money invested - Origin of Mudaraba Money

Annual Murabaha Return = Murabaha Transaction Profit ÷ Study Period

To compare the results, an example was set in which six cases in which the investment periods differed, namely: 8, 7, 6, 5, 4, and 3 years, respectively, and the same indicators were calculated, namely: Mqam, annual return ROI, Murabaha ratio, money operation ratio , (Table 71).

Then a table was developed in which all the previous results were collected and the changes of the indicators were calculated to track their movement (Table 72), and they were represented graphically (Figure 11 and Figure 12).

Table: 71 -

							660,000	Total Cash CF
							220,000	Mudaraba Amou
							8	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
i	Mqam(i)	CF(i)	m(i)	M1(i)	P(i)	M2(i)	PV(i)	M3(i)
1	1.12983	82,500	27,500.00	220,000.00	28,562.81	43,566.58	15,003.77	35,525.84
2	1.27652	82,500	27,500.00	192,500.00	24,992.46	43,566.58	18,574.12	62,282.67
3	1.44225	82,500	27,500.00	165,000.00	21,422.11	43,566.58	22,144.47	96,083.72
4	1.62950	82,500	27,500.00	137,500.00	17,851.76	43,566.58	25,714.82	137,843.53
5	1.84106	82,500	27,500.00	110,000.00	14,281.41	43,566.58	29,285.18	188,595.42

6	2.08008	82,500	27,500.00	82,500.00	10,711.05	43,566.58	32,855.53	249,506.82
7	2.35014	82,500	27,500.00	55,000.00	7,140.70	43,566.58	36,425.88	321,896.76
8	2.65526	82,500	27,500.00	27,500.00	3,570.35	43,566.58	39,996.23	
		660,000	220,000.00		128,532.65	348,532.65	220,000.00	
		CF	m		P	M2		
						M4	450,429.42	Total Murabaha F
			Mqam Rate	12.98%		P1	230,429.42	Murabaha profit
			annual ROI	13.09%		P2	28,803.68	Annual return
			Murabaha rate	7.30%				
			Receipt Operat	5.79%				
							7	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
1	1.14720	94,286	31,428.57	220,000.00	32,384.59	49,934.05	17,549.46	42,308.62
2	1.31607	94,286	31,428.57	188,571.43	27,758.22	49,934.05	22,175.83	75,338.76
3	1.50980	94,286	31,428.57	157,142.86	23,131.85	49,934.05	26,802.20	117,857.40
4	1.73205	94,286	31,428.57	125,714.29	18,505.48	49,934.05	31,428.57	171,261.27
5	1.98701	94,286	31,428.57	94,285.71	13,879.11	49,934.05	36,054.94	237,152.70
6	2.27951	94,286	31,428.57	62,857.14	9,252.74	49,934.05	40,681.31	317,369.90
7	2.61506	94,286	31,428.57	31,428.57	4,626.37	49,934.05	45,307.68	
		660,000	220,000.00		129,538.37	349,538.37	220,000.00	
							446,908.27	Total Murabaha F
			Mqam Rate	14.72%			226,908.27	Murabaha profit
			annual ROI	14.73%			32,415.47	Annual return
			Murabaha rate	8.41%				
			Receipt Operat	6.32%				
							6	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
1	1.16993	110,000	36,666.67	220,000.00	37,384.78	58,474.45	21,089.68	51,993.93
2	1.36874	110,000	36,666.67	183,333.33	31,153.98	58,474.45	27,320.47	94,380.57
3	1.60133	110,000	36,666.67	146,666.67	24,923.19	58,474.45	33,551.27	150,200.81
4	1.87344	110,000	36,666.67	110,000.00	18,692.39	58,474.45	39,782.06	221,737.41
5	2.19180	110,000	36,666.67	73,333.33	12,461.59	58,474.45	46,012.86	311,661.09
6	2.56425	110,000	36,666.67	36,666.67	6,230.80	58,474.45	52,243.66	
		660,000	220,000.00		130,846.73	350,846.73	220,000.00	
							442,507.81	Total Murabaha F
			Mqam Rate	16.99%			222,507.81	Murabaha profit
			annual ROI	16.86%			37,084.64	Annual return
			Murabaha rate	9.91%				

			Receipt Operat	6.94%				
							5	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
1	1.20094	132,000	44,000.00	220,000.00	44,206.13	70,523.68	26,317.55	66,764.49
2	1.44225	132,000	44,000.00	176,000.00	35,364.90	70,523.68	35,158.77	124,179.94
3	1.73205	132,000	44,000.00	132,000.00	26,523.68	70,523.68	44,000.00	201,973.51
4	2.08008	132,000	44,000.00	88,000.00	17,682.45	70,523.68	52,841.23	304,239.90
5	2.49805	132,000	44,000.00	44,000.00	8,841.23	70,523.68	61,682.45	
		660,000	220,000.00		132,618.39	352,618.39	220,000.00	
							436,858.29	Total Murabaha F
			Mqam Rate	20.09%			216,858.29	Murabaha profit
			annual ROI	19.71%			43,371.66	Annual return
			Murabaha rate	12.06%				
			Receipt Operat	7.66%				
							4	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
1	1.24573	165,000	55,000.00	220,000.00	54,060.81	88,788.00	34,727.20	91,503.14
2	1.55185	165,000	55,000.00	165,000.00	40,545.61	88,788.00	48,242.40	175,745.90
3	1.93318	165,000	55,000.00	110,000.00	27,030.40	88,788.00	61,757.60	294,204.90
4	2.40822	165,000	55,000.00	55,000.00	13,515.20	88,788.00	75,272.80	
		660,000	220,000.00		135,152.02	355,152.02	220,000.00	
							429,356.92	Total Murabaha F
			Mqam Rate	24.57%			209,356.92	Murabaha profit
			annual ROI	23.79%			52,339.23	Annual return
			Murabaha rate	15.36%				
			Receipt Operat	8.43%				
							3	CASE A
Year	Mqam	Expected Cash flow	Capital distribution according to the minimum return on the Mudaraba funds		Murabaha return in comparison to the return on Mudaraba funds		net discounted money	reinvested money
1	1.31607	220,000	73,333.33	220,000.00	69,536.28	114,532.36	44,996.08	137,710.00
2	1.73205	220,000	73,333.33	146,666.67	36,040.54	114,532.36	78,491.83	277,748.64
3	2.27951	220,000	73,333.33	73,333.33	18,020.27	114,532.36	96,512.09	-
		660,000	220,000.00		123,597.09	343,597.09	220,000.00	
							401,345.73	Total Murabaha F

			Mqam Rate	31.61%			181,345.73	Murabaha profit
			annual ROI	27.48%			60,448.58	Annual return
			Murabaha rate	18.73%				
			Receipt Operat	8.75%				

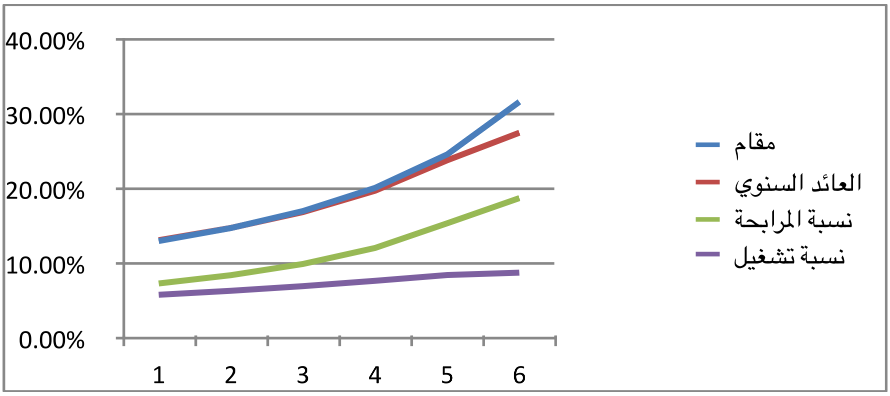


Figure (11)

Table: 72 -

Status	Mqam Move	Annual ROI move	Murabaha Move	Operation Move	Mqam	Annual Return	Murabaha Rate	Operation Rate	Years
1					12.98%	13.09%	7.30%	5.79%	8
2	1.74%	1.64%	1.11%	0.53%	14.72%	14.73%	8.41%	6.32%	7
3	2.27%	2.12%	1.50%	0.62%	16.99%	16.86%	9.91%	6.94%	6
4	3.10%	2.86%	2.14%	0.71%	20.09%	19.71%	12.06%	7.66%	5
5	4.48%	4.08%	3.30%	0.77%	24.57%	23.79%	15.36%	8.43%	4
6	7.03%	3.69%	3.37%	0.32%	31.61%	27.48%	18.73%	8.75%	3

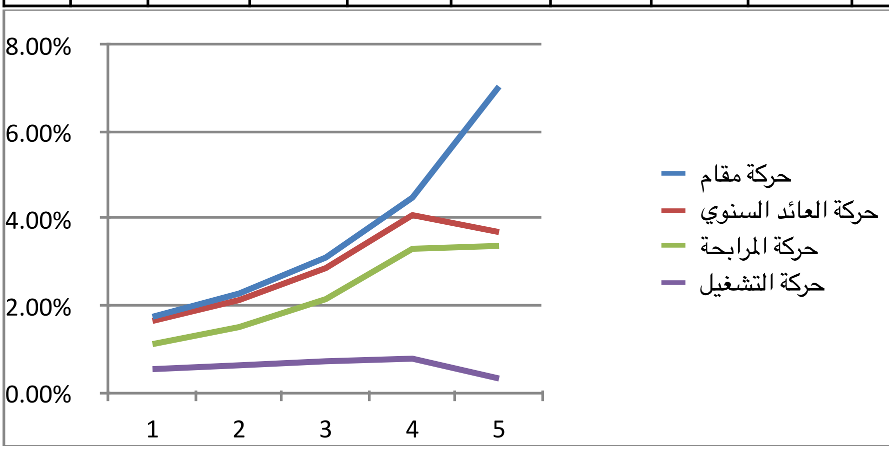


Figure (12)

Concludes; From the above that with the standardization of the flows and the reduction of the years, the table did not show a close correlation between the decrease in the period (one year) and the increase in the annual return and Mqam.

The above expresses the supply and demand for liquidity in the market. The bank represents the demand for liquidity, while the owner of the deposit (investment) represents the supply of liquidity. Determining the fair price between supply and demand is a challenge for any fair competitive market. As for the imbalance in the price differences, it is a tendency in favor of one The two market teams (supply and demand). The price tendency may be an expression of an existing monopoly in the market that reflects the nature of an economic crisis.

any way; In our opinion, Mqam offers an objective and unbiased scientific solution. The acceleration of the scandals of banks and bankers in particular is nothing but a witness to that:

- Like the Swiss bank (UBS), which plunged itself into the world of scandals with its involvement in the (Libor) scandal; He was fined £940m for unfairly affecting Libor and manipulating its rates.
- Bank employees in Tokyo were also proven to be involved in this corruption.
- He was preceded by Barclays for manipulating interest rates, which was also fined a third of what was imposed on UBS.
- Credit Agricole, Societe Generale and HSBC are not doing well.

- Misconduct is prevalent even among the employees of large banks, and it is unfortunate that these banks and their employees are the ones who determine LIBOR and its like!

Section Five
Prove the Hypothesis of MQAM Equation

The Mqam rate is the rate at which *the minimum Mqam return equals the cost of financing*.

Returning to Equation No. (1) of the Mqam model to prove it as the hypothesis of the model;

$$\frac{\sum_{i=1}^{n}(CF_i)}{R^n} = R \,.\, C$$

or:

Total Cash flows ÷ (Mqam rate +1)^n = Investment Cost x (Mqam rate +1)

or

Investment Cost = ROI

To prove this, we present the following examples:

Example:

If a project has a cost of 10,000 and a flow of 12,000 for a year, then:

Mqam rate = (12,000÷10,000)^(1÷2) - 1 = 9.54%

Modulus = (12,000 x 1,0954) ÷ (10000 x 1,0954) = 1,0954

Sensitivity = 12,000 ÷ 1.0954 = 10,000

ROI = **954**

Finance Cost = (Cash Flows - Discounted Flows) ÷ Modulus

= (12000 - 10954) ÷ 1.0954 = **954**

Therefore, the cost of the investment equals the return on the investment.

Example:

The cost of financing is:

Finance Cost = (Cash Flows - Discounted Flows) ÷ Modulus

= 130911 ÷ 1.4549465 = **89,977**

Or that the traditional financing cost is equal to the difference between (cash flows and discounted flows at the end of the seventh year), as we assumed the same results; and accordingly; The cost of financing at 9.387% and a capital of 220,000 for seven years, according to the mathematical tables, is equal to:

Finance cost = ((220,000 ÷ 4.96857) x 7) – 220,000 = **89,977**

The calculations of Table (72) in its upper part for calculating the financing cost show that the financing cost is 89,977. See the following table (72):

Table: 72

تكلفة التمويل							
				1.0939			
Year	R	220,000-	Calculated Money	Flows - deducted money	Assuming financing cost	Reinvest the Assuming financing cost	41026.95
1	1.0939	64,429	58,899.18	5,529.39	20,653.16	41,026.95	60,887.03
2	1.1966	64,429	53,844.34	10,584.23	18,434.89	60,887.03	79,957.24
3	1.3089	64,429	49,223.31	15,205.26	16,008.52	79,957.24	97,914.23
4	1.4318	64,429	44,998.87	19,429.70	13,354.20	97,914.23	114,380.92
5	1.5662	64,429	41,136.97	23,291.60	10,450.69	114,380.92	128,919.23
6	1.7132	64,429	37,606.52	26,822.05	7,274.61	128,919.23	
7	1.8741	64,429	34,379.05	30,049.52	3,800.36		
Sum		**451,000**	**320,088.23**	**130,911.76**	**89,976.44**		
MQAM		9.39%		**89,977.03**			
Mudulus		1.4549465					

Sensitivity		220,000.00					
Investment ROI							
				220,000	Capital		
				7	Financing Periods		
				0.0939	Mqam		
				1	scalar constant		
son of premiums computed in Mqam and in the traditional straight installment, assuming the sam							
Year	R	Capital ÷ Financing Period	Annual installment in Mqam	Earnings by period	Conventional fixed installment	Reinvest the premium the traditional method	Reinvest the premium in a Mqam method
1	1.0939	31,428.57	34,379.05	2,950.48	44,282.43	92,722.0458	75,213.04
2	1.1966	31,428.57	37,606.52	6,177.95	44,282.43	145,709.1195	123,410.93
3	1.3089	31,428.57	41,136.98	9,708.41	44,282.43	203,670.5613	179,995.49
4	1.4318	31,428.57	44,998.87	13,570.30	44,282.43	267,073.3596	246,116.58
5	1.5662	31,428.57	49,223.32	17,794.74	44,282.43	336,428.3428	323,066.08
6	1.7132	31,428.57	53,844.35	22,415.78	44,282.43	412,294.2956	412,294.36
7	1.8741	31,428.57	58,899.19	27,470.62	44,282.43		
			320,088.28	**100,088.28**	309,977.01		
					0.8741		
					0.1759		
					4.9681		
					44,282.44		

Table (72) - the column (profits by periods) - shows that the return on investment is equal to **100088**.

and accordingly; In this example, there is savings where the return on investment exceeds the cost of financing, and the negotiation tends to favor the owner of the money.

Section Six
Pricing of Future SWAP

In front of the IRS Interest Rate Swap proposals and scenarios recently submitted by data science software to rescue LIBOR, which was announced to be discontinued at the end of 2021 - as we mentioned in the second chapter - and as a proof of Mqam's flexibility and ability to evolve and meet the needs of financial markets, The two researchers (Ohaj-Kantakji) presented a development for the pricing of forward swaps using a Mqam.

In its pricing of forward swaps, a Mqam distinguishes between regular and irregular cash flows; Mqam, in its previous versions, calculated the spot swap rate, and for the pricing of forward swaps; It will start from the spot rate for the first year and then all the way to the fifth year - assuming we want to price the forward swaps in the fifth year -. Then, after determining the forward rate and its future cash flows, the Mqam helps to prepare the table of accounts for pricing the forward swaps.

We have included in the calculations a column for the internal rate of return (IRR) to compare its results reflecting LIBOR and Mqam results.

First - the case of regular cash flows

The calculations needed to determine the forward rate of regular cash flows are done using a Mqam; According to the following sequential steps, and benefit from Table (73), which shows the calculations with an example (included in Excel[1] exercises under the name SWAP_Pricing), and the steps are:

1- A Mqam is calculated as usual, which represents the spot price, (Equation 4).

Spot Price = Mqam

According to Table (73), the spot price = 30.766 %

2- The Mqam price for the fifth year is considered as the swap price for the fifth year, and it is equivalent to raising the Mqam to the five power - that is, the arrangement of the studied year - (Equation 6).

Swap Price for five years = Mqam ^n

According to Table (73), the swap price for five years = 1.30766 ^5 = 3.823,622

3- The forward price is calculated by dividing the swap price for the studied year by the number of years, and in our case by dividing the swap price for the fifth year by five, (Equation 39).

Forward Rate = Five-year Swap Price ÷ n (39)

According to Table (73), the forward price = 3.823,622 ÷ 5 = 76.4724 percent

[1] To download the book exercises: mqam_excersises.zip

The forward rate of 76.4% can be compared with the Mqam of the internal rate of return of 96.5% for the same cash flows.

4- Forward annual cash flows are calculated from the forward rate by multiplying it by the investment amount (Equation 40).

Forward Annual Cashflow = Forward Price x Investment Amount (40)

According to Table (73), the annual forward cash flow = 76.4724 % x 100,000 = 76,472

It is useful to determine the forward annual cash flow; Access to the total annual cash flow that will be discounted at the forward rate.

5- Calculate the sum of the future net cash flows that achieve the annual forward cash flow, and it is equal to the net cash flows divided by (Mqam + 1) (Equation 41).

Total Forward Net Cashflows = Net Cashflows ÷ (Mqam + 1) (41)

According to Table (73), the total net flows that achieve the annual cash flow = 240026 ÷ 1.30766 = 183553

Determining the total net cash flows that achieve the annual cash flow benefits from knowing the total net cash flows after applying the specified cash flows at the forward rate, and it represents a control point for the accuracy of the accounts in the solution table.

6- Calculate a Mqam coefficient, which represents the ratio of net cash flows divided by the investment cost, (Equation 42).

Mqam Modulus for Regular Cash Flows = Net Cash Flows ÷ Investment Cost (42)

According to Table (73), the Mqam modulus = 240026 ÷ 100000 = 2.40026

By replacing the calculated results in the lower part of the table (73), we have the expected cash flows and their sum:

			100,000	Investment cost	
Regular Cash Flow Status					
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
100,000		76,472.45	100,000	1.307660	1
100,000	158,480.35	58,480.35	100,000	1.709976	2
100,000	251,959.86	44,721.36	100,000	2.236068	3
100,000	363,677.47	34,199.52	100,000	2.924018	4
100,000	501,719.86	26,153.21	100,000	3.823622	5
96.59%		240,026.89	500,000	Total	
			30.77%	Spot price	
			3.823622	Swap price for five years	
			76.47%	forward price	
			76,472	Forward annual cash flow	
			183,554	Total forward net flows	
			2.400269	Mqam modulus for uniform flow	
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
76,472		58,480.36	76,472	1.307660	1
76,472	121,193.81	44,721.36	76,472	1.709976	2
76,472	192,679.88	34,199.52	76,472	2.236068	3
76,472	278,113.07	26,153.21	76,472	2.924018	4
76,472	383,677.47	20,000.00	76,472	3.823622	5
71.29%		183,554.45	382,362	Total	
			198,807.80	Differnces	

Table (73) is an example of pricing future swaps with regular cash flows

Second, the case of irregular cash flows

The calculations needed to determine the forward rate of irregular cash flows are done using a Mqam; According to the following sequential steps, and benefit from Table (74), which shows the calculations with an example (included in the previously mentioned Excel exercises):

1- A Mqam is calculated as usual, and it represents the spot price, equation (4).

Spot Price = Mqam

According to Table (74), the spot price = 16.4993%

2- Calculate a Mqam modulus, which represents the ratio of (five-year swap price - 1) divided by (five-year swap price x spot price), (Equation 43).

Mqam for Irregular Flows = (5-Year SWAP Rate - 1) ÷ (Five-year SWAP Rate x Spot Rate) (43)

According to Table (74), the Mqam modulus = (2.145936 - 1) ÷ (2.145936 x 1.164993) = 3.236517

3- The forward annual cash flows are calculated by the ratio of net cash flows divided by (Mqam + 1) divided by the Mqam coefficient, (Equation 44).

Forward Annual Cashflow for Irregular Flows = (Net Cashflows ÷ (Mqam + 1)) ÷ Mqam modulus (44)

According to Table (74), the annual cash flow = 138521 ÷ 1.16,4993 ÷ 3.236,517 = 36738

It is benefited from determining the forward annual cash flow to know the total annual cash flows that will be deducted at the forward rate, and it represents a control point for the accuracy of the accounts in the solution table.

4- The swap price for five years, which is divided by the annual cash flow by the investment cost) multiplied by the number of calculated years, which is five in our example, (Equation 45).

Five-year SWAP Rate for Irregular Flows = (Annual Cash Flow ÷ Investment Cost) x n (45)

According to Table (74), the swap price for five years = (36738 ÷ 100,000) x 5 = 1.836904

5- Calculating the forward rate, which is by dividing the swap price for five years by the number of years, which is five in our example, (Equation 39) above.

Forward Rate = Swap Price for Five Years ÷ 5

According to Table (74), the forward price = 36738 ÷ 5 = 36.74%

The forward rate of 36.74% can be compared with the Mqam of the internal rate of return of 27.21% for the same cash flows.

6- Calculating the sum of the future annual net flows, (formula 41) above:

Total Future Annual Net Flows = Net Cashflows ÷ (Mqam + 1)

According to Table (74), the total net flows that achieve the annual cash flow = 138521.64 ÷ 1.164993 = 118,903

Determining the total net cash flows that achieve the annual cash flow benefits from knowing the total net cash flows after applying the specified cash flows at the forward rate.

By replacing the calculated results in the lower part of the table (74), we have the expected cash flows and their sum:

			100,000	Investment Cost	
Irregular Cash Flow Situation					
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
10,000		8,583.74	10,000	1.164993	1
20,000	24,736.13	14,736.13	20,000	1.357209	2
30,000	47,791.08	18,973.67	30,000	1.581139	3
100,000	109,964.63	54,288.35	100,000	1.842016	4
90,000	170,047.78	41,939.75	90,000	2.145936	5
27.21%		138,521.64	250,000	Total	
			111,478.36	Differnces	
			16.50%	Spot price	
			3.236517	Swap price for five years	
			36,738	forward price	
			1.836904	Forward annual cash flow	
			36.74%	Total forward net flows	
			118,903	Mqam modulus for uniform flows	
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
36,737		31,534.44	36,737	1.164993	1
36,737	63,805.75	27,068.35	36,737	1.357209	2
36,737	97,568.02	23,234.77	36,737	1.581139	3
36,737	133,610.20	19,944.13	36,737	1.842016	4
36,737	172,774.48	17,119.53	36,737	2.145936	5
24.41%		118,901.21	183,687	Total	
			64,785.79	Differnces	

Table (74) is an example of pricing future swaps with irregular cash flows

Table (75) shows another example of pricing futures swaps with irregular cash flows where the cash flow has been concentrated in the last year:

			100,000	Investment Cost	
Irregular Cash Flow Status at the End of the Fifth Year					
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
0		0.00	0	1.259921	1
0	0.00	0.00	0	1.587401	2
0	0.00	0.00	0	2.000000	3
0	0.00	0.00	0	2.519842	4
400,000	125,992.10	125,992.10	400,000	3.174802	5
31.95%		125,992.10	400,000	Total	
			274,007.90	Differnces	
			25.99%	Spot price	
			2.635492	Swap price for five years	
			37,944	forward price	
			1.897179	Forward annual cash flow	
			37.94%	Total forward net flows	
			100,000	Mqam modulus for uniform flows	
IRR	Reinvestmet	net cash flow	cash flow	Discount rate	Year
-100,000					
37,944		30,115.84	37,944	1.259921	1
37,944	61,846.54	23,902.96	37,944	1.587401	2
37,944	96,893.54	18,971.79	37,944	2.000000	3
37,944	137,136.14	15,057.92	37,944	2.519842	4
37,944	184,732.18	11,951.48	37,944	3.174802	5
25.99%		99,999.99	189,718	Total	
			89,717.91	Differnces	

Table (75) is another example of pricing forward swaps with irregular cash flows at the end of the fifth year.

Conclusion

The power of usurious indicators has begun to decline due to its invalidity as an objective or impartial pricing tool. In our opinion, this decline has come at its time, as all totalitarian regimes have escaped and comprehensive tools must have the same end as well.

We talked about this many years ago, and we presented the mathematical solution after the solution, but the firmness of the faith of those applying those indicators was stronger than any change that could occur; Many people love what they are familiar with at one time from time and are often opposed to changing it.

As for the Mqam model, which we presented in this research, it exceeds the Profit Index among Islamic Banks (IIBR), which was issued by (AAOIFI) at a date close to the Mqam issuance in cooperation with (Thomson Reuters) company; Because the IIBR methodology is based on simulating LIBOR with better realism, and this is the case for bankers in simulation, not innovation.

The need of financial institutions, especially Islamic ones, for LIBOR and similar ones is imposed by the necessities of their work (according to the belief of those in charge of them). For example, these institutions attract funds from the market in the form of Mudaraba and then re-inject them into the market in many forms such as Murabaha and others;

Therefore, these institutions are faced with two opposite constraints:

- On the one hand; It shall secure a reasonable profit for the owners of funds whose funds are drawn into the investment accounts; This improves their reputation, especially if they seek to maximize their profitability. Which qualifies it to gain the top spot of liquidity attractors; You earn the right loyalty and market reputation.
- On the other hand, it must price its Murabaha in the best way, by investigating the lowest rate sufficient to fulfill the first condition, in order to maintain its market competition towards its customers to gain their loyalty. The reduction of the Murabaha rates (Minimize) is conditional on the institutions maintaining their expected dividends.

Mathematical solutions are an effective tool for improving decisions taken on rational grounds. Appreciation is often tainted by bias and subjectivity, and the (Libor) scandals have been a living witness to all of this, as we mentioned.

Based on the foregoing; The (Ohaj-Kantakji) model is a suggested mechanism that can:

- Using it as an alternative to traditional lending and borrowing operations that rely on forbidden usury.
- Its application to Islamic participation and Mudaraba; Where the owner of the money usually bears the losses if they are not caused by the negligence of the Mudarib; To determine the rates of participation between the partnership or Mudaraba parties.

- To help set the target ratio (as a better alternative to LIBOR) as a break-even point; Mqam is the break-even point or minimum return targeted by the financier based on the expected cash flows of the project to be financed; And not based on usurious indicators.
- To be a tool for deciding whether or not to grant a funding decision.
- To be an aid in drawing and defining targeted cash flows.

From the foregoing: Mqam the feasibility of a Mqam model and its validity as a new tool in project evaluation; Especially after we clarified the model supported by illustrative examples.

Praise be to God, researchers have begun to adopt a shrine within their research and scientific theses, supported by reputable universities. Such as Damascus University, and the Libyan Academy of Higher Studies, Misurata branch. A researcher informed me that the Sorbonne University has included a Mqam within its students' research as a subject of research. Some professionals from well-known Islamic banks - including credit managers - expressed their acceptance of Mqam and their support for its implementation.

What we hope from God to prepare for this model to develop and apply it in order to get rid of usury and its dust completely; The zealous Muslim does not accept for himself to approach usury or its tools, because he stood at the limits of God, and God Almighty has forbidden Muslims to deal with usury and ordered them to stop using it and he has threatened them with a war that is useless for them, and there is no crime in the Qur'an that has received such a threat.

And finally…

We have endeavored in this research and have done what God has enabled and helped us in it, but the work of human beings is not free from some error or shortcomings - excluding the prophets -; Whatever was right in our work is from the grace and success of God upon us, and whatever was wrong or shortened, it is from ourselves.

I ask God for pardon and forgiveness, to help us to correct our shortcomings, to inspire us with righteousness and grant us repayment, and to meet Him while He is satisfied with us.

And the God of the intent behind.

O Allah, accept this deed of ours purely for your honorable countenance, and make its reward in the newspaper of our parents.

And it was written by Samer Mazhar Kantakji in Hama
On 26 Shaaban 1439 AH corresponding to 12 May 2018 AD

The fifth edition was issued on Safar 3, 1443 AH
corresponding to September 10, 2021 AD

The work is still in progress

Appendix A
Present Value Table of Equal Payments

Year	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517
6	5.795	5.601	5.417	5.242	5.076	4.917	4.766	4.623	4.486	4.355	4.231	4.111	3.998
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.3a5	5.146	4.968	4.799
9	8.566	8.162	7.785	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132
10	9.471	8.983	8.530	8.111	7.722	7–360	7.024	8.710	6.418	6.145	5.889	5.650	5.426
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687
12	11.255	10.575	9.954	9.385	8.853	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	0.290	6.750	6.424	6.122
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	0.326	0.290	7.191	6.811	6.462
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.312	7.824	7.379	6.974	6.604
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729
18	16.398	14.992	13.75.4	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840
19	17.226	15.678	14.324	13.134	12.085	11.15.8	10.336	9.604	8.950	8.365	7.839	7.366	6.938
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.128	8.514	7.963	7.469	7.025

Appendix B
Language R Program for Pricing (IRS Interest Rate Swap)

```
#====================================================================
===============#
# Financial Econometrics & Derivatives, ML/
DL using R, Python, Tensorflow
# by Sang-Heon Lee
#
# https://kiandlee.blogspot.com
#-----------------------------------------------------------------------#
# Libor 5-year fixed versus floating IRS Pricing
#====================================================================
===============#

graphics.off()  # clear all graphs
rm(list = ls()) # remove all files from your workspace

#-----------------------------------------------------------------------
# 1. Market Information
#-----------------------------------------------------------------------

# Zero curve from Bloomberg as of 2021-06-30
df.zero <- data.frame(
   date = c("2021-10-04","2021-12-15","2022-03-16","2022-06-15",
         "2022-09-21","2022-12-21","2023-03-15","2023-07-03",
         "2024-07-02","2025-07-02","2026-07-02","2027-07-02",
         "2028-07-03","2029-07-02","2030-07-02","2031-07-02",
         "2032-07-02","2033-07-05","2036-07-02","2041-07-02",
         "2046-07-02","2051-07-03","2061-07-05","2071-07-02"),

   rate = c(0.00147746193495074, 0.00144337757980778,
         0.00166389741542625,0.00175294804717070,0.0019607137459
7585,
         0.00224582504806747,0.00264462838911974,0.0032840800898
4121,
         0.00571530169527018,0.00795496282359075,0.0097000386667
3104,
```

```
        0.01113416387898720,0.01229010329346910,0.0132066029163
9990,
        0.01396222829363160,0.01461391064905110,0.0151887691416
5160,
        0.01567359620429550,0.01673867348140660,0.0177153983073
4830,
        0.01798302077085120,0.01801516858533200,0.0170700858900
9480,
        0.01580574448899780
    )
)

#-----------------------------------------------------------------------
# 2. Libor Swap Specification
#-----------------------------------------------------------------------

spot_date_ymd  <- as.Date("2021-07-02")  # spot date

no_amt     <- 10000000     # notional amount
fixed_rate <- 0.0096495

# cf_scedule from Bloomberg
lt.cf_date <- list(
  fixed = c("2022-01-04","2022-07-05","2023-01-03","2023-07-03",
            "2024-01-02","2024-07-02","2025-01-02","2025-07-02",
            "2026-01-02","2026-07-02"),
  float = c("2021-10-04","2022-01-04","2022-04-04","2022-07-05",
            "2022-10-03","2023-01-03","2023-04-03","2023-07-03",
            "2023-10-02","2024-01-02","2024-04-02","2024-07-02",
            "2024-10-02","2025-01-02","2025-04-02","2025-07-02",
            "2025-10-02","2026-01-02","2026-04-02","2026-07-02")
)

#-----------------------------------------------------------------------
# 3. Swap Pricing - Preprocessing
#-----------------------------------------------------------------------

# spot date as serial number
spot_date <- as.numeric(as.Date(spot_date_ymd))
```

```
# Interpolation of zero curve
v.date   <- as.numeric(as.Date(df.zero$date))
v.zero   <- df.zero$rate
f_linear <- approxfun(v.date, v.zero, method="linear")
v.date.inter <- spot_date:max(v.date)
v.zero.inter <- f_linear(v.date.inter)

# Figures for zero curve
x11(width=6, height=5);
plot(v.date, v.zero, type = "b", col = "green", pch = 16, cex = 1.5)
lines(v.date.inter, v.zero.inter, col = "blue", type="l", lwd = 3)
legend("bottomright",
       legend = c("market zero rate", "interpolated zero rate"),
       col = c("green", "blue"), lty = 1, bty = "n", lwd = 2)

# number of CFs
ni <- length(lt.cf_date$fixed)
nj <- length(lt.cf_date$float)

# output dataframe with CF dates and its interpolated zero
df.fixed = data.frame(ymd = as.Date(lt.cf_date$fixed),
                      date    = as.numeric(as.Date(lt.cf_date$fixed)))

df.float = data.frame(ymd = as.Date(lt.cf_date$float),
                      date = as.numeric(as.Date(lt.cf_date$float)))

#-----------------------------------------------------------------------
# 4. Swap Pricing - Calculation
#-----------------------------------------------------------------------

#-------------------------------------------------------
#  1)  Fixed Leg
#-------------------------------------------------------
# zero rate for discounting
df.fixed$zero_DC = f_linear(df.fixed$date)

# discount factor
df.fixed$DF <- exp(-df.fixed$zero_DC*(df.fixed$date-spot_date)/365)

# tau, CF
```

```
for(i in 1:ni) {

   ymd      <- df.fixed$ymd[i]
   ymd_prev <- df.fixed$ymd[i-1]
   if(i==1) ymd_prev <- spot_date_ymd

   d <- as.numeric(strftime(ymd, format = "%d"))
   m <- as.numeric(strftime(ymd, format = "%m"))
   y <- as.numeric(strftime(ymd, format = "%Y"))

   d_prev <- as.numeric(strftime(ymd_prev, format = "%d"))
   m_prev <- as.numeric(strftime(ymd_prev, format = "%m"))
   y_prev <- as.numeric(strftime(ymd_prev, format = "%Y"))

   # 30I/360
   tau <- (360*(y-y_prev) + 30*(m-m_prev) + (d-d_prev))/360

   # cash flow rate
   df.fixed$rate[i] <- fixed_rate

   # Cash flow at time ti
   df.fixed$CF[i] <- fixed_rate*tau*no_amt # day fraction
}

# Present value of CF
df.fixed$PV = df.fixed$CF*df.fixed$DF


#-------------------------------------------------------
#  2)  Floating Leg
#-------------------------------------------------------

# zero rate for discounting
df.float$zero_DC = f_linear(df.float$date)

# discount factor
df.float$DF <- exp(-df.float$zero_DC*(df.float$date-spot_date)/365)

# tau, forward rate, CF
for(i in 1:nj) {
```

```
  date      <- df.float$date[i]
  date_prev <- df.float$date[i-1]

  DF        <- df.float$DF[i]
  DF_prev   <- df.float$DF[i-1]

  if(i==1) {
    date_prev <- spot_date
    DF_prev   <- 1
  }

  # ACT/360
  tau <- (date - date_prev)/360

  # forward rate
  fwd_rate <- (1/tau)*(DF_prev/DF-1)

  # cash flow rate
  df.float$rate[i] <- fwd_rate

  # Cash flow amount at time ti
  df.float$CF[i] <- fwd_rate*tau*no_amt # day fraction
}

# Present value of CF
df.float$PV = df.float$CF*df.float$DF

#-------------------------------------------------------
#  3)  Swap Price at spot date
#-------------------------------------------------------

df.fixed[,-2]
df.float[,-2]
print(paste0("Fixed Leg = ", round(sum(df.fixed$PV),6)))
print(paste0("Float Leg = ", round(sum(df.float$PV),6)))
print(paste0("Swap Price at spot date = ",
          round(sum(df.fixed$PV) - sum(df.float$PV),6)))
```

Appendix C
VBA Macro for Simple Libor IRS Pricing with OIS Discount

```
Option Explicit

Public Function OIS_bootstrapping(ByRef curves As Range) As Variant
   '
   ' import source data from Excel range into matrix
   Dim source As Variant: source = curves.Value2
   '
   ' create all the needed matrices and define dimensions
   Dim nSwaps As Integer: nSwaps = UBound(source, 1)
   Dim fixed As Variant: ReDim fixed(1 To nSwaps, 1 To 1)
   Dim float As Variant: ReDim float(1 To nSwaps, 1 To nSwaps)
   Dim forward As Variant: ReDim forward(1 To nSwaps, 1 To 1)
   '
   ' counters and other temp variables
   Dim i As Integer, j As Integer, k As Integer, nCashFlows As Integer
   Dim OIS_DF As Double, OIS_Rate As Double, t As Double


   """ added by S.H. Lee
   Dim v_OIS_DF As Variant: ReDim v_OIS_DF(1 To nSwaps, 1 To 1)

   '
   ' loop for cash flows processing
   nCashFlows = nSwaps: k = 0
   For i = 1 To nSwaps
      '
      ' create OIS discount factor
      OIS_Rate = source(i, 2): t = source(i, 1)
      If (t <= 1) Then OIS_DF = 1 / (1 + (OIS_Rate * t))
      If (t > 1) Then OIS_DF = 1 / (1 + OIS_Rate) ^ t

      """ added by S.H. Lee
      v_OIS_DF(i, 1) = OIS_DF

      '
```

```
    ' create sum of fixed leg pv's for each individual swap and create all
    ' cash flows (excluding coupon rate) for floating legs for each individ
ual swap
    For j = 1 To nSwaps
      If (j <= nCashFlows) Then
        fixed(j + k, 1) = fixed(j + k, 1) + 100 * source(j + k, 3) * OIS_DF
        float(i, j + k) = 100 * OIS_DF
      Else
        ' replace empty array value with zero value
        float(i, nSwaps – j + 1) = 0#
      End If
    Next j
    '
    k = k + 1: nCashFlows = nCashFlows – 1
  Next i
  '
  ' solve for implied forward rates, which are going to be used to generat
e coupons
  ' for floating legs. matrix operation: [A * x = b] —> [x = Inverse(A) * b]
  ' where A = float (N x N), x = forward rates (N x 1), b = sum of swap fixe
d leg pv's (N x 1)
  forward = WorksheetFunction.MMult(WorksheetFunction.MInverse(W
orksheetFunction.Transpose(float)), fixed)

  '''' commented by S.H. Lee
  'OIS_bootstrapping = forward

  '''' added by S.H. Lee
  ' two output : OIS DF and Adjusted Libor Curve
  Dim m_out As Variant: ReDim m_out(1 To nSwaps, 1 To 2)

  For i = 1 To nSwaps
    m_out(i, 1) = v_OIS_DF(i, 1)
    m_out(i, 2) = forward(i, 1)
  Next i

  OIS_bootstrapping = m_out

End Function
```

```
Sub macro1()

   Worksheets("Sheet1").Range("H4:I11").Value = _
     OIS_bootstrapping(Worksheets("Sheet1").Range("C4:E11"))

End
```

Appendix D
Program R for Simple Libor IRS Pricing with OIS Discount

```
#===================================================================#
# Financial Econometrics & Derivatives, ML/DL using R, Python, Tensorflow
# by Sang-Heon Lee
#
# https://kiandlee.blogspot.com
#——————————————————————————-#
# OIS swap pricing by using a VBA macro in R through RDCOMClient
#===================================================================#

library(RDCOMClient)

graphics.off()  # clear all graphs
rm(list = ls()) # remove all files from your workspace

#===================================================================
# functions using RDCOMClient
#===================================================================

f_read_vector <- function(xlWbk1, sheet1, range1){

    sheet <- xlWbk1$Worksheets(sheet1)
    range <- sheet$Range(range1)
    data  <- do.call("cbind",range[["Value"]])
    data  <- matrix(unlist(data), dim(data)[1], dim(data)[2])
    return(data)
}

f_write_vector <- function(xlWbk1, sheet1, range1, data1) {

    sheet <- xlWbk1$Worksheets(sheet1)
    range <- sheet$Range(range1)
    range[["Value"]] <- asCOMArray(data1)
}
```

```
#=====================================================================
# MAIN
#=====================================================================

  # set working directory
  setwd("D:/SHLEE/blog/excel_com")

  # Create Excel Application
  xlApp <- COMCreate("Excel.Application")

  # Open the Macro Excel book
  fn <- "sample_ois.xlsm"
  xlWbk <- xlApp$Workbooks()$Open(paste0(getwd(),"/",fn))

  # use TRUE for Excel Spreadsheet to be visible
  xlApp[['Visible']] <- TRUE # FALSE

#=====================================================================
# Communicate between R and Excel
#=====================================================================

  # Arguments for Excel Spreadsheet and VBA macro
  sheet      <- "Sheet1"
  range_in   <- "D4:E11"
  range_out  <- "H4:I11"
  macro_name <- "macro1"

  #———————————————————————
  # Pass Input Market Swap Rates to Excel
  # and Get OIS DFs and adjusted FWD Rates from Excel
  #———————————————————————

  # 1) write input values from R to Excel
  #   1st column : OIS swap rates
  #   2nd column : Libor Swap Rates
  m.input <- rbind(c(0.00100, 0.00500),
                   c(0.00620, 0.01040),
                   c(0.01100, 0.01580),
                   c(0.01640, 0.02120),
                   c(0.02004, 0.02440),
```

```
             c(0.02354, 0.02760),
             c(0.02676, 0.03080),
             c(0.02958, 0.03400))

  f_write_vector(xlWbk, sheet, range_in, m.input)

  # 2) run Excel macro
  xlApp$Run(macro_name)

  # 3) read output values from R to Excel
  m.output <– f_read_vector(xlWbk, sheet, range_out)

  print(cbind(m.input, m.output))

  #———————————————————
  # Libor IRS pricing with OIS discounting
  # Check if a swap price is at par for each maturity
  #———————————————————

  v.Lib_SR <– m.input [,2] # Libor Swap Rates (input)
  v.OIS_DF <– m.output[,1] # OIS discount factor (output)
  v.adj_FD <– m.output[,2] # Adjusted Forward Rate (output)

  for(i in 1:nrow(m.output)) {
    v.fixed_leg <– sum(v.Lib_SR[i]*(3/12)*v.OIS_DF[1:i])
    v.float_leg <– sum(v.adj_FD[1:i]*(3/12)*v.OIS_DF[1:i])
    swap_pr <– v.fixed_leg – v.float_leg
    print(paste0(i,"-quarter swap price = ", swap_pr))
  }

#==========================================================
# save and quit
#==========================================================
xlWbk$close(TRUE); xlApp$Quit()
```

Appendix E
Program R to Smooth the Zero Curve of IRS LIBOR SWAP Rates

```
#==========================================================#
# Financial Econometrics & Derivatives, ML/
DL using R, Python, Tensorflow
# by Sang-Heon Lee
#
# https://kiandlee.blogspot.com
#——————————————————————————-#
# Generate Libor 3M IRS zero curve by using Bootstrapping
#==========================================================#

graphics.off()  # clear all graphs
rm(list = ls()) # remove all files from your workspace

#——————————————————————————
# Functions – Definition – Start
#——————————————————————————

# IRS swap pricer
f_zero_pricer_IRS <– function(
   fixed_rate,                  # fixed rate
   vd.fixed_date, vd.float_date, # date for two legs
   vd.zero_date,  v.zero_rate,   # zero curve (dates, rates)
   d.spot_date,                 # spot date
   no_amt) {                    # nominal principal amount

   #————————————————————-
   # 0) Preprocessing
   #————————————————————-

   # convert spot date from date(d) to numeric(n)
   n.spot_date <– as.numeric(d.spot_date)

   # Interpolation of zero curve
   vn.zero_date <– as.numeric(vd.zero_date)
   f_linear <– approxfun(vn.zero_date, v.zero_rate,
```

```
                 method="linear")
vn.zero_date.inter <- n.spot_date:max(vn.zero_date)
v.zero_rate.inter  <- f_linear(vn.zero_date)

# number of CFs
ni <- length(vd.fixed_date)
nj <- length(vd.float_date)

# output dataframe with CF dates and its interpolated zero
df.fixed = data.frame(d.date = vd.fixed_date,
                 n.date = as.numeric(vd.fixed_date))
df.float = data.frame(d.date = vd.float_date,
                 n.date = as.numeric(vd.float_date))

#----------------------------------------------------------------------
#  1)  Fixed Leg
#----------------------------------------------------------------------

# zero rate for discounting
df.fixed$zero_DC = f_linear(as.numeric(df.fixed$d.date))

# discount factor
df.fixed$DF <- exp(-df.fixed$zero_DC*
               (df.fixed$n.date-n.spot_date)/365)

# tau, CF
for(i in 1:ni) {

   ymd      <- df.fixed$d.date[i]
   ymd_prev <- df.fixed$d.date[i-1]
   if(i==1) ymd_prev <- d.spot_date

   d <- as.numeric(strftime(ymd, format = "%d"))
   m <- as.numeric(strftime(ymd, format = "%m"))
   y <- as.numeric(strftime(ymd, format = "%Y"))

   d_prev <- as.numeric(strftime(ymd_prev, format = "%d"))
   m_prev <- as.numeric(strftime(ymd_prev, format = "%m"))
   y_prev <- as.numeric(strftime(ymd_prev, format = "%Y"))
```

```
    # 30I/360
    tau <- (360*(y-y_prev) + 30*(m-m_prev) + (d-d_prev))/360

    # cash flow rate
    df.fixed$rate[i] <- fixed_rate

    # Cash flow at time ti
    df.fixed$CF[i] <- fixed_rate*tau*no_amt # day fraction
}

# Present value of CF
df.fixed$PV = df.fixed$CF*df.fixed$DF


#----------------------------------------------
#  2)  Floating Leg
#----------------------------------------------

# zero rate for discounting
df.float$zero_DC = f_linear(as.numeric(df.float$d.date))

# discount factor
df.float$DF <- exp(-df.float$zero_DC*
                (df.float$n.date-n.spot_date)/365)

# tau, forward rate, CF
for(i in 1:nj) {

    date      <- df.float$n.date[i]
    date_prev <- df.float$n.date[i-1]

    DF        <- df.float$DF[i]
    DF_prev   <- df.float$DF[i-1]

    if(i==1) {
        date_prev <- n.spot_date
        DF_prev   <- 1
    }

    # ACT/360
```

```
    tau <- (date - date_prev)/360

    # forward rate
    fwd_rate <- (1/tau)*(DF_prev/DF-1)

    # cash flow rate
    df.float$rate[i] <- fwd_rate

    # Cash flow amount at time ti
    df.float$CF[i] <- fwd_rate*tau*no_amt # day fraction
  }

  # Present value of CF
  df.float$PV = df.float$CF*df.float$DF

  return(sum(df.fixed$PV) - sum(df.float$PV))
}

# objective function to be minimized
objf <- function(
  v.unknown_swap_zero_rate, # unknown zero curve (rates)
  vn.unknown_swap_maty,     # unknown swap maturity
  v.swap_rate,              # fixed rate
  vd.fixed_date,            # date for fixed leg
  vd.float_date,            # date for float leg
  vd.zero_date_all,         # all dates for zero curve
  v.zero_rate_known,        # known zero curve (rates)
  d.spot_date,              # spot date
  no_amt) {                 # nominal principal amount

  # zero curve augmented with zero rates for swaps
  v.zero_rate_all <- c(v.zero_rate_known,  v.unknown_swap_zero_rate)

  v.swap_price <- NULL

  k <- 1
  for(i in vn.unknown_swap_maty) {

    # calculate IRS swap price
    swap_price <- f_zero_pricer_IRS(
```

```
      v.swap_rate[k],       # fixed rate,
      vd.fixed_date[1🙁2*i)], # semi-annual date
      vd.float_date[1🙁4*i)], # quarterly  date
      vd.zero_date_all,     # zero curve (dates)
      v.zero_rate_all,      # zero curve (rates)
      d.spot_date,          # spot date,
      no_amt)          # nominal principal amount

    print(paste0(“Swap Price at spot date = “, round(swap_price,6)))

    # concatenate swap prices
    v.swap_price <– c(v.swap_price, swap_price)
    k <– k + 1
  }

  return(sum(v.swap_price^2))
}

#—————————————————————————
# Functions – Definition – End
#—————————————————————————

#—————————————————————————
# 1. Market Information
#—————————————————————————

# Zero curve from Bloomberg as of 2021-06-30 until 5-year maturity
df.market <– data.frame(

  d.date = as.Date(c(“2021-10-04”,“2021-12-15”,
            “2022-03-16”,“2022-06-15”,
            “2022-09-21”,“2022-12-21”,
            “2023-03-15”,“2023-07-03”,
            “2024-07-02”,“2025-07-02”,
            “2026-07-02”)),

  # we use swap rate not zero rate.
  swap_rate= c(0.00145750000000000,
        0.00139609870272047,
```

```
            0.00203838571440434,
            0.00197747863867587,
            0.00266249271921742,
            0.00359490949297661,
            0.00512603194652204,
            0.00328354999423027,
            0.00571049988269806,
            0.00793000012636185,
            0.00964949995279312
   ),

   # zero rate is only used for comparison.
   zero_rate = c(0.00147746193495074,
             0.00144337757980778,
             0.00166389741542625,
             0.00175294804717070,
             0.00196071374597585,
             0.00224582504806747,
             0.00264462838911974,
             0.00328408008984121,
             0.00571530169527018,
             0.00795496282359075,
             0.00970003866673104
   )
)

#——————————————————————————
# 2. Libor Swap Specification
#——————————————————————————

d.spot_date  <– as.Date("2021-07-02")    # spot date (date type)
n.spot_date  <– as.numeric(d.spot_date)  # spot date (numeric type)

no_amt    <– 10000000     # notional principal amount

# swap cash flow schedule from Bloomberg
lt.cf_date <– list(

   fixed = as.Date(c("2022-01-04","2022-07-05",
                "2023-01-03","2023-07-03",
```

```
              "2024-01-02","2024-07-02",
              "2025-01-02","2025-07-02",
              "2026-01-02","2026-07-02")),

   float = as.Date(c("2021-10-04","2022-01-04",
              "2022-04-04","2022-07-05",
              "2022-10-03","2023-01-03",
              "2023-04-03","2023-07-03",
              "2023-10-02","2024-01-02",
              "2024-04-02","2024-07-02",
              "2024-10-02","2025-01-02",
              "2025-04-02","2025-07-02",
              "2025-10-02","2026-01-02",
              "2026-04-02","2026-07-02"))
)

# for bootstrapped zero curve
df.zero <- data.frame(
   d.date = df.market$d.date,
   n.date = as.numeric(df.market$d.date),
   tau    = as.numeric(df.market$d.date) – n.spot_date,
   taui   = as.numeric(df.market$d.date) – n.spot_date,
   swap_rate = df.market$swap_rate,
   zero_rate = rep(0,length(df.market$d.date)),
   DF        = rep(0,length(df.market$d.date)))

# tau(i) = t(i) – t(i-1)
df.zero$taui[2:nrow(df.zero)] <-
   df.zero$n.date[2:nrow(df.zero)] –
   df.zero$n.date[1:(nrow(df.zero)–1)]

#——————————————————————————
# 3. Bootstrapping – Deposit : row 1
#——————————————————————————

# 1) calculate discount factor for deposit
df.zero$DF[1] <- 1/(1+df.zero$swap_rate[1]*df.zero$tau[1]/360)

# 2) convert DF to spot rate
df.zero$zero_rate[1] <- 365/df.zero$tau[1]*log(1/df.zero$DF[1])
```

```
df.zero

#————————————————————————————
# 4. Bootstrapping – Futures : rows from 2 to 7
#————————————————————————————

# No convexity adjustment is made
for(i in 2:7) {

   # 1) discount factor from t(i-1) to t(i)
   df.zero$DF[i] <– 1/(1+df.zero$swap_rate[i]*df.zero$taui[i]/360)

   # 2) discount factor from spot date to t(i)
   df.zero$DF[i] <– df.zero$DF[i–1]*df.zero$DF[i]

   # 3) zero rate from discount factor
   df.zero$zero_rate[i] <– 365/df.zero$tau[i]*log(1/df.zero$DF[i])
}

df.zero_until_futures <– df.zero

#————————————————————————————
# 5. Bootstrapping – Swaps : rows from 8 to 11
#————————————————————————————

#===========================================================
# method 1 : Sequential Optimization for each observed swap maturity
#===========================================================
# Bootstrapping zero rates sequentially using Brent minimization
# with known (already bootstrapped) zero rates
#—————————————————————————-

# initialization for fair comparison
df.zero <– df.zero_until_futures

for(i in 8:11) {

   # 1) find one unknown zero rate for one swap maturity
   m<–optim(0.01, objf,
```

```
      control = list(abstol=10^(-20), reltol=10^(-20),
                 maxit=50000, trace=2),
      method = c("Brent"),
      lower = 0, upper = 0.1,            # for Brent
      vn.unknown_swap_maty = 2:(i-6),       # unknown zero maturity
      v.swap_rate = df.zero$swap_rate[8:i],  # observed swap rate
      vd.fixed_date = lt.cf_date$fixed,      # date for fixed leg
      vd.float_date = lt.cf_date$float,      # date for float leg
      vd.zero_date_all = df.zero$d.date[1:i],# all dates for zero curve
      v.zero_rate_known  = df.zero$zero_rate[1:(i-1)], # known zero rates
      d.spot_date = d.spot_date, no_amt = no_amt)

   # 2) update this zero curve with the newly found zero rate
   df.zero$zero_rate[i] <- m$par

   # 3) convert this new zero rate to discount factor
   df.zero$DF[i] <- exp(-df.zero$zero_rate[i]*df.zero$tau[i]/365)
}

df.zero_seq <- df.zero # output for sequential optimization

#===============================================================
# method 2 : Global Optimization
#===============================================================

# initialization for 2nd optimization for fair comparison
df.zero <- df.zero_until_futures

   # 1) find 4 unknown zero rates for each swap maturity
   m<-optim(c(0.01, 0.01, 0.01, 0.01), objf,
      control = list(abstol=10^(-20), reltol=10^(-20),
                 maxit=50000, trace=2),
      method = c("Nelder-Mead"),
      vn.unknown_swap_maty = 2:5,           # unknown zero maturity
      v.swap_rate = df.zero$swap_rate[8:11],  # observed swap rate
      vd.fixed_date = lt.cf_date$fixed,      # date for fixed leg
      vd.float_date = lt.cf_date$float,      # date for float leg
      vd.zero_date_all = df.zero$d.date[1:11],# all dates for zero curve
      v.zero_rate_known  = df.zero$zero_rate[1:7], # known zero rates
      d.spot_date = d.spot_date, no_amt = no_amt)
```

```
  # 2) update this zero curve with the newly found 4 zero rates
  df.zero$zero_rate[8:11] <- m$par

  # 3) convert this new zero rates to discount factors
  df.zero$DF[8:11] <- exp(-df.zero$zero_rate[8:11]*
                          df.zero$tau[8:11]/365)

df.zero_glb <- df.zero # output for global optimization

#-------------------------------------------------------------
# 6. Comparison of two zero curves
#-------------------------------------------------------------

df.output <- data.frame(date     = df.market$d.date,
                        zero_mkt = df.market$zero_rate,
                        zero_seq = df.zero_seq$zero_rate,
                        zero_glb = df.zero_glb$zero_rate)

# to avoid redundant expressions of df.output$ ....
df.output <- within(df.output, {
  diff_seq = zero_mkt - zero_seq;
  diff_glb = zero_mkt - zero_glb
})

print("Comparison with Bloomberg Zero Curve")
df.output
```

Appendix F
Program R for Delta Sensitivity of Interest Rate Swap

```
#================================================================#
# Financial Econometrics & Derivatives, ML/
DL using R, Python, Tensorflow
# by Sang-Heon Lee
#
# https://kiandlee.blogspot.com
#——————————————————————————————-#
# Calculate Delta Sensitivities of Libor IRS
#================================================================#

graphics.off()  # clear all graphs
rm(list = ls()) # remove all files from your workspace

#=================================================================
# Functions – Definition
#=================================================================

#—————————————————————————
# Calculation of IRS swap price
#—————————————————————————
f_zero_prr_IRS <– function(
  fixed_rate,                # fixed rate
  vd.fixed_date, vd.float_date, # date for two legs
  vd.zero_date,  v.zero_rate,   # zero curve (dates, rates)
  d.spot_date,   no_amt,        # spot date, nominal amt
  save_cf_yn) {              # “y” : CF save

  #————————————————————————-
  # 0) Preprocessing
  #————————————————————————-

  # convert spot date from date(d) to numeric(n)
  n.spot_date <– as.numeric(d.spot_date)

  # Interpolation of zero curve
```

```
vn.zero_date <– as.numeric(vd.zero_date)
f_linear     <– approxfun(vn.zero_date, v.zero_rate,
                method="linear")
vn.zero_date.inter <– n.spot_date:max(vn.zero_date)
v.zero_rate.inter  <– f_linear(vn.zero_date)

# number of CFs
ni <– length(vd.fixed_date)
nj <– length(vd.float_date)

# output data.frame with CF dates and its interpolated zero
df.fixed = data.frame(d.date = vd.fixed_date,
                n.date = as.numeric(vd.fixed_date))
df.float = data.frame(d.date = vd.float_date,
                n.date = as.numeric(vd.float_date))

#————————————————————-
#  1)  Fixed Leg
#————————————————————-

# zero rate for discounting
df.fixed$zero_DC = f_linear(as.numeric(df.fixed$d.date))

# discount factor
df.fixed$DF <– exp(–df.fixed$zero_DC*
              (df.fixed$n.date–n.spot_date)/365)

# tau, CF
for(i in 1:ni) {

   ymd      <– df.fixed$d.date[i]
   ymd_prev <– df.fixed$d.date[i–1]
   if(i==1) ymd_prev <– d.spot_date

   d <– as.numeric(strftime(ymd, format = "%d"))
   m <– as.numeric(strftime(ymd, format = "%m"))
   y <– as.numeric(strftime(ymd, format = "%Y"))

   d_prev <– as.numeric(strftime(ymd_prev, format = "%d"))
   m_prev <– as.numeric(strftime(ymd_prev, format = "%m"))
```

```
    y_prev <- as.numeric(strftime(ymd_prev, format = "%Y"))

    # 30I/360
    tau <- (360*(y-y_prev) + 30*(m-m_prev) + (d-d_prev))/360

    # cash flow rate
    df.fixed$rate[i] <- fixed_rate

    # Cash flow at time ti
    df.fixed$CF[i] <- fixed_rate*tau*no_amt # day fraction
}

# Present value of CF
df.fixed$PV = df.fixed$CF*df.fixed$DF


#----------------------------------------------
#  2)  Floating Leg
#----------------------------------------------

# zero rate for discounting
df.float$zero_DC = f_linear(as.numeric(df.float$d.date))

# discount factor
df.float$DF <- exp(-df.float$zero_DC*
              (df.float$n.date-n.spot_date)/365)

# tau, forward rate, CF
for(i in 1:nj) {

    date      <- df.float$n.date[i]
    date_prev <- df.float$n.date[i-1]

    DF        <- df.float$DF[i]
    DF_prev   <- df.float$DF[i-1]

    if(i==1) {
       date_prev <- n.spot_date
       DF_prev   <- 1
    }
```

```
    # ACT/360
    tau <- (date - date_prev)/360

    # forward rate
    fwd_rate <- (1/tau)*(DF_prev/DF-1)

    # cash flow rate
    df.float$rate[i] <- fwd_rate

    # Cash flow amount at time ti
    df.float$CF[i] <- fwd_rate*tau*no_amt # day fraction
  }

  # Present value of CF
  df.float$PV = df.float$CF*df.float$DF

  # check for cash flows
  if (save_cf_yn == "y") {
    # print(df.float); print(df.fixed)
    write.csv(df.float, "CF_float.csv")
    write.csv(df.fixed, "CF_fixed.csv")
  }

  return(sum(df.float$PV) - sum(df.fixed$PV))
}

 #-----------------------------------------------------------
# IRS swap zero curve generator
#-----------------------------------------------------------
f_zero_maker_IRS <- function(
  df.mt,                 # market information data.frame
                         # [d.date, swap_rate, source]]
  v.unknown_swap_maty_all,  # all unknown swap maturity
  vd.fixed_date,         # date for fixed leg
  vd.float_date,         # date for float leg
  d.spot_date,           # spot date
  no_amt) {              # nominal principal amount

  # convert spot date from date(d) to numeric(n)
```

```
n.spot_date <– as.numeric(d.spot_date)

# for bootstrapped zero curve
df.zr <– data.frame(
   d.date    = df.mt$d.date,
   n.date    = as.numeric(df.mt$d.date),
   tau       = as.numeric(df.mt$d.date) – n.spot_date,
   taui      = as.numeric(df.mt$d.date) – n.spot_date,
   swap_rate = df.mt$swap_rate,
   zero_rate = rep(0,length(df.mt$d.date)),
   DF        = rep(0,length(df.mt$d.date)))

# tau(i) = t(i) – t(i-1)
df.zr$taui[2:nrow(df.zr)] <–
   df.zr$n.date[2:nrow(df.zr)] –
   df.zr$n.date[1:(nrow(df.zr)–1)]

# divide rows according to its source or instrument type
rows_deposit <– which(df.mt$source==“deposit”)
rows_futures <– which(df.mt$source==“futures”)
rows_swap    <– which(df.mt$source==“swap”)

#——————————————————————————
# 3. Bootstrapping – Deposit
#——————————————————————————

for(i in rows_deposit) {

   # 1) calculate discount factor for deposit
   df.zr$DF[i] <– 1/(1+df.zr$swap_rate[i]*df.zr$tau[i]/360)

   # 2) convert DF to spot rate
   df.zr$zero_rate[i] <– 365/df.zr$tau[i]*log(1/df.zr$DF[i])
}

#——————————————————————————
# 4. Bootstrapping – Futures
#——————————————————————————

# No convexity adjustment is made
```

```
for(i in rows_futures) {

   # 1) discount factor from t(i-1) to t(i)
   df.zr$DF[i] <– 1/(1+df.zr$swap_rate[i]*df.zr$taui[i]/360)

   # 2) discount factor from spot date to t(i)
   df.zr$DF[i] <– df.zr$DF[i–1]*df.zr$DF[i]

   # 3) zero rate from discount factor
   df.zr$zero_rate[i] <– 365/df.zr$tau[i]*log(1/df.zr$DF[i])
}

#————————————————————————
# 5. Bootstrapping – Swaps
#————————————————————————

k <– 1
for(i in rows_swap) {

   # unknown swap maturity in year
   swap_maty <– v.unknown_swap_maty_all[k]

   # 1) find one unknown zero rate for one swap maturity
   m<–optim(0.01, objf,
      control = list(abstol=10^(–20), reltol=10^(–20),
                     maxit=50000, trace=2),
      method = c("Brent"),
      lower = 0, upper = 0.1,            # for Brent
      v.unknown_swap_maty = swap_maty,      # unknown zero maturit
y
      v.swap_rate = df.zr$swap_rate[i],     # observed swap rate
      vd.fixed_date = vd.fixed_date,        # date for fixed leg
      vd.float_date = vd.float_date,        # date for float leg
      vd.zero_date_all = df.zr$d.date[1:i], # all dates for zero curve
      v.zero_rate_known  = df.zr$zero_rate[1:(i–1)], # known zero rates
      d.spot_date = d.spot_date,
      no_amt = no_amt)

   # 2) update this zero curve with the newly found zero rate
   df.zr$zero_rate[i] <– m$par
```

```
    # 3) convert this new zero rate to discount factor
    df.zr$DF[i] <- exp(-df.zr$zero_rate[i]*df.zr$tau[i]/365)

    k <- k + 1
  }
  return(df.zr)
}

#———————————————————————————
# objective function to be minimized
#———————————————————————————
objf <- function(
  v.unknown_swap_zero_rate, # unknown zero curve (rates)
  v.unknown_swap_maty,      # unknown swap maturity
  v.swap_rate,              # fixed rate
  vd.fixed_date,            # date for fixed leg
  vd.float_date,            # date for float leg
  vd.zero_date_all,         # all dates for zero curve
  v.zero_rate_known,        # known zero curve (rates)
  d.spot_date,              # spot date
  no_amt) {                 # nominal principal amount

  # zero curve augmented with zero rates for swaps
  v.zero_rate_all <- c(v.zero_rate_known,
                       v.unknown_swap_zero_rate)

  v.swap_pr <- NULL # vector of swap prices

  k <- 1
  for(i in v.unknown_swap_maty) {

    # calculate IRS swap price
    swap_pr <- f_zero_prr_IRS(
      v.swap_rate[k],          # fixed rate,
      vd.fixed_date[1🙁2*i)],  # semi-annual date
      vd.float_date[1🙁4*i)],  # quarterly  date
      vd.zero_date_all,        # zero curve (dates)
      v.zero_rate_all,         # zero curve (rates)
```

```
        d.spot_date, no_amt, "n")

      # concatenate swap prices
      v.swap_pr <- c(v.swap_pr, swap_pr)
      k <- k + 1
   }

   return(sum(v.swap_pr^2))
}

#================================================================
# Main
#================================================================

#————————————————————————
# 1. Market Information
#————————————————————————

# Zero curve from Bloomberg as of 2021-06-30 until 5-year maturity
df.mt <- data.frame(

   d.date = as.Date(c("2021-10-04","2021-12-15",
                 "2022-03-16","2022-06-15",
                 "2022-09-21","2022-12-21",
                 "2023-03-15","2023-07-03",
                 "2024-07-02","2025-07-02",
                 "2026-07-02")),

   # we use swap rate not zero rate.
   swap_rate= c(0.00145750000000000,
            0.00139609870272047,
            0.00203838571440434,
            0.00197747863867587,
            0.00266249271921742,
            0.00359490949297661,
            0.00512603194652204,
            0.00328354999423027,
            0.00571049988269806,
            0.00793000012636185,
            0.00964949995279312
```

```
  ),

  source = c("deposit", rep("futures",6), rep("swap", 4))
)

#-----------------------------------------------------
# 2. Libor Swap Specification
#-----------------------------------------------------

d.spot_date  <- as.Date("2021-07-02")   # spot date (date type)
n.spot_date  <- as.numeric(d.spot_date) # spot date (numeric type)

no_amt    <- 10000000     # notional principal amount

# swap cash flow schedule from Bloomberg
lt.cf_date <- list(

  fixed = as.Date(c("2022-01-04","2022-07-05",
             "2023-01-03","2023-07-03",
             "2024-01-02","2024-07-02",
             "2025-01-02","2025-07-02",
             "2026-01-02","2026-07-02")),

  float = as.Date(c("2021-10-04","2022-01-04",
             "2022-04-04","2022-07-05",
             "2022-10-03","2023-01-03",
             "2023-04-03","2023-07-03",
             "2023-10-02","2024-01-02",
             "2024-04-02","2024-07-02",
             "2024-10-02","2025-01-02",
             "2025-04-02","2025-07-02",
             "2025-10-02","2026-01-02",
             "2026-04-02","2026-07-02"))
)


#-----------------------------------------------------
# 3. 5-year swap price : base
#-----------------------------------------------------
```

```
i = 5 # 5-year swap

# zero pricing
df.zr <– f_zero_maker_IRS(
        df.mt, c(2,3,4,5),
        lt.cf_date$fixed, lt.cf_date$float,
        d.spot_date, no_amt)

pr   <– f_zero_prr_IRS(
        df.mt$swap_rate[i+6],
        lt.cf_date$fixed[1🙁2*i)],
        lt.cf_date$float[1🙁4*i)],
        df.zr$d.date, df.zr$zero_rate,
        d.spot_date,no_amt, save_cf_yn = “y”)

print(paste0(i,“-year Swap price at spot date = “, pr))

df.zr_delta   <– df.mt_delta   <– df.zr[,–c(2,3,4)]
df.zr_delta$pr <– df.mt_delta$pr <– pr

#———————————————————————————
# 3. Bump and Reprice for Market Greeks
#———————————————————————————

df.mt_delta$delta <– df.mt_delta$pr_up <– df.mt_delta$pr_dn <– NA

# iteration for all market maturities
for(r in 1:11) {

   #—————————
   # bump up (1bp up)
   #—————————
   df.mt_bump <– df.mt   # initialization
   df.mt_bump$swap_rate[r] <– df.mt_bump$swap_rate[r] + 0.0001

   # zero pricing
   df.zr <– f_zero_maker_IRS(df.mt_bump, c(2,3,4,5),
           lt.cf_date$fixed, lt.cf_date$float,
           d.spot_date, no_amt)
```

```
pr   <– f_zero_prr_IRS(df.mt$swap_rate[i+6],
          lt.cf_date$fixed[1🙁2*i)],
          lt.cf_date$float[1🙁4*i)],
          df.zr$d.date, df.zr$zero_rate,
          d.spot_date, no_amt, “n”)

# save price with bumping up
df.mt_delta$pr_up[r] <– pr

# check whether swap prices at spot date is at par
pr   <– f_zero_prr_IRS(df.mt_bump$swap_rate[i+6],
          lt.cf_date$fixed[1🙁2*i)],
          lt.cf_date$float[1🙁4*i)],
          df.zr$d.date, df.zr$zero_rate,
          d.spot_date,no_amt, “n”)

print(paste0(i,“-year Swap price at spot date = “, pr))

#————————
# bump down (1bp down)
#————————
df.mt_bump <– df.mt   # initialization
df.mt_bump$swap_rate[r] <– df.mt_bump$swap_rate[r] – 0.0001

# zero pricing
df.zr <– f_zero_maker_IRS(df.mt_bump, c(2,3,4,5),
          lt.cf_date$fixed, lt.cf_date$float,
          d.spot_date, no_amt)

pr <– f_zero_prr_IRS(df.mt$swap_rate[i+6],
       lt.cf_date$fixed[1🙁2*i)], lt.cf_date$float[1🙁4*i)],
       df.zr$d.date, df.zr$zero_rate, d.spot_date,no_amt, “n”)

# save price with bumping down
df.mt_delta$pr_dn[r] <– pr

# check whether swap prict at spot date is at par
pr <– f_zero_prr_IRS(df.mt_bump$swap_rate[i+6],
```

```
        lt.cf_date$fixed[1🙁2*i)], lt.cf_date$float[1🙁4*i)],
        df.zr$d.date, df.zr$zero_rate, d.spot_date,no_amt, “n”)

  print(paste0(i,“-year Swap price at spot date = “, pr))
}

# Market Greeks : Delta calculation
df.mt_delta$delta <– (df.mt_delta$pr_up –
              df.mt_delta$pr_dn)/2

df.mt_delta

x11(width = 5, height = 3.5)
barplot(delta ~ substr(d.date,1,7), data = df.mt_delta,
     width = 0.5, col = “blue”)

x11(width = 5, height = 3.5)
barplot(delta ~ substr(d.date,1,7), data = df.mt_delta[1:10,],
     width = 0.5, col = “green”)

#——————————————————————————
# 4. Bump and Reprice for Zero Greeks
#——————————————————————————

df.zr_delta$delta <– df.zr_delta$pr_up <– df.zr_delta$pr_dn <– NA

# zero pricing
df.zr <– f_zero_maker_IRS(df.mt, c(2,3,4,5),
                  lt.cf_date$fixed, lt.cf_date$float, d.spot_date, no_amt)

for(r in 1:11) {

  #—————————
  # bump up (1bp up)
  #—————————
  df.zr_bump   <– df.zr  # initialization
  df.zr_bump$zero_rate[r] <– df.zr_bump$zero_rate[r] + 0.0001

  # zero pricing
```

```
   pr   <– f_zero_prr_IRS(df.mt$swap_rate[i+6],
           lt.cf_date$fixed[1🙁2*i)], lt.cf_date$float[1🙁4*i)],
           df.zr_bump$d.date, df.zr_bump$zero_rate,
           d.spot_date, no_amt, “n”)

   # save price with bumping up
   df.zr_delta$pr_up[r] <– pr

   #————————
   # bump down (1bp down)
   #————————
   df.zr_bump    <– df.zr  # initialization
   df.zr_bump$zero_rate[r] <– df.zr_bump$zero_rate[r] – 0.0001

   # zero pricing
   pr <– f_zero_prr_IRS(df.mt$swap_rate[i+6],
         lt.cf_date$fixed[1🙁2*i)], lt.cf_date$float[1🙁4*i)],
         df.zr_bump$d.date, df.zr_bump$zero_rate,
         d.spot_date,no_amt, “n”)

   # save price with bumping down
   df.zr_delta$pr_dn[r] <– pr
}

# Market Greeks : Delta calculation
df.zr_delta$delta <– (df.zr_delta$pr_up –
                 df.zr_delta$pr_dn)/2

df.zr_delta

x11(width = 5, height = 3.5)
barplot(delta ~ substr(d.date,1,7), data = df.zr_delta,
      width = 0.5, col = “blue”)

x11(width = 5, height = 3.5)
barplot(delta ~ substr(d.date,1,7), data = df.zr_delta[1:10,],
      width = 0.5, col = “green”)
# Financial Econometrics & Derivatives, ML/
DL using R, Python, Tensorflow
```

```
# by Sang-Heon Lee
#
# https://kiandlee.blogspot.com
#———————————————————————————————-#
# Calculate Delta Sensitivities of Libor IRS
#=============================================================#

graphics.off()  # clear all graphs
rm(list = ls()) # remove all files from your workspace

#==============================================================
# Functions – Definition
#==============================================================

#—————————————————————————
# Calculation of IRS swap price
#—————————————————————————
f_zero_prr_IRS <– function(
   fixed_rate,                  # fixed rate
   vd.fixed_date, vd.float_date, # date for two legs
   vd.zero_date,  v.zero_rate,   # zero curve (dates, rates)
   d.spot_date,   no_amt,        # spot date, nominal amt
   save_cf_yn) {                 # "y" : CF save

   #————————————————————————-
   # 0) Preprocessing
   #————————————————————————-

   # convert spot date from date(d) to numeric(n)
   n.spot_date <– as.numeric(d.spot_date)

   # Interpolation of zero curve
   vn.zero_date <– as.numeric(vd.zero_date)
   f_linear     <– approxfun(vn.zero_date, v.zero_rate,
                    method="linear")
   vn.zero_date.inter <– n.spot_date:max(vn.zero_date)
   v.zero_rate.inter  <– f_linear(vn.zero_date)

   # number of CFs
   ni <– length(vd.fixed_date)
```

```
nj <- length(vd.float_date)

# output data.frame with CF dates and its interpolated zero
df.fixed = data.frame(d.date = vd.fixed_date,
                      n.date = as.numeric(vd.fixed_date))
df.float = data.frame(d.date = vd.float_date,
                      n.date = as.numeric(vd.float_date))

#----------------------------------------------------------------
#  1)  Fixed Leg
#----------------------------------------------------------------

# zero rate for discounting
df.fixed$zero_DC = f_linear(as.numeric(df.fixed$d.date))

# discount factor
df.fixed$DF <- exp(-df.fixed$zero_DC*
                   (df.fixed$n.date-n.spot_date)/365)

# tau, CF
for(i in 1:ni) {

    ymd      <- df.fixed$d.date[i]
    ymd_prev <- df.fixed$d.date[i-1]
    if(i==1) ymd_prev <- d.spot_date

    d <- as.numeric(strftime(ymd, format = "%d"))
    m <- as.numeric(strftime(ymd, format = "%m"))
    y <- as.numeric(strftime(ymd, format = "%Y"))

    d_prev <- as.numeric(strftime(ymd_prev, format = "%d"))
    m_prev <- as.numeric(strftime(ymd_prev, format = "%m"))
    y_prev <- as.numeric(strftime(ymd_prev, format = "%Y"))

    # 30I/360
    tau <- (360*(y-y_prev) + 30*(m-m_prev) + (d-d_prev))/360

    # cash flow rate
    df.fixed$rate[i] <- fixed_rate
```

```
    # Cash flow at time ti
    df.fixed$CF[i] <- fixed_rate*tau*no_amt # day fraction
}

# Present value of CF
df.fixed$PV = df.fixed$CF*df.fixed$DF


#-----------------------------------------------------
#  2)  Floating Leg
#-----------------------------------------------------

# zero rate for discounting
df.float$zero_DC = f_linear(as.numeric(df.float$d.date))

# discount factor
df.float$DF <- exp(-df.float$zero_DC*
                (df.float$n.date-n.spot_date)/365)

# tau, forward rate, CF
for(i in 1:nj) {

    date      <- df.float$n.date[i]
    date_prev <- df.float$n.date[i-1]

    DF       <- df.float$DF[i]
    DF_prev   <- df.float$DF[i-1]

    if(i==1) {
        date_prev <- n.spot_date
        DF_prev   <- 1
    }

    # ACT/360
    tau <- (date - date_prev)/360

    # forward rate
    fwd_rate <- (1/tau)*(DF_prev/DF-1)

    # cash flow rate
```

```
      df.float$rate[i] <– fwd_rate

      # Cash flow amount at time ti
      df.float$CF[i] <– fwd_rate*tau*no_amt # day fraction
   }

   # Present value of CF
   df.float$PV = df.float$CF*df.float$DF

   # check for cash flows
   if (save_cf_yn == "y") {
      # print(df.float); print(df.fixed)
      write.csv(df.float, "CF_float.csv")
      write.csv(df.fixed, "CF_fixed.csv")
   }

   return(sum(df.float$PV) – sum(df.fixed$PV))
}

 #————————————————————————
# IRS swap zero curve generator
#————————————————————————
f_zero_maker_IRS <– function(
   df.mt,                # market information data.frame
                         # [d.date, swap_rate, source]]
   v.unknown_swap_maty_all,  # all unknown swap maturity
   vd.fixed_date,          # date for fixed leg
   vd.float_date,          # date for float leg
   d.spot_date,            # spot date
   no_amt) {               # nominal principal amount

   # convert spot date from date(d) to numeric(n)
   n.spot_date <– as.numeric(d.spot_date)

   # for bootstrapped zero curve
   df.zr <– data.frame(
      d.date   = df.mt$d.date,
      n.date   = as.numeric(df.mt$d.date),
      tau      = as.numeric(df.mt$d.date) – n.spot_date,
      taui     = as.numeric(df.mt$d.date) – n.spot_date,
```

```
    swap_rate = df.mt$swap_rate,
    zero_rate = rep(0,length(df.mt$d.date)),
    DF        = rep(0,length(df.mt$d.date)))

# tau(i) = t(i) – t(i-1)
df.zr$taui[2:nrow(df.zr)] <–
    df.zr$n.date[2:nrow(df.zr)] –
    df.zr$n.date[1:(nrow(df.zr)–1)]

# divide rows according to its source or instrument type
rows_deposit <– which(df.mt$source==“deposit”)
rows_futures <– which(df.mt$source==“futures”)
rows_swap    <– which(df.mt$source==“swap”)

#—————————————————————————
# 3. Bootstrapping – Deposit
#—————————————————————————

for(i in rows_deposit) {

    # 1) calculate discount factor for deposit
    df.zr$DF[i] <– 1/(1+df.zr$swap_rate[i]*df.zr$tau[i]/360)

    # 2) convert DF to spot rate
    df.zr$zero_rate[i] <– 365/df.zr$tau[i]*log(1/df.zr$DF[i])
}

#—————————————————————————
# 4. Bootstrapping – Futures
#—————————————————————————

# No convexity adjustment is made
for(i in rows_futures) {

    # 1) discount factor from t(i-1) to t(i)
    df.zr$DF[i] <– 1/(1+df.zr$swap_rate[i]*df.zr$taui[i]/360)

    # 2) discount factor from spot date to t(i)
    df.zr$DF[i] <– df.zr$DF[i–1]*df.zr$DF[i]
```

```
    # 3) zero rate from discount factor
    df.zr$zero_rate[i] <- 365/df.zr$tau[i]*log(1/df.zr$DF[i])
  }

  #-------------------------------------------
  # 5. Bootstrapping - Swaps
  #-------------------------------------------

  k <- 1
  for(i in rows_swap) {

    # unknown swap maturity in year
    swap_maty <- v.unknown_swap_maty_all[k]

    # 1) find one unknown zero rate for one swap maturity
    m<-optim(0.01, objf,
      control = list(abstol=10^(-20), reltol=10^(-20),
                     maxit=50000, trace=2),
      method = c("Brent"),
      lower = 0, upper = 0.1,          # for Brent
      v.unknown_swap_maty = swap_maty,     # unknown zero maturit
y
      v.swap_rate = df.zr$swap_rate[i],     # observed swap rate
      vd.fixed_date = vd.fixed_date,       # date for fixed leg
      vd.float_date = vd.float_date,       # date for float leg
      vd.zero_date_all = df.zr$d.date[1:i], # all dates for zero curve
      v.zero_rate_known  = df.zr$zero_rate[1:(i-1)], # known zero rates
      d.spot_date = d.spot_date,
      no_amt = no_amt)

    # 2) update this zero curve with the newly found zero rate
    df.zr$zero_rate[i] <- m$par

    # 3) convert this new zero rate to discount factor
    df.zr$DF[i] <- exp(-df.zr$zero_rate[i]*df.zr$tau[i]/365)

    k <- k + 1
  }
  return(df.zr)
}
```

```
#————————————————————————
# objective function to be minimized
#————————————————————————
objf <– function(
   v.unknown_swap_zero_rate, # unknown zero curve (rates)
   v.unknown_swap_maty,      # unknown swap maturity
   v.swap_rate,              # fixed rate
   vd.fixed_date,            # date for fixed leg
   vd.float_date,            # date for float leg
   vd.zero_date_all,         # all dates for zero curve
   v.zero_rate_known,        # known zero curve (rates)
   d.spot_date,              # spot date
   no_amt) {                 # nominal principal amount

   # zero curve augmented with zero rates for swaps
   v.zero_rate_all <– c(v.zero_rate_known,
                        v.unknown_swap_zero_rate)

   v.swap_pr <– NULL # vector of swap prices

   k <– 1
   for(i in v.unknown_swap_maty) {

      # calculate IRS swap price
      swap_pr <– f_zero_prr_IRS(
         v.swap_rate[k],        # fixed rate,
         vd.fixed_date[1🙁2*i)],  # semi-annual date
         vd.float_date[1🙁4*i)],  # quarterly   date
         vd.zero_date_all,      # zero curve (dates)
         v.zero_rate_all,       # zero curve (rates)
```

References

ARABIC BOOKS:

1. Ibn Taymiyyah, Ahmad Al-Harrani Al-Dimashqi, (The Hesba in Islam), Dar Al-Bayan, Damascus, 1967.
2. Ibn Abdin, Hashiyat Ibn Abdin, Volume 4.
3. Judge Abdul-Jabbar, (The singer in the chapters on monotheism and justice), vol. 11.
4. Kantakji, Dr. Samer Mazhar, Controls of Islamic Economics in Dealing with Global Crises, 2008, published by Dar Al-Nahda (Damascus), Dar Shuaa (Aleppo), and Dar Al-Sayed (Riyadh).
5. Kantakji, Dr. Samer Mazhar, (The Finance Industry in Islamic Banks and Financial Institutions), Dar Shuaa Publishing.
6. Kantakji, Dr. Samer Mazhar, (The Transactions Series: The Standard for Measuring the Performance of Islamic Financial Transactions as an Alternative to the LIBOR Index), Dar Shuaa, 2003.
7. Kantakji, Dr. Samer Mazhar, (Rationalizing Maintenance Operations by Quantitative Methods), Master's Thesis, University of Aleppo, 2000.
8. Lotfy, Dr. Amer, (The Stock Swap and the Foundations of Investment and Employment), Dar Shuaa Publications, 1999.
9. Al-Dimashqi, Abi Al-Fadl Jaafar bin Ali, (Referring to the advantages of trade and knowing the good symptoms and

their redness and the deceit of those who deceive them), Dar Sader, Beirut, 1999.

ENGLISH BOOKS:

10. Eugene F. Brigham and Michael C. Ehrhardt, (Financial Management Theory & Practice), Thompson, South Western, USA, 2005.

MAGAZINES:

11. Global Islamic Economics Magazine, No. 15-2016.
12. The Economist, Issue 25-08-2016, entitled: When 2% is not enough.

WEBSITES:

13. www.bba.org.uk
14. www.thomsonreuters.com
15. www.aaoifi.com
16. www.en.wikipedia.org/wiki/Internal_rate_of_return
17. Di Cook, Interest Rate Swap Pricing using R, R-Bloggers website, July 10, 2021, Link.
18. Di Cook, Bootstrapping the Zero Curve from IRS Swap Rates using R code, July 18, 2021, Link.
19. K & L Fintech Modeling, RDCOM Client: A Simple Libor IRS Pricing with OIS Discounting, Jul 31, 2021, Link.
20. Sang-Heon Lee, Delta Sensitivity of Interest Rate Swap, R-bloggers, July 23, 2021, Link.

To download the book exercises: mqam_excersises.zip

صدر للمؤلف

١) **ترشيد عمليات الصيانة بالأساليب الكمية** – نشر الكتروني. ويتضمن ثلاثة نماذج رياضية فريدة:
- – نموذج استبدال التجهيزات (أسلوب البرمجة الديناميكية).
- – نموذج تخزين قطع التبديل (أسلوب البرمجة الخطية والبرمجة الديناميكية).
- – نموذج قياس الموثوقية.

٢) **دور الحضارة الإسلامية في تطوير الفكر المحاسبي** – نشر الكتروني.

٣) **فقه المحاسبة الإسلامية / الجزء الأول: المنهجية العامة**، نشرته مؤسسة الرسالة ناشرون بدمشق – والآن منشور الكترونيا.

٤) **معجم مصطلحات فقهية عربي / عربي** – نشر الكتروني.

٥) **فقه المحاسبة الإسلامية / الجزء الثاني: المحاسبة الاجتماعية**، نشرته دار النهضة بدمشق – والآن منشور الكترونيا.

٦) **مشكلة البطالة وعلاجها في الفقه الإسلامي**، نشرته مؤسسة الرسالة ناشرون بدمشق – والآن منشور الكترونيا.

٧) **الفروق الجوهرية بين المصارف الإسلامية والمصارف الربوية**، دار شعاع – والآن منشور الكترونيا.

٨) **صناعة التمويل في المصارف والمؤسسات المالية الإسلامية**، دار شعاع. – والآن منشور الكترونيا.

٩) **التأمين الإسلامي التكافلي، أسسه ومحاسبته**، دار شعاع.

١٠) **لغة الإفصاح المالي والمحاسبي XBRL**، دار أبي الفداء للنشر والتوزيع والترجمة – والآن منشور الكترونيا.

١١) **سياستا تحصيل الزكاة وإلغاء الضرائب الماليتين (فقه الاقتصاد المالي)**، دار شعاع – والآن منشور الكترونيا.

١٢) **صندوق القرض الحسن**، دار شعاع – والآن منشور الكترونيا.

١٣) **ضوابط الاقتصاد الإسلامي في معالجة الأزمات المالية العالمية**، نشرته دار النهضة بدمشق – ودار السيد بالمملكة العربية السعودية – ونشرته دار شعاع بحلب (نسخة مزيدة ومنقحة) – والآن منشور الكترونيا.

١٤) **فقه المعاملات الرياضي**، دار أبي الفداء للنشر والتوزيع والترجمة – نشر الكتروني.

ويتضمن خمسة نماذج رياضية فريدة :

- النموذج الرياضي للربا.
- النموذج الرياضي للبيوع.
- النموذج الرياضي للغرر.
- النموذج الرياضي للاقتصاد الإسلامي.
- نموذج قياس أداء المعاملات المالية الإسلامية بديلا عن مؤشر ليبور.

١٥) **فقه الأسواق**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.

١٦) **فقه الإيراد**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا. والكتاب مترجم للغة الأوردو.

١٧) **فقه التكلفة**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.

١٨) **فقه الربح**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.

١٩) **أيهما أصلح في الاستثمار معيار الربح أم معيار الاستثمار؟**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.

٢٠) **نموذج توزيع أرباح وخسائر شركات المضاربة الإسلامية – نموذج رياضي–**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا. والكتاب مترجم للانكليزية.

٢١) **الفساد، أسبابه ونتائجه والحلول المقترحة للقضاء عليه**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.

٢٢) **معيار قياس أداء المعاملات المالية الإسلامية (بديلاً عن مؤشر الفائدة)**، (سلسلة فقه المعاملات الإسلامية) مؤسسة الرسالة ناشرون بدمشق – والآن منشورة الكترونيا.
٢٣) **مؤسسات البنية التحتية للصناعة المالية الإسلامية** – نشر الكتروني.
٢٤) **أربعون قاعدة في الاقتصاد لبناء الأمة وإصلاح البلاد قواعد اقتصادية من أحاديث النبي صلى الله عليه وسلم** – نشرته دار الحديث والسيرة النبوية بدمشق – نشر الكتروني، ونشرته هيئة الاعجاز العلمي في القرآن والسنة لشمال المغرب.
٢٥) **البحثُ العلميُّ نظراتٌ في مَنهجِهِ ورسالتِهِ** – نشر الكتروني.
٢٦) **فقه الابتكار المالي بين التثبت والتهافت** – نشر الكتروني.
٢٧) **منهج التغيير في كلمات رئيس التحرير** – نشر الكتروني.
٢٨) **نظرات في كتاب لمحة الناظر في مسك الدفاتر** (تأليف مشترك) – نشر الكتروني.
٢٩) **حلو الكلام** – نشر الكتروني.
٣٠) **إضاءات على الهداية الإلهامية في مسك الدفاتر والأعمال التجارية** (تأليف مشترك) – نشر الكتروني.
٣١) **معيار قياس أداء المعاملات المالية الإسلامية، مقام بديلا عن مؤشر ليبور** – نشر الكتروني.
٣٢) **محاسبة التأمين الإسلامي** – نشر الكتروني.
٣٣) **نظرات اقتصادية في تفسير الآي القرآنية – الجزء الأول: التفسير التحليلي** – نشر الكتروني.
٣٤) **فقه الإدارة المالية والتحليل المالي** – نشر الكتروني.
٣٥) **السياسات النقدية والمالية والاقتصادية، المثلث غير المتساوي الأضلاع بنظرة إسلامية**، منشورات كاي، نشر إلكتروني.
٣٦) **إدراك الحقائق طريق الإيمان**، منشورات كاي، نشر إلكتروني.
37) **Performance Measurement Standard Financial Transactions** - MQAM (Ohaj - Kantakji) Model, KIE Publication.

إضافة لأكثر من ٣٧٠ مقالًا متخصصًا والمؤلفات متاحة بالرابط: https://kantakji.com