Istijrar Contracts – An Untapped Gem in Hedging Price Risk in Commodity Accumulators

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Abstract

Derivatives continue to play an integral role in hedging several types of risk in conventional as well as Islamic finance. While there has been, and continues to be, a lack of consensus from Islamic scholars regarding the complete permissibility of the usage of derivatives in risk management, efforts have been made in order to develop and innovate Shariah-compliant equivalents to conventional contracts in order to ensure that Islamic Financial Institutions (IFIs) and Shariah-compliant clients have prudent risk management tools to minimize their risk exposure on several fronts. This study proposes a Shariah-compliant Istijrar Accumulator model to hedge against price and commodity risk by using Murabaha-based Istijrar contracts as a way to set a price mechanism for the supply of commodities during a long time period. A binomial option pricing model, Cox, Ross & Rubenstein (1976), is used to determine the intrinsic value of the contract, adjusted for the Ribawi factor (interest factor) by replacing risk-free rate with the AAA sukuk return. The proposed Shariah-compliant model is also compared with the conventional KODA structures model as a test for fairness between each party involved in the contract. The results of the model show that the proposed Islamic Istijrar Accumulator limits the downside risk that is observed in the conventional commodity accumulators (dubbed as ‘I’ll kill you later” contracts). Risk is shared rather than transferred between both counterparties in the Istijrar accumulator model which confirms that the payoffs to each party is fair and therefore, a better alternative as an accumulator structure than the conventional model.

Keywords: Islamic derivatives, price risk, payoff fairness, Islamic commodity accumulator, Istijrar contracts, Istijrar Accumulator
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CHAPTER 1: INTRODUCTION

1.1 Background

The increase in global financial integration and cross-investments has prompted a rise in seeking prudent financial risk management practices with the objective of hedging against risks involving price movements, interest rate movements, and foreign exchange impact on global investments. This is further exacerbated by the consequences of previous financial crises making it clear that any gains that had been achieved through decades of strategized financial management can be lost within a day if no substantive frameworks for the management of financial risks in the financial sector have been put in place. As such, many financial institutions started developing financial derivatives in order to protect their assets and investments from bankruptcy and mitigate the effects of an economic collapse, despite the fact the these very same derivatives which were meant to hedge risks may themselves become a source of danger and instability if their use is abused by speculators who aim to benefit from short-term gains and other investors who have no understanding of the implication of the usage of these financial instruments on their investments, case in point, the Credit Default Swaps (CDSs) that were a contributor to the global financial crisis of 2007/08.

As with other financial institutions, Islamic Financial Institutions (IFIs) are exposed to different categories of risk, financial and otherwise, and with the exponential growth that the Islamic finance sector has seen over the past decade, we find that this expansion has exposed the IFIs to new emerging risks (Ehsan & Ruslan, 2015). With that said, risk management through the use of derivatives and conventional hedging techniques has not historically been an interest to said IFIs due to the absence of instruments that comply to the Shariah principles of avoiding riba (interest), gharar (uncertainty) and maysir (gambling), which has left Islamic institutions
vulnerable to volatility in the markets without sufficient measures to control risk. With this lack of adequate hedging instruments, we find that most of the Islamic investment portfolios are allocated to low-risk assets such as Murabahah and Ijarah contracts, while higher risk investments in Musharaka and Mudarabah contracts are less frequent. Given that, some Islamic financial institutions have started using the Islamic equivalents of forwards and futures as a way to hedge risk, but there is always the case of the degree of sophistication now required to reflect the more complex and fast-paced environment, which IFIs are still far behind compared to their conventional counterparts.

1.2 Significance of Innovation and Financial Engineering in Islamic Financial Markets

The Islamic financial sector’s growth has been exponential during the past decade with global Islamic finance assets increasing from $2 trillion in 2016 to $2.6 trillion in 2017, according to (IFSB, 2017). The industry is currently at the stage where it is faced with the primary objective of maintaining this upswing to achieve sustainable growth. There are still a limited set of Shariah-compliant instruments that are used to keep up with the growing needs and sophistication of the Muslim investors as well as the competitive products and innovations in the conventional finance realm, however, it remains a fact that the market size remains far below its real potential in terms of asset base and annual turnover due to the absence of breadth and depth in the market. However, given the nature of the innovation process with its complexity and sensitivity and the fact that it requires multidisciplinary considerations that entail a thorough understanding of Islamic jurisprudence, the process of innovation in the Islamic Finance realm is slow compared to the pace at which products are developed and commercially utilized in conventional financial markets. Today’s market, however, is exhibiting a high demand for innovative instruments to help manage risk in increasingly sophisticated business environments and to enhance market liquidity, develop a secondary market, and perform risk management.
Iqbal & Mirakhor (2011) define the process of financial engineering as building complex instruments by utilizing basic building blocks or unbundling and repackaging different components of existing financial instruments, e.g. return, price risk, credit risk, country risk, etc. Therefore, when scrutinizing the instruments underlying the Islamic financial system we find that such instruments have similar characteristics to many of today’s basic building blocks and it becomes only a matter of structuring and designing sophisticated instruments without violating any of the boundaries put forth by the Shariah jurisprudence.

1.3 Problem Statement

While there have been scarce mentions for the potential of using Istijrar contracts (being a product of financial engineering) as a hedging instrument, there is an absolute lack of literature present on pricing Istijrar contracts and defining the structure through it which it can be commercially utilized. Additionally, the Accumulator structure used in conventional finance depends primarily on the usage of knock-out options, which cease to exist as soon as the price of the commodity breaches a certain barrier. Alternatively, this study uses knock-in barrier options by way of using Wa’ads to structure this model, which is not used in conventional accumulator structures, and which will also work on a risk-sharing (rather than a risk transfer mechanism) in order to comply to Shariah standards.

1.4 Objective of this study

The objective of this study is to apply the concept of the conventional Accumulator structure (Knock Out Discount Accumulators) in Islamic finance using shariah compliant elements by utilizing Istijjar contracts with Murabaha and Wa’ad elements to alleviate the consequences of price movements on companies that have an intermittent need to source raw materials/
commodities. Conventional pricing methodologies of such contracts are also modified to comply with the Shariah principles.

1.5 Research Questions

This study makes an attempt at answering the following research questions:

1) How can an accumulator model be structured using a Murabaha-based Istijrar contract with Wa’ad elements to distribute the risk between both parties involved in the agreement.

2) What are the payoffs to each party in the agreement?

3) How can the CRR pricing model be applied in valuing an Istijrar structure using up-and-in call barrier option and down-and-in put barrier option pricing?

4) What is the profitability of an Istijrar structure compared to the conventional KODA structure when hedging price risk, and in terms of the fairness to each party?

1.6 Motivation and Contribution

Pointing to the fact that the field of derivatives in Islamic finance is still in its infancy stage with a lack of the sophistication and depth present in many conventional derivative structures, this study attempts to add to the field of Islamic risk management through the creation of an Istijrar Accumulator structure, especially due to the lack of academic research geared towards using Istijrar contracts as a derivative instrument that can be used to hedge against the risk of price movements, and also as a means to accumulate commodities/raw materials for suppliers while managing the risk of price movements during the tenor of the contract. Therefore, this study creates and evaluates an Istijrar model using Wa’ad and Murabaha elements as a present day Islamic Accumulator to manage the price risk in such supply agreements.
1.7 Structure of this study

Chapter 2 of this study conducts a literature review on the permissibility of derivatives in an Islamic context, the current alternatives to conventional derivative structures, the use of Wa’ad contracts as hedging tools as well as the definition, the types, and the applications of Istijrar contracts. The last section of the literature review highlights the usage of KODA structure in a conventional sense as a way to cumulate commodities over a certain time period.

The 3rd Chapter provides an insight into the Istijrar Accumulator model development, the payoffs to each of the parties, and pricing model used to find its intrinsic value. The 4th and 5th chapter then move on to discuss the findings and results obtained from the study as well as a conclusion to the study, its limitations and finally the recommendations to future research in the subject matter.
CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The explicit use of derivatives remains highly controversial in the Islamic finance field, to the degree that even though some common conventional products (such as futures, options and warrants) may be approved by one group of scholars there is no current consensus permitting those types of products/transactions as freely as investors might hope. This stems from the fact that Islamic finance is governed by Shariah principles which bans interest, short selling and speculation, and stipulates that income must be derived as profits from shared risk rather than guaranteed return. Additionally, it has become apparent that the use of derivatives in conventional finance is often carried out to maximize profit through speculations rather than facilitating business activity (Luiz Rossi, 2013) which is a differentiating factor in the risk management practices of Islamic finance where hedging is allowed and considered a prudent practice if used solely for the purpose of protecting against the loss of value of an investment as a result of market conditions e.g. currency or price fluctuations, or any risk that arises during the course of operating a business or managing an asset. Another important differentiating factor is the requirement for the ownership of the underlying asset by the selling party before entering into any agreement to comply with the Hadith as reported by At-Tirmithi (1232), Abu Dawoud (3503), an- Nasaai’ (4613) and Ibn Majah (2187) “Do not sell that which you do not possess.”

Due to the lack of empirical studies on the subject matter, this literature review aims to discuss the theoretical scholarly views on the use of derivatives, as well as Islamic option contracts, Wa’ad, which are a major element of the proposed Istijrar portfolio, as well as their application in Islamic products. This chapter is divided into four sections, the first section clarifying the appropriateness of conventional derivatives from an Islamic perspective, the
second section highlighting the usage of Wa’ad contracts as option equivalents in risk management, the third section defining Istijrar contracts and the previous theoretical literature published on the matter, with the fourth and final section discussing the KODA Accumulator structures used in conventional finance.

2.2 Derivatives in an Islamic context

2.2.1 Complying with Sharia standards:

It has always been reiterated that in order for any transaction to comply to the Shariah standards it has to be free from five elements, as named by (Iqbal & Mirakhor, 2013); i) usury ii) rashwa (corruption/bribery) iii) maysir (gambling) iv) gharar (unnecessary risk); and v) jahl (ignorance). With a good understanding of these five boundaries we get a clearer picture of the appropriate hedging that is in compliance with the Shariah jurisprudence. Riba is essentially an addition of interest, and some scholars define it as a positive return without undertaking any form of risk as defined by the legal maxim in Islamic jurisprudence, “al-ghorm bil ghonm” or “no reward without risk”. This means that one cannot expect to make profit without associating it with risk in his undertakings, as construed in the Quran and Hadith.

With regard to Gharar, there is no clear agreement by consensus from the scholars on the exact definition, but it has been defined by Al-Zarqa, in Al-Zuhayli (Kunhibava and Shanmugam, 2010) as the sale of probable items the existence or characteristics of which are uncertain, therefore making it a risky business similar to gambling. In the context of financial transactions, gharar can be said to be a form of contractual uncertainty that can cause one or both parties to be unclear about the final outcome to be achieved from the transaction, making it a ‘danger’ or ‘risk’ and making the transaction equal to a ‘zero-sum game with uncertain payoffs’. This excessive uncertainty is the major reason that marks Gharar sales as invalid (Kunhibava and Shanmugam, 2010).
Maysir, or gambling, naturally carries a high risk and uncertain outcome. Jahl (ignorance) in sales, without any knowledge or understanding, also tends to carry a very high risk and uncertain outcome as well. Therefore, it follows that Maysir and Jahalah can be described as subsets of Jahalah. It should be noted however that not all gharar sales are jahalah (a classic example of this from the past is buying a runaway slave with known characteristics) and that gharar does not always result in a zero sum outcome. Jahalah and Maysir are unrelated unless, in cases of extreme ignorance, a person makes a transaction that could be a gamble or is ignorant of the consequences. *(Kunhibava & Shanmugam, 2010)*

### 2.2.2 Current discussion of derivatives under Sharia Law:

Derivatives is a term for legally binding agreements whose values are derived from the value of an underlying commodity, financial instrument or reference rate. Derivatives are essentially an instrument of transferring risk arising from a variable factor, such as the price of a commodity or the exchange rate of a currency, from one party to another who is willing or able to accept the risk *(Malkawi, 2014)*.

The nature of derivatives is such, that they inherently lead to excessive uncertainty, unnecessary risks (gharar), or speculation that verges on gambling (maysir) since the objective of a transaction does not exist at the time a contract is signed for derivatives *(Jobst, 2013)*.

Under Islamic law, for topics such as the use of derivatives which aren’t covered by the Quran and Hadith, fiqh must be called upon by Shariah scholars to derive laws appropriate to the subject matter. Under the Shariah law, the main grounds upon which contemporary Islamic scholars base their objections to financial derivatives may be summarised as follows *(Kunhibava and Shanmugam, 2010)*:
1. In futures transactions, because neither counter-value, i.e., money or goods, is present at the time of contract, the sale is not genuine but merely an exchange of promises. A sale is only valid under Shariah law as long as only the price or delivery, but not both, is postponed.

2. Futures transactions fail to meet the requirement of taking possession of goods prior to resale. For a sale to be valid, ownership of the item sold must exchange hands. Therefore, a seller who does not own the item cannot transfer ownership. The rationale behind ‘taking possession’ is to prevent 

gharar, as in most of these future and option transactions, seller and buyers reverse their positions before delivery or maturity of the contracts meaning that physical delivery hardly ever takes place. This combines 2 features which are subject to intense criticism by Islamic scholars. The first feature is selling before delivery and the second feature is selling goods not in one’s possession, which provides the grounds upon which scholars base their objections.

3. Futures and option trading that involve speculation verge on maysir, qimār and gharar. A majority of scholars opine that the speculation involved in derivatives leads to an uncertainty which amounts to gambling, labelling derivatives as essentially a zero-sum game, and an indirect way to gamble and bet. However, counter-arguments do exist that highlight certain advantages of derivatives, such as creating vehicles for trade, setting a price and providing an arena for profitable commerce. It is also argued that the standardization of contracts, third-party monitoring and mutual consent between contracting parties can help minimize gharar.

4. Option trading is merely the right to buy or sell, for which charging fees is impermissible. An option transaction requires the payment of a fee on the promise, thereby invalidating this type of derivative under Sharia law. This ruling applies to all
types of options, including calls and puts, since options are a right, not a physical asset, hence, they can’t be bought or sold.

5. Futures trading, where both counter-values are deferred, is the illegal exchange of one debt for another, i.e., baiʿ ul-kālī bī l-kālī. Baiʿ ul-kālī bī l-kālī (also known as baiʿ ud-dayn bī l-dayn) is defined as the exchange of a debt for a debt, and is generally prohibited in Islamic finance, with a Hadith where Mūsā ibn Ubayd reported from Abd Allāh ibn Umar simply that the “the Prophet prohibited baiʿ ul-kālī bī l-kālī”. This general prohibition has been prescribed to futures whereby parties selling debts owed to themselves to other parties before delivery of the underlying asset can offset their transactions, amounting to the sale of a debt which is forbidden.

2.2.3 Compliance of derivatives with Sharia Law:

While all these arguments exist in opposition to the use of derivatives in Islamic finance under Sharia Law, there are futures-like instruments that exist under the umbrella of Islamic finance. Future delivery of commodities is permissible (as in salam and istisna), but payments must be immediate (Jobst 2013). Below is a list of principals which, if followed, can make financial derivatives compatible with Sharia Law:

The Five Axioms of Shariah Compliant Financial Derivatives (Jobst, 2013):

In principal, financial derivatives may be compatible with Shariah law if they:

1) Reflect genuine hedging demand associated with effective and intended ownership (qabd) in an identifiable asset or venture.

2) Guarantee certainty of payment obligations and clearly defined object characteristics and/or delivery results, mitigating the risk of exploitation from ignorance (jahl).

3) Disavow deferment of contractual obligations (nasia) from the actual and direct transfer of a physical asset as the object of an unconditional transaction, except for cases when
the doctrine of extreme necessity applies, and/or established forward contracts on agricultural commodities (salam) or manufactured goods (istisna) with delayed delivery and payment respectively, whose premise of creating commercial value (diversity of trade) overrides the prohibition of term contingencies until fulfillment of the contract.

4) Contain collateralized payment for the use of risk protection, but rule out provisions aimed at generating unilateral gains from interim price changes of the underlying asset beyond the original scope of risk-sharing (sharik) among counterparties.

5) Eschew all prohibited sinful activities (haram), in particular those deemed similar to gambling (maysir) and speculation due to uncertainty (gharar).

In addition, shariah compliant derivatives must be employed in keeping with the precept of maintaining an equitable system of distributive justice as a public good (maslahah).

Several scholars also consider options to be a violation of the principles of Islamic Finance for similar reasons, as Usmani (1999) defines Options as ‘a promise to sell or purchase a thing at a specific price within a specified period.’ Such promises are in themselves permissible and binding on the promissor, however, this promise cannot be the subject matter of a sale or purchase, so the promissor cannot charge the promisee a fee for making the promise (Jobst, 2013).

2.3 Wa’ad

2.3.1 Wa’ad in Modern Islamic Finance

Wa’ad (promise) is defined by (Sulaiman, 2017) as the expression of a willingness and a commitment by one party to perform a certain action in the future. It’s a unilateral promise binding the promisor only, without any obligation on the promise to accept the offer. Whereas
the offer of the offeror is the promise, acceptance of the offeree in a bilateral contract is also considered a promise (Sulaiman, 2017).

There are no set rules prescribed in the Quran or Sunnah pertaining to the nature of Wa’ad (promise, so the responsibility falls on the shoulders of jurists to discover its binding nature, both morally and legally. According to research, there are differing views among Muslim jurists about the binding nature of Wa’ad (promise), not only across different school of thought, but also within the same school of thought (Qazi, 2012). With all the controversy surrounding risk management instruments in Islamic finance, there is a diverse heterogeneity of opinions about the shariah compliance of derivatives. This is a sign of the difficulties faced in reconciling financial innovation with a principled interpretation of different sources of religious doctrine, via analogous deduction (qiyas), independent analytical reasoning (ijtihad), and scholarly consensus (Ijma) (Jobst, 2013).

With the rise of illicit practices of interest financing, there was a need for a viable financial system that to replace it, and most Islamic financial institutions turned towards business transaction such as Murabaha, Ijarah, Musharakah and Mudarabah. In the modern Islamic financial sphere, Wa’ad plays a central role in these transactions such as Murabaha, Ijara Wa Iqtina or Sukuk, and it is difficult to overstate just how vital and important Wa’ad is to these transactions, and by extension, the whole modern Islamic financial model (Qazi, 2012). It is important to remember that regulatory consolidation and harmonization of the supervision through setting agreed-upon standards is still at an early stage as efforts to develop legal standards and uniform practices for shariah-compliant derivatives has only started recently (Jobst, 2013).
2.3.2 Views of the Jurists on the Binding Status of Wa’ad:

a) Wa’ad (Promise) is not Binding

A large majority of jurists view Wa’ad as a voluntary contract which is not enforceable in a court of law, and is not legally binding (mulzim qadha’a), as much as it is religiously binding (mulzim diyanatan), where the promisee has a moral right on ethical and religious grounds (Sulaiman, 2017). This is why the dominant view on this issue is that fulfilling a Wa’ad is a noble quality, with it being advisable for the promisor to observe it, and its violation is viewed as reproachable, though it is neither wajib (mandatory) nor enforceable Qada’a (through the courts). Jurists that hold this view include: Hanafi, Shafia, Hanbili, Zahiri, and Maliki (Qazi, 2012).

The argument for the jurists who hold this view comes from narrations from the Prophet (PBUH) including a Hadith ("When a man makes a promise to his brother with the intention of fulfilling it and does not do so, and does not come at the appointed time, he is guilty of no sin") and a specific incident where a man came to the Prophet (PBUH) and asked: "Can I lie to my wife, Messenger of Allah?" The Messenger of Allah (PBUH) said, "There is no good in lying." The man said, "Messenger of Allah! Shall I make her a promise and tell her?" The Messenger of Allah (PBUH), said, "It will not be held against you". From this incident, jurists noted that while lying was prohibited (haram) and the companion was stopped from lying, when the Prophet (PBUH) was asked about not fulfilling the Wa’ad, the Prophet (PBUH) replied that it wouldn’t be held against him, meaning that there is no sin if the man does not fulfill his Wa’ad (Qazi, 2012).
**b) Wa’ad (Promise) is Binding**

On the other side of the spectrum, a number of Muslim jurists establish that a Wa’ad is binding if (i) it is one sided, (ii) the promisee incurs expenses by action or refrain from action in reliance upon the promise, (iii) it leads to entering the intended contract with particular offer and acceptance, otherwise, the mere promise itself is not the ultimately intended contract (Sulaiman, 2017). Under this view, the Wa’ad is mandatory and the promisor is under a moral as well as legal obligation to fulfill his Wa’ad and the Wa’ad can also be enforced through the courts of law. Therefore, it is *haram* (impermissible) not to fulfill a Wa’ad without any acceptable excuses and the promisor can be held accountable on the Day of Judgement and in the courts of law, with the promise able to claim for compensation from any damages suffered (damages include actual monetary loss suffered but not the actual opportunity cost). This opinion is shared by Hanafi, Hanbili, Maliki, Ibn Tamiya, Qazi Saeed bin Umar al-Shqa’a, Umar ibn Abdul Aziz, Ibn Arabi, and Muhammad al-Qurtabi. Due to its importance, the fulfillment of a Wa’ad was greatly emphasized in several different places and contexts in the Quran and Sunnah, and presented as one of the best character traits of all Prophets (PBUT) (Qazi, 2012).

There is a variety of arguments for the jurists who believe in this view. One of the major arguments jurists who support this view use is the following Ayah, where Allah Almighty says in Surah As Saff: “O you who believe! Why do you say that which you do not do? Most hateful it is with Allah that you say that which you do not do (34).” Jurists argue that Allah Almighty in this verse condemned people who say something and then don’t do it, and it is also said that a person not honoring his word will incur the wrath of Allah Almighty, and jurists argue that can incur the wrath of Allah except not doing something which is *Wajib* (obligatory acts) or doing something *haram* (prohibited acts). Another argument jurists allude to is the fact that the
incident used by people who argue that Wa’ad is not Wajib with the man who asks the Prophet (PBUH) about a Wa’ad he gave his wife was misinterpreted, as it was related only to the relationship of a husband and wife and had nothing to do with general rules of law, and that if reflected on from a different angle, the binding nature of a Wa’ad can be seen as the in the other Hadith mentioned in their arguments, it is clearly mentioned that there should be an intention of fulfilling the Hadith, conveying the message that a Wa’ad is made to be fulfilled (Qazi, 2012).

2.3.3 Consensus of scholars on Wa’ad

Not every aspect of Wa’ad is controversial among jurists, with jurists reaching a consensus on certain aspects of Wa’ads in general. These aspects include a unanimous agreement among scholars that no person must fulfill a Wa’ad which had been given to do a haram (prohibited thing), that a person must fulfill a Wa’ad to do a Wajib (obligatory act) and a person is recommended to fulfill a Wa’ad to do what is Mubah (allowed and optional).

2.4 Istijrar Contracts

Bai ‘al-Istijrar (abbreviated Istijrar) is not a specific financing model, but merely a repeat sale or a repeat purchase supply agreement of an ordinary sale (normal sale). In the agreement, the seller agrees to sell an item in various quantities or units repeated over time; each time there is no offer or acceptance or bargain (Usmani & Zubairi, 2002). There is one master agreement where all terms and conditions are finalized. As for the modern Ijtihad for defining the Istijrar contracts, (Jomah, 2000) and the Kuwaiti Fiqh Academy define it as “A buyer taking the needed quantity of a commodity from the seller and paying for it at a later date”, while (Hammad, 2008), defines it as “A buyer taking his need of a commodity from a seller without bargaining or setting a price and then the price is paid after the commodity is consumed”.
As such, there are four types of Istijrar (Ashqar, 2016), each varying according to the different schools of thought in Islamic Shariah,

a. Taking the commodity from the seller time by time with the price determined at each date of undertaking, and payment is made at later dates (Ibn Abideen, 1992), (Hattab, 1992).

b. The determination and payment of the total price of the commodities at the beginning of the contract and the commodities are delivered in varying quantities during a set time period.

c. The seller sends the contracted quantities of the commodity to the buyer while implicitly agreeing that the market price at each fixing date is the determined price to be paid later.

d. Taking various quantities of the commodity throughout the set time period and the total price is determined as the price on the last fixing date at the end of the contractual period.

The first type is relevant with the Islamic mode of financing, and is permissible with certain conditions as highlighted by (Usmani & Zubairi, 2002).

1. In the case where the seller discloses the price of the goods at the time of each transaction; the sale becomes valid only when the goods are in possession. The amount is paid after all transactions have been completed.

2. If the seller does not disclose the price of the goods sold then the buyer must know that the price of the goods is in accordance with the existing price in the market and the price of the goods must be specific and not up for change so that it does not differentiate the sale and purchase with another price.
3. If, at the time of possession, the price of the subject matter was unknown or the contractors agree that whatever the price shall be, the sale will be executed. However, if there is a significant difference between the market price and the agreed price it may cause a conflict. In such a case, at the time of possession, the sale will not be valid. However, at the time of settlement of the payment, the sale will be valid.

Given the above, there is no difference of opinion between the Shariah scholars as far as accepting this transaction as a *Bai-at-Ta’ati*, in which the buyer takes possession of the goods and pays the price to the seller who accepts it without both parties sitting down and drawing up a contract at each time.

**2.4.1 The usage of Istijrar contracts by Financial Institutions**

Istijrar contracts in banks can be utilized in four modes, namely, *Murabaha*, *Ijarah*, *Mudarabah* and *Musharakah*. In the case of Murabahah, the concept of *Ta’ati* was treated with caution as it can lead directly to *Riba* in case if the bank does not take possession of the assets before they are sold to the customer. Therefore, the only way to implement this transaction with the limits of the Shariah jurisprudence is if the bank purchases the assets some time before selling it to the customer. This would ensure possession that is not just constructive but the bank would have title to the assets before they are sold to the customer (*Usmani & Zubairi, 2002*).

**2.5 Conventional Accumulator Structures**

In this section, papers written in the topic of accumulator contracts in multiple asset classes are analyzed with the objective of understanding the pricing methodology and mechanics underlying the conventional contracts in order to test its applicability to the Istijrar structure as
an accumulator with several major differences between the mechanism used in the Istijrar structure versus the conventionally used knock-out accumulator structures.

Options and their various kinds and extensions (such as barrier options) are considered one of the fastest growing derivative investments in the world. Knock out discount accumulator equity linked investments (KODA ELI), or accumulators for short, are a complex option that recently came upon the world market (Kwong, et al., 2012). Conventionally, accumulator contracts can come in two forms, a producer accumulator and a consumer accumulator, with consumer accumulators allowing for the accumulation of the underlying asset while the producer contracts essentially allow for the decumulation of the underlying asset. Consumer accumulators follow that during the contract’s lifetime $t$, the consumer buys a fixed quantity $q$ of the underlying stock $S$ at the accumulation strike price $X$ on the defined observation day $t_i$, delivered on the settlement date $T_i$, and contingent on the continuous knock-out barrier $H_c$. Lam, Yu and Xin (2009) provide the pay-offs for the accumulator structure with delayed settlement and continuous knock-out barrier monitoring as,

1) $0$ \quad if $\max_{0 \leq \tau \leq t_i} S_{\tau} \geq H_c$
2) $S_{T_i} - X$ \quad if $\max_{0 \leq \tau \leq t_i} S_{\tau} < H_c$ , $S_{t_i} \geq X$
3) $2(S_{T_i} - X)$ \quad if $\max_{0 \leq \tau \leq t_i} S_{\tau} < H_c$ , $S_{t_i} < X$

Where: $S_{t_i}$ is the stock price on the observation day,

$S_{T_i}$ is the stock price on the settlement day,

$S_{\tau}$ is the continuous stock price,

$X$ is the accumulation strike price,

$H_c$ is the knockout barrier price with continuous monitoring,
\( ti \) is the observation day, \( \tau \) is the continuously observed price for all time, and \( Ti \) is the maturity date of the forward contract \((Lam et al., 2009)\).

The first payoff is zero, which is the natural case if at any trading hours \( \tau \) the underlying stock price for all trading hours \( S\tau \) is greater than or equal to the continuous knock-out barrier price \( Hc \), the knock out prompts the conclusion of the contract permanently, fixing no sales on the current observation day \( ti \), but leaving former fixed sales \( qi \) effective.

On the other hand, the second payoff is the difference between the stock price on the settlement day \( STi \) and the accumulation strike price \( X \). It follows that the stock price for all trading hours \( S\tau \) is strictly less than the continuous knock-out barrier price \( Hc \) and on the observation day \( ti \) the stock’s closing price \( Si \) is greater than or equal to the accumulation strike price \( X \), then the consumer buys the fixing quantity \( q \).

The third payoff is two times the difference between the stock price on the settlement day \( STi \) and the accumulation strike price \( X \). This is due to the leveraging and gearing factor embedded in such contracts where the buyer of the contract would have to purchase double the quantity \( 2q \) of the underlying at the strike price \( X \), compounding the losses than the purchaser incurs.

Due to this reason, these KODA structures have been nicknamed as “I’ll kill you later” structures \((Lam et al., 2009)\).

Combining one long up-and-out call on a forward contract and two short up-and-out puts on a forward contract creates the portfolio known as the zero-cost accumulator structure with delayed settlement as defined in the Equation 1 below by \((Lam et al, 2009)\):

\[
(1) \quad V_{\text{Delay}} = \sum_{i=1}^{n} \left[ C_{\text{up}}^F(X, Hc, ti, Ti) - 2 \cdot P_{\text{down}}^F(X, Hc, ti, Ti) \right]
\]

where \( V_{\text{Delay}} \) is the value of the accumulator structure with delayed settlement, \( C_{\text{up}}^F(X, Hc, ti, Ti) \) is the value of the up-and-out call option, while \( 2 \cdot P_{\text{down}}^F(X, Hc, ti, Ti) \) is the value of 2 down-and-out put options, with the other symbols as previously explained.
Kwong, et al., 2012, in their study determined the profitability and risk associated with the consumer accumulator on two metrics, namely the discount percentage, which specifies the distance from the strike price and the underlying asset’s price at origination; and the knock-out percentage, which indicates the distance between the out barrier located above the underlying asset’s price at origination. They compared consumer accumulators with differing knock-out percentages (2 – 7%) and discount percentages (4 -15%), and concluded their findings showing that higher knock-out percentages combined with higher discount percentages yielded the greatest cumulative profits. Alternatively, when a high knock-out percentage is united with a low discount percentage, significant cumulative losses occurred (Kwong, et al., 2012).

Contingent on contract structure and asset class, other factors can have significant effects on the pricing and the valuation of the accumulator structures (Lam et al, 2009) the first being whether the underlying asset’s settlement can either be immediate (observation and delivery day are the same), or delayed (the observation and delivery days are not on the same day). They stated that, in practice, delayed settlement is more routine than immediate settlement (Lam et al, 2009). The second factor is whether there is discrete monitoring (price observation takes place at a certain point in time), or continuous monitoring (price observation is continuous at all market hours if the knock-out barrier is ever breached during the trading hours). Applying the same pricing methodology of the continuous barrier accumulator to the discrete barrier accumulator results in significant valuation error. Consequently, for the discrete barrier accumulator, correction term is used to modify the valuation used for the continuous accumulator (Lam et al, 2009). Kou (2013) states that in the market, most of the barrier options contain a discretely monitored barrier, due to the fact that if the barrier is continuously monitored, illiquid markets may present arbitrage opportunities since markets around the world support inconsistent trading hours.
2.5.1 Profit distribution in Accumulator structures

In their paper published in 2009, Lam et al. computed an asymmetrical profit and loss distribution with an extended left tail and short right tail for the consumer accumulator, which conveys the potential for significant downside losses and limited upside profit. Therefore, their findings quantitively display a higher risk for the buyer than the seller, displayed by high Vega and Delta values when the investor is losing compared to winning, and is therefore more prone to volatility and directional price changes. Concluding findings convey that regardless of the market, accumulator contracts exhibit strong asymmetrical risk; therefore, large profits are unlikely and high loss is probable (Lam et al., 2009).

Another paper authored by Kwong et al. (2012) studied accumulator profit and loss probability through Monte Carlo simulation using HSBC data for 2006 and 2007. To judge the symmetry of the profit distribution of the accumulator, the average and cumulative profit or loss and standard deviation were calculated, and their findings show that early knock-outs are the deterministic factor for positive or negative profits, with early knock-outs leading to positive profits. Alternatively, when the accumulator continued through contract expiry, profit was continually negative. Market trend was naturally found to affect accumulator profitability, with results showing that markets that are displaying a neutral or upward trend were found to be more profitable for investors. Heightened volatility also led to a higher probability of knock-out and purchase of double the daily fixing quantity of shares. Similar to the results published by Lam et al., 2009 the concluding results for this study show that accumulator contracts are an unfair investment for buyers due to their limited upside profit potential and unlimited downside loss potential (Kwong et al., 2012).
Finally, Cheng (2010) reviewed pricing and simulation under the Black-Scholes and Heston frameworks for three structurally unique accumulators: suspension feature, knock-out feature, and double-commitment with knock-out feature. Accumulating GBP/USD, the FX-linked accumulator with suspension feature attains a positive simulated contract price and positively skewed payoffs. The equity accumulator with knock-out feature, accrues HSBC shares, has a negative contract price under simulation and Black-Scholes, but a positive simulated contract price under the Heston framework. Payoffs are unbalanced and skewed toward negative profit, and concluding findings demonstrate that volatility is the most powerful parameter in accumulator pricing. When volatility is low, simulated accumulator prices are slightly positive; however, when volatility is high, simulated accumulator prices are heavily negative. The Heston model is found to produce inconsistent results with simulation and the Black-Scholes model illustrating that the Heston framework inefficiently prices accumulator contracts (Cheng, 2010).

In conclusion, the research papers published by Lam et al. (2009), Kwong et al. (2012), and Cheng (2010) deemed the consumer accumulator to be an unfair and risky investment strategy due to simulation results confirming large negative asymmetric risk. Consumer and Istijrar accumulators differ, however, as explained in the next section due to several differentiating factors that should share the risk among the buyer and the seller while capping both downside and upside risk, contrary to the consumer accumulators that cap upside profit and leave unlimited downside risk. Due to this difference in mechanics, this study plans to dispel the notion that the Istijrar accumulator suffers from the same negative asymmetric risk as the conventional consumer accumulator, and with confirming my results, the objective is to verify that the Istijrar accumulator is a favorable risk management tool for Islamic Financial Institutions to employ. As such, my research adds to the accumulator contract literature and
pricing theory by identifying a theoretical pricing model and quantifying simulation performance of the Istijrar accumulator within the Gold commodity market.
CHAPTER 3: MODEL STRUCTURING AND PRICING

As discussed in the previous section, there does not seem to be significant literature on the usage of Istijrar contracts as a risk management tool, especially for real-life applicability. The most prominent literature on its modern use was begun by Mufti Taqi Usmani and its structure and price mechanism were discussed in some detail in (Bacha, 1999). In that publication, the author outlines the structure of an Istijrar contract and how it can be used as a settlement price determination mechanism at the end of the contract tenor (as shown in figure (3)). He introduces the idea of applying barrier options in order to initiate a call or put option to fix the price of the commodity (at Murabaha price) if it breaches a certain range. No practical application of such structure has been implemented. Therefore, this study aims to apply the theory of using Istijrar accumulator by way of using real Gold commodity prices and showcasing the hedging effect by structuring 2 barrier options (Wa’ad contracts) into a portfolio based on a Murabaha contract, as well as showcasing the symmetry of risk sharing in the structure as compared to the conventional accumulators.

The chapter consists of 2 sections, the first introduces the model, defines the parties and the payoffs perceived for each party, and the second section discusses the pricing methodology used in valuing the Istijrar accumulator model.

3.1 Istijrar Accumulator Model Structure

The Istijrar Accumulator model is complex in that it is a cumulation of options, average prices and Murabaha Agreements. According to (Bacha, 1999) a master Istijrar structure contract is initiated by signing an agreement between the Islamic financial institution and its client under which various stipulations would be extended.

There are 2 parties involved in the transaction:
- **Party 1:** The Islamic Financial Institution (IFI) as the seller of the underlying commodity/asset, and holds a long position in the knock-in seller Wa’ad, written by the Client.

- **Party 2:** The client is the buyer of the underlying commodity/asset, and holds a long position in the knock-in buyer Wa’ad, and a short position in the knock-in seller Wa’ad.

### 3.1.1 Proposed Mechanism of the model

**Figure 1: Proposed Istijrar Accumulator**

As illustrated in Figure 1 above, the following points detail the mechanism of the Istijrar accumulator model, initiated by both parties (Party 1 and Party 2) entering into an oral wa’ad on purchase order agreement at T₀ for Party 2 to purchase the commodity at different quantities throughout an agreed tenor T₁ – T₃₆₀; after which:

1) The IFI purchases the underlying asset from a supplier at the market price (P₀) in order to adhere to the Islamic principle of having the possession of the underlying asset before entering into a sale transaction.
2) A Master Murabaha-based Istijjar agreement is signed between the IFI and the client detailing
   i) the exercise price \( P_0 \times (1+r) \), where the markup ‘r’ is determined based on the
      average AAA sukuk rate determined at the end of the previous period, ii) the price barriers that
      would trigger the knock-in Wa’ads entered among the IFI and client iii) the tenor of the
      contract as well as the fixing dates (in this case every 3 months), iv) the periodic quantity to be
      delivered at each fixing date, v) the price determination mechanism if the commodity market
      price trades within the agreed-upon bounds (without breaching the barriers).
3) The IFI writes a knock-in buyer Wa’ad with an obligation to sell the underlying asset at the
   determined strike price if the commodity spot price breaches the upper bound. Additionally,
   the IFI goes long on a knock-in seller Wa’ad which gives them the right to sell the underlying
   commodity at the determined strike price if the commodity price breaches the lower barrier.
4) In turn, the client writes a knock-in seller Wa’ad with an obligation to buy the underlying
   asset at the determined strike price if the commodity spot price breaches the lower bound; and
   goes long on a knock-in buyer Wa’ad which gives them the right to buy the underlying
   commodity at the determined strike price if the commodity price breaches the upper barrier.
5) At each fixing date, the contracted quantity is delivered to the Client from the IFI and the
   price is determined at each observation date depending on whether either barrier Wa’ad was
   breached or not.
6) The Client pays the price for the total quantity at the end of the contract, or at each fixing
   date as stipulated in the contract.

3.1.2 The price determination mechanism

The main purpose of the proposed structure is to hedge against price movements in the
underlying commodity market, especially in the case where there is a repeat sale throughout
the designated time period. As such, the barrier Wa’ads attempt to allow for the impact of price changes but to cap the benefits that accrue as a result of price movements. By definition, since price changes are allowed only within a band, the advantage to one party and the disadvantage to the other is capped. The maximum potential gain or loss is limited. Such a contract fulfills the need to avoid a fixed return on a riskless asset which would be considered Riba and also avoids gharar (Bacha, 1999) in that both parties know upfront, the exercise Murabaha price ($P^*$) and the range of possible prices between the upper and lower bounds. Figure 2 below illustrates the price determination mechanism following the price movements of the underlying asset/commodity, followed by an explanation of the graph during each scenario:

**Figure 2: Price determination mechanism**

Unlike a typical Murabaha contract where the settlement price would simply be a predetermined price, where $P^* = P_0(1+r)$, with ‘r’ being the IFI’s required return/earning, the price at which the Istijrar is settled upon maturity date could either be $P^*$ or an average price
(\(P\)) of the commodity between the period \(T_0\) and \(T_{360}\). As to which of the two prices will be used for settlement, this will depend on how prices behaved and which party chooses to ‘fix’ the settlement price. Figure 2 above elucidates the following:

\[ P_0 = P_{LB} = \text{The price that the IFI pays to purchase the underlying commodity. This is set as the lower bound as it is the natural stop-loss level for the IFI, given that it would not deliberately incur losses by selling the underlying at a price lower than its cost price. As such, it is also depicted as the Murabaha price } P^* \text{ (strike price) minus the discount percentage (D\%)} \]

\[ P^* = \text{The Murabaha price; } P^* = P_0(1+r) \]

\[ P_{UB} = \text{The upper bound price; equal to the Murabaha price (strike price) plus a knock-in percentage (K\%)} \]

The settlement price \((P_s)\) at would therefore be determined as below \((Bacha, 1999)\):

- If \(S > \text{upper bound}\)
  - (buyer loses, bank gains until exercise)
  - Buyer Exercises: \(P_s = P^*\)
- If \(\text{lower bound } \leq P_t \leq \text{upper bound}\)
  - \(P_s = \text{Avg. Price}\)
- If \(S < \text{lower bound}\)
  - (bank loses, buyer gains until exercise)
  - Bank Exercises: \(P_s = P^*\)

\(\text{Figure 3: Price Path}\)

For either party to exercise its option and thereby fix the settlement price at \(P^*\), the spot price during the term of the contract must have exceeded the bounds at any time. Which party would exercise would depend on the direction of the spot price movement. For example, if the spot price at any time breaks though the upper bound, the buyer would get worried, but whether he will exercise or not would depend on his expectations of the spot price over the remaining
period of the contract. If he believes that the price is likely to keep increasing, it will be in his interest to exercise the Wa’ad by fixing the settlement price now at $P^*$. The client would then notify the bank that he is exercising his Wa’ad and that the settlement would be $P^*$. Should spot prices be falling such that it breaks the lower bound, the seller (IFI) would also have the option to fix the settlement price at $P^*$.

3.1.3 Payoff Schedules for each Party

Barrier options come in four types: *up-and-out, up-and-in, down-and-out, down-and-in*. An in barrier option, or knock-in option only pays off if the underlying finishes in the money and the barrier is crossed sometime before expiration. When the stock crosses the barrier, the in barrier option is knocked in and becomes a standard option of the same type (call or put), with the same strike and expiration. On the other hand, if the underlying’s price never crosses the barrier, the option expires worthless. The different barrier options and the effect of crossing the barrier on their payoff are described in the Exhibit below, as compiled by *(Derman & Kani, 1996)*:

<table>
<thead>
<tr>
<th>Option</th>
<th>Barrier Type</th>
<th>Location</th>
<th>Effect of Barrier on Payoff</th>
<th>Crossed</th>
<th>Not Crossed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call</td>
<td>Down-and-Out</td>
<td>Below Spot</td>
<td>Worthless</td>
<td>Standard Call</td>
<td>Standard Call</td>
</tr>
<tr>
<td></td>
<td>Down-and-In</td>
<td>Below Spot</td>
<td>Standard Call</td>
<td>Worthless</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Up-and-Out</td>
<td>Above Spot</td>
<td>Worthless</td>
<td>Standard Call</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Up-and-In</em></td>
<td><em>Above Spot</em></td>
<td><em>Standard Call</em></td>
<td><em>Worthless</em></td>
<td></td>
</tr>
<tr>
<td>Put</td>
<td>Down-and-Out</td>
<td>Below Spot</td>
<td>Worthless</td>
<td>Standard Put</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Down-and-In</em></td>
<td><em>Below Spot</em></td>
<td><em>Standard Put</em></td>
<td><em>Worthless</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Up-and-Out</td>
<td>Above Spot</td>
<td>Worthless</td>
<td>Standard Put</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Up-and-In</td>
<td>Above Spot</td>
<td>Standard Put</td>
<td>Worthless</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1: Barrier option payoffs*

In this model, we structured the Istijrar accumulator by combining 2 barrier Wa’ads into a portfolio where they both maintain the same accumulation strike price ($P^*$), settlement day, discrete barrier monitoring and expiration day. Therefore, those two Wa’ad contracts provide
offsetting amounts of premium received and paid. Based on the premise that the payoff for either barrier option is the same as a standard put or call if the barrier is crossed, the payoffs for each Party involved in the Istijrar structure at each point in time, are highlighted below:

1) At time 0:

Both parties pay and receive premiums ($\beta$) at the initiation of the Wa’ads. Since each party is both the buyer and the seller of the Wa’ad contracts with the same strike price, the net payoff at time 0 is 0, as demonstrated below:

**Party 1 (IFI):** $\beta_1 - \beta_2 = 0$

**Party 2 (Client):** $\beta_2 - \beta_1 = 0$

However, at time zero, Party 1 (IFI) purchases the commodity at the market price, showing a negative net payoff for that party, as follows: **Party 1 (IFI):** $\beta_1 - \beta_2 - P_0 = -P_0$, noting that the costs of storage involved in the actual physical ownership of the commodity have not been incorporated.

2) At Time ($T_1 - 360$):

The following are three different payoff scenarios depending on the path taken by the market price movements:

   a) *The price does not breach any of the upper or lower bounds:*

   Party 1 (IFI) sells the stipulated portion ($\alpha$) of the commodity to the client (Party 2) at an average price ($\bar{P}$) set as the average price between the periods ($T_0 - T_1$). Party 2 takes delivery of the commodity and pays the price ($\bar{P}$)

   **Payoff for Party 1 (IFI):** $\bar{P} - \alpha_1(P_0)$; where $\alpha_1$ is the first portion of the total contracted quantity of the commodity sold to the 2<sup>nd</sup> party (the client). The seller barrier Wa’ad is worthless at this point.

   **Payoff for Party 2 (the client):** $P_{S1} - \bar{P}$, indicating the profit booked from the purchase of the underlying commodity/asset at a discount from the spot price ($P_{S1}$) at $T_1$. 


b) The price breaches the upper bound, the Buyer Knock-in Barrier is activated:

During this scenario, the client (party 2) would worry about the upwards trend of the underlying prices and would prefer to exercise the Wa’ad to purchase the underlying asset at the stipulated strike price (P*). As such, Party 1 (IFI) would sell α2 of the underlying at the strike price of P* (which is the cost + profit Murabaha price). The buyer up-and-in barrier Wa’ad is activated and the standard call option payoff is applied, while the seller down-and-in barrier remains inactive and worthless.

**Payoff for Party 1 (IFI):** Max [(αt(P* − PST)),0] − Max [(αt(PST − P*)),0]

**Payoff for Party 2 (the client):** Max [αt(PST − P*)),0] − Max [(αt(P * − PST)),0]

c) The price breaches the lower bound, the Seller Knock-in Barrier is activated:

During this scenario, the IFI (party 1) would worry about the downwards trend of the underlying prices and would prefer to exercise the Wa’ad to sell the underlying asset at the stipulated strike price (P*). As such, Party 1 (IFI) would sell α2 of the underlying at the strike price of P* (which is the cost + profit Murabaha price). The seller down-and-in barrier Wa’ad is activated and the standard put option payoff is applied, while the buyer up-and-in barrier remains inactive and worthless.

**Payoff for Party 1 (IFI):** Max [(αt(P* − PST)),0] − Max [(αt(PST − P*)),0]

**Payoff for Party 2 (the client):** Max [αt(PST − P*)),0] − Max [(αt(P * − PST)),0]

### 3.1.4: The Istijrar Accumulator Term Sheet

An example of a synthetic Istijrar accumulator that was back-tested using the MC simulator is detailed below:

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Islamic Financial Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accumulator Type</td>
<td>Istijrar Knock-in Accumulator</td>
</tr>
</tbody>
</table>
**Gold Price**  
USD 1,267

**Start Date**  
01/06/2016

**End Date**  
01/06/2017

**Periods**  
4 - quarterly

**Accumulation Strike**  
USD 1322.7

**Buyer Knock-in percentage/price**  
5% / USD 1388.9

**Seller Knock-in percentage**  
4.4% / USD 1267

**On a quarterly basis, if the referenced underlying price settles at or between the two knock-in barrier levels, 100% of the quarterly quantity is priced at the average price during the period.**

**If on any date between start and end date, the referenced underlying ever trades or settles at or above/below either Knock-in barrier, accumulation Wa’ads come into existence where the buyer/seller will price the weekly commodities at the accumulation strike price.**

3.2 Pricing model – Cox, Ross, Rubenstein (CRR) Model

The assumptions of a binomial model are followed as the synthetic Istijrar accumulator contracts are constructed from barrier options priced using the binomial model. These assumptions include: no transaction costs, no taxes, no margin requirements, no arbitrage, the investor is risk neutral, binomial distribution of returns, constant return rate for the Wa’ad’s lifetime, and volatility is constant (Cox, Ross, and Rubinstein, 1979).

Cox, Ross and Rubenstein (1979) proposed the binomial options pricing model (BOPM) to value American and European options in discrete time. The CRR binomial model assumes that there only two potential prices for the underlying asset $S$ at the end of each time interval $t + 1$, either an up price $Su$ with probability $p$ or a down price $Sd$ with probability $1 - p$ (Cox et al., 1979). The CRR binomial tree consists of nodes at each time interval between option valuation.
and expiration. Each node represents a potential future price of the underlying asset at a specific point in time. Options are valued through the numerical method in a three-step process for American options. The binomial price tree is established by working forward, calculating the underlying asset’s price at each node from the valuation date to expiration date. Underlying price can either branch up or down by a fixed value at each node, which is calculated based on volatility $\sigma$ and time $t$, following the random walk theory. Node positions for the binomial tree are established by the following equations:

$$u = e^{\sigma \sqrt{\delta t}}$$
$$d = e^{-\sigma \sqrt{\delta t}}$$
$$p = e^{R \delta t} - d / u - d$$

where $R$ is the risk-free rate of return and $\delta t$ is the time interval between $t$ and $t + 1$.

At the option’s expiration, intrinsic values are calculated at each final node. For a call option, the option value at the final node is defined as,

$$V_n = \text{Max}[(S_n - X), 0]$$

and for a put option, the option value at the final node is defined as,

$$V_n = \text{Max}[X - (S_n), 0]$$

where $V_n$ is the value of the node at expiration, $S_n$ is the price of the underlying asset and $X$ is the option’s strike price. The option’s theoretical value is calculated by backward induction or discounting the option’s payoffs backward from expiration to the valuation date. Through backward induction, a value is consecutively calculated at each node in the tree by the following for an American-style call option that is expressed as,

$$V_n = \text{Max}[(S_n - Xe^{-R \delta t}(pu + (1 - p)v) + (1 - p)v)]$$

and an American-style put option as shown below,

$$V_n = \text{Max}[(X - S \text{ne}^{-R \delta t}(pu + (1 - p)v)]$$
where $V_u$ is the value of the option from an upper node in the next time period $t+1$ and $V_d$ is the value of the option from the lower node in the next time period $t+1$.

Discounted payoff value and early exercise value or intrinsic value are calculated at each node between the expiration date and the valuation date. Due to the no arbitrage rule, the greater of the discounted payoff value or early exercise value is taken for the option’s value at each node. European options have a similar process, although they only consider the discounted payoff value at each node and not the early exercise value. This difference in valuation process ensues since early exercise is a feature of American options, not European options (Cox et al., 1979).

3.2.1 Shariah-Compliant CRR model:

In order to ensure that the CRR model complies with the Shariah requirements, a few assumptions are included in line with the assumptions already put in place as adapted by (Omarana et al, 2015) when modelling the pricing of Bai Al-Orboun, where the compliance requirements to allow the usage of the model include that:

- The underlying asset must be Shariah compliant.
- The underlying asset must be tangible, identifiable and owned by the owner of the asset at the time of conclusion of the contract (asset backing principle).
- $R$ is the low risk return rate of a riskless asset whose issuer is characterized by a higher level of solvency (for example, Sovereign AAA Sukuk returns).
CHAPTER 4: FINDINGS AND RESULTS

4.1 Introduction

This study aims to model and price an Islamic hedging instrument to protect the buyer or accumulator of a commodity from adverse movements in the commodity prices, especially if said buyer is required to source raw materials/commodities used in the operations of his business throughout the year. Therefore, this study tests the effectiveness and accuracy of the proposed model as a hedging technique against price movements in Gold as an underlying asset to evaluate its ability to shield the buyer and seller from price risk.

Following the previous discussions, the intrinsic value of the proposed model was calculated and priced it with a modified version of the CRR model (1979) on a discrete basis by substituting the risk-free rate with the AAA sukuk return as adapted by several research papers, one of which is (Omarana et al, 2015) when pricing Bai Al-Arboun structures as well as (Hakim et al, 2016) when using the Islamic asset pricing model, iCAPM.

4.2 Data Description

Given the importance of ensuring the quality of the data tested in terms of normality and to check for outliers, a descriptive statistics report was generated using E-Views, with the results shown in the table below:
### Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Data</th>
<th>Obs</th>
<th>Mean</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Prices</td>
<td>259</td>
<td>1258.3</td>
<td>1366.33</td>
<td>1128.38</td>
<td>1366.33</td>
<td>57.6653</td>
<td>-0.111586</td>
<td>-1.33</td>
</tr>
<tr>
<td>AAA Suk. Ret.</td>
<td>259</td>
<td>0.254873</td>
<td>0.2</td>
<td>-4.2799</td>
<td>4.4127</td>
<td>0.612756</td>
<td>0.404968</td>
<td>3</td>
</tr>
</tbody>
</table>

The average price and returns of the data displayed shows that the mean Gold price during the studied period was $1258.3 per ounce of gold, while the average AAA sukuk return was 0.25. The standard deviation, which measures the volatility and spread around the mean was 57.7 and 0.613 for Gold and the AAA sukuk return, respectively, which leads to the conclusion that there are no significant outliers in the data, and that the data provides a symmetrical distribution around the mean, as evidenced by the low levels of skewness (-.11 and 0.4) for each data set. Additionally, the kurtosis levels for a normally distributed data set is within the -3 to 3 range, and therefore, we are able to conclude that the data is normally distributed around the mean.

### 4.3 Fairness Testing – A comparison between KODA and Istijrar Accumulators:

In this section, a Monte Carlo simulation is used to characterize Istijrar accumulator contracts in a historical context in order to determine whether the model is considered a fair risk-sharing instrument between the IFI and the client, which was done by simulating whether there was a probability of making profits off of the structure, or whether it was a zero-sum game that led to unfair profit distribution among the parties, as is the case in KODA structures where the results explained in the literature review pointed towards the unfairness of the investment. By tracking the price movements of Gold as the underlying commodity, we attained a trend model.
and volatility figures to input into the Monte Carlo Simulation and running the simulation and calculating the payoffs multiple times, we were able to make generalizations about the Istijjar structure under those circumstances. Additionally, by changing the market conditions (such as volatility) or the contract assumptions (such as the knock-in percentage or discount percentage) used in the model, we were able to determine under which circumstances the structure would be considered a fair investment for both parties. The reason for choosing the Monte Carlo method is due to the fact that they are ideal for pricing options where the payoff is path dependent (such as Asian options and spread options), which is applicable to our case. As such, in order to test for fairness between the Istijjar accumulator structure and the conventional KODA structure, actual data was used from a Knock-Out Discount Accumulator with a Gold underlying issued by UBS bank in June 2016 for a full year tenor till June 2017. According to the term sheet, the strike price was 5% below the underlying’s price at the origination of the structure, while the knock-out price was set above 6% of the underlying spot price at initiation. When testing the structure, the KODA model struck out after 80 trading sessions, and the cumulative profit was found to be approximately USD$152,000, which is an average daily profit of $1900, with a standard deviation of $435.

For the second step, we run a simple linear regression for the Gold prices 30 days prior to the KODA initiation date to determine a trend line, and we input the standard error and mean after which a random number generator simulated hypothetical stock prices based on a negative trend and normal distribution. Five separate tests were run under the same circumstances, while only changing the seed investment and varying the market conditions and expectations, which resulted in losses ranging from $150,000 to $181,000, which is an average of $875 per trading session and the standard deviation increased to $1,675. Similarly, the regression equation for the data only 15 days prior to the opening date of the contract also showed a negative trend.
with losses at a much higher magnitude than that of the 30 days prior, causing the simulation model to show the losses to be much greater, reaching c. $400,000, as displayed in the table below:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Knock-out Date</th>
<th>Cumulative Profit/Loss (USD)</th>
<th>Average Daily Profit/Loss (USD)</th>
<th>Standard Deviation of Profit/Loss (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Data (5% KO)</td>
<td>Session 80</td>
<td>$152,000.00</td>
<td>$1,900.00</td>
<td>$435.00</td>
</tr>
<tr>
<td>Actual Data (10% KO)</td>
<td>None</td>
<td>$1,564,000.00</td>
<td>$6,256.00</td>
<td>$10,984.00</td>
</tr>
<tr>
<td>Simulated Data (5% KO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-sessions before</td>
<td>None</td>
<td>$400,000.00</td>
<td>$1,600.00</td>
<td>$2,196</td>
</tr>
<tr>
<td>30-sessions before (First trial)</td>
<td>None</td>
<td>$150,756.00</td>
<td>$603.02</td>
<td>$1,722</td>
</tr>
<tr>
<td>30-sessions before (Second trial)</td>
<td>None</td>
<td>$181,432.00</td>
<td>$725.73</td>
<td>$1,774</td>
</tr>
<tr>
<td>30-sessions before (Third trial)</td>
<td>None</td>
<td>$164,565.00</td>
<td>$658.26</td>
<td>$1,783</td>
</tr>
<tr>
<td>30-sessions before (Fourth trial)</td>
<td>None</td>
<td>$163,503.00</td>
<td>$654.01</td>
<td>$1,779</td>
</tr>
<tr>
<td>30-sessions before (Fifth trial)</td>
<td>None</td>
<td>$150,470.00</td>
<td>$601.88</td>
<td>$1,720</td>
</tr>
<tr>
<td>45-sessions before</td>
<td>None</td>
<td>$51,280.00</td>
<td>$205.12</td>
<td>$478</td>
</tr>
<tr>
<td>60-sessions before</td>
<td>Session 23</td>
<td>$39,584.00</td>
<td>$2,399</td>
<td>$231</td>
</tr>
<tr>
<td>90-sessions before</td>
<td>Session 94</td>
<td>$84,234.00</td>
<td>$2,106</td>
<td>$243</td>
</tr>
</tbody>
</table>

**Table 3: KODA structure – Simulation results**

On the other hand, we can see that the regressions for the 60th and 90th session prior to the initiation of the KODA contract showed some profits, due to a positive trend shown, but they are very limited compared to the significant losses that have been simulated in negative trend environments.

To measure the risk sharing characteristics of the Istijrar accumulator, the same modelling was applied on historical data, however, since there is no presence of an Istijrar accumulator in the market, we could not compare it to an actual KODA profit/loss based on a practical model in
the market. Therefore, we created hypothetical Istijrar contracts with different combinations of knock-in percentages and simulated the profit that the investor would have received had he entered into an Istijrar accumulator on that day (June 2016) for a full year ahead (June 2017), with the results displayed in the table below for both the buyer and the seller of the knock-in Wa’ad:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Buyer Knock-in Date</th>
<th>Cumulative Profit/Loss (USD)</th>
<th>Seller Knock-in Date</th>
<th>Cumulative Profit/Loss (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulated Data (5% KI &amp; Disc.)</td>
<td>Session 24</td>
<td>$64,534.00</td>
<td>Session 30</td>
<td>$43,250.00</td>
</tr>
<tr>
<td>Simulated Data (10% KI &amp; Disc.)</td>
<td>Session 50</td>
<td>$23,423.00</td>
<td>None</td>
<td>$28,323.00</td>
</tr>
<tr>
<td>Simulated Data (15% KI &amp; Disc.)</td>
<td>None</td>
<td>$35,485.00</td>
<td>None</td>
<td>$49,234.00</td>
</tr>
<tr>
<td>15 sessions before - Negative</td>
<td>None</td>
<td>$73,924.00</td>
<td>Session 43</td>
<td>$44,000.00</td>
</tr>
<tr>
<td>60 sessions before - Positive</td>
<td>Session 41</td>
<td>$25,234.00</td>
<td>None</td>
<td>$26,234.00</td>
</tr>
<tr>
<td>90 sessions before - Positive</td>
<td>Session 45</td>
<td>$56,023.00</td>
<td>None</td>
<td>$80,342.23</td>
</tr>
</tbody>
</table>

**Table 4: Istijrar Accumulator – Simulation Results**

The results showcase risk sharing in terms of the symmetry of profits and losses when the knock in and discount percentages are determined at the reasonable rates of (5 – 10%), which are close to the return on the AAA Sukuk contracts. However, it can be seen that with the increase in knock-in percentages to high levels (15%), the cumulative profits for each party decreases, and the buyer actually incurs losses of $35,485, which are still considerably smaller than the losses that could be incurred in a conventional KODA structure. This points towards the fact that the Istijrar accumulator structure barriers should be placed within the 5-10% range from the strike for maximum efficiency and control in the price volatility during the period.
We ran the same trend line for prior sessions before the hypothetical initiation date for the Istijrar accumulator structure, and the payoffs were extracted in a negative trend environment (15 sessions prior) and a positive trend environment (60 and 90 days prior), as for the KODA structure. The results indicate that in the 15 day session, where there was a downward trend in high magnitude, the buyer and seller of the Istijrar contract gain c. $74,000 and $44,000 respectively, which is contrary to the $400,000 losses that the KODA investor had incurred in the same period. During the 90 session period, where the magnitude of the positive trend was high as well, both the buyer and seller of the accumulator were able to gain a share from the profit upsides, albeit it was a smaller profit than the conventional KODA structure.
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The goal of this study was to build and test an Istijrar accumulator model where it would enable a buyer in a supply contract to hedge against the risk of commodity price movements. The premise of the study was to evaluate the use of Istijrar accumulators as an alternative to the KODA structures due to the extreme downside losses that the investors incur when utilizing such a structure to hedge price risk.

A Monte Carlo simulation in a historical context was used in order to determine whether the model is considered a fair risk-sharing instrument between the IFI and the client, which was done by simulating whether there was a probability of making profits off of the structure, or whether it was a zero-sum game that led to unfair profit distribution among the parties, as is the case in KODA structures where the results explained in the literature review pointed towards the unfairness of the investment.

The results showed the efficiency of the Istijrar accumulator structure in sharing the risk of price movements among Islamic Financial Institutions and their clients while giving each party the exposure to upside price movements in the underlying commodity. This ensure the fairness of payoffs between each party, which complies with the Shariah standards of not fixing returns and avoiding Gharar whereby each party knows the mechanism through which the price of the underlying commodity will be determined at each fixing date.
5.2 Implications of this study

The results of this study provide a good base for further research in the financial field of using Istijrar contracts as a risk management tool, especially due to their flexibility and accommodation of several different types of contracts, such as Ijarah, Musharaka, and Mudarabah. As is it in its infancy stage, the conclusion deduced from real data showcase its strong standing as a risk management tool for Islamic Financial institutions, or even to conventional banks with the use of knock-in barrier options to limit the excessive downside risk of KODA structures.

5.3 Limitations of the study:

One major limitation of the study is the complete lack of literature in the subject matter from both English and Arabic sources, as well as the apparent opposition from some Muslim scholars to the concept of derivatives as a whole. The lack of existing structures also prevented the comparison of this structure to actual data that could have been back-tested to provide another layer of data intelligence in the matter. Additionally, there was a lack of previous studies in the use of knock-in barrier options as risk management tools in conventional finance which did not provide a working model for such a structure to be tested side by side with knock-out structures.

5.4 Recommendations

It is recommended to enhance the sparse literature currently available on Istijrar contracts by using different pricing methodologies to value such accumulator structure, especially with the use of knock-in barrier *Wa’ads* as there was a lack of such literature even in the conventional realm. Additionally, it is recommended to test other factors that could have an effect on the
profit/loss mechanism for the Istijrar contract such as a change in the market conditions and the change in other factors that are present and stipulated in the contract to get a better overall picture on the profitability of such structures in the long-term.
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