



Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance

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Abstract: Islamic finance ecosystem could leverage from blockchain technology in order to improve business processes and streamline operations. The characteristics and conditions of blockchain are in alignment with the principles of Islamic Law as it creates the possibility of coordinating institutions' transactional activities within a strong mechanism of trust and transparency. Blockchain technology allows businesses to build decentralized models and opens new horizons for them to conduct transactions and make agreements. And one of the technologies that is proposing an alternative to the traditional model is smart contract. Smart contracts are closer to Islamic contracts with an undiluted focus on avoidance of any kind of uncertainty regarding settlement of the contracts. One would witness a sharp reduction in the element of gharar with contracting between unknown parties that meet on the internet, when Islamic contracts take the form of self-executing digital or smart contracts, with "electronically coded" terms of executions. The contractual terms will execute only if the pre-configured conditions are met. This will automate the entire contractual process for Islamic institutions. The Islamic contracts will now be easy to verify, immutable and secure, mitigating gharar in the form of operational risks arising from settlement, as well counterparty risks. The adoption of Smart contracts by the Islamic finance industry is the most natural thing to do, not just to gain a strong foothold in this technological revolution, but also to be able to fully comply with the Shari'ah in a transparent way. The Shari'ah laws can form the conditions of a smart contract. Honesty, transparency and trustworthiness are qualities that should make a financial transaction in the Islamic finance industry, and smart contracts are inherently all of these. In the era of faster globalization, risk management is of essential importance for banks. As credit risk being the most significant risk in Islamic Finance Institutions' (IFIs), we stressed our attention in this paper on it and as per our opinion we believe that the new ledger technology will add value for IFIs in terms of reducing it. Blockchain and particular Smart contracts would help reducing credit losses; provide more transparent and accurate credit ratings for capital allocation, which could lead to minimization of the required capital allocation for credit loss, as well better and cheaper administration and facilitation of collaterals. All the above will improve IFI's profitability and shareholders value. Not only the Islamic banks will abide fully with Shari'ah rules, but they could gain more international customers seen as the more reliable choice. The purpose of the study consists of analyzing the role of blockchain and smart contracts as a tool for risk management. We used Allnma bank as a case study to show the impact of using new FINTECH in Islamic finance. The main findings of the paper show that using blockchain and smart contracts as a tool of risk management reduces costs for IFIs considerably. The paper is organized as follows: section one will present the introduction and literature review. Section two describes Blockchain technology and Smart contracts and finally we focus on how risk management could benefit from these technologies in Islamic financing. The rest of the sections will present and discuss the use of blockchain in risk management.

Keywords: Islamic financing, Risk Management, Blockchain technology, Smart contract, Shari'ah principles.

JEL Classifications: G32



1. Introduction

In order to be Shariah-compliant, Islamic finance products must observe the fundamentals of contracts in Islamic law. The three main fundamentals are contractual expression (offer and acceptance), parties to the contracts and subject matter of the contracts. Each of these fundamentals comes with certain guidelines. For examples, the offer and acceptance must be unambiguous, the parties must have the competency to conclude the contracts and the subject matter must be ascertained by the parties at the time of the contracts. In the implementation of Islamic finance products, these fundamental guidelines are translated into a set of legal documentations which must be executed according to the right sequence. In Murabahah, for instance, the contractual expression is in the form of a sale and purchase (S&P) agreement. To avoid uncertainty (gharar) of selling something that has not been possessed, the sequence in signing of the S&P documents will have to follow the direction of the transfer of assets (subject matter of the contract) between the financial institution and the customer.

The number or legal documents will be more and the order in which the documents need to be executed will be trickier for hybrid Shari'ah contract structures, as there are more contracts and more parties. Let's look at tawarruq (also referred to as commodity murabahah) as a case in point. Tawarruq refers to the contract of purchasing a commodity on credit by those who need cash and selling the commodity to another party (not the original seller) for a lower price on cash basis. In addition to the Islamic financial institution (IFI) and the customer, at least two other parties known as commodity brokers are involved in the transactions.

Assuming the product is Islamic personal financing, the sequence of transactions is:

- (1) IFI purchases commodity from commodity broker A;
- (2) IFI sells the commodity to customer on deferred payment;
- (3) Customer appoints IFI to sell the commodity to commodity broker B; and
- (4) IFI sells the commodity on behalf of customer to commodity broker B.

Step 3 involves an agency contract known as "wakalah".

At present, most of the steps described above are still controlled manually. This exposes IFIs to Shari'ah incompliance risk¹. In the event a bank disburses the financing amount to the customer before full completion of the above steps, the transaction violates the condition precedent of the contract. In tawarruq application for personal financing, cash can only be generated out of selling the commodity purchased earlier to another commodity broker on a cash basis. In addition, the current processes in handling tawarruq in financial institutions are time consuming and costly.

The objective of the study is to show the importance of the FINTECH in Islamic finance. Nowadays, Islamic finance is growing and requires sophisticated tools to manage all types of risks that could arise. The most recent tools are Blockchain and Smart Contracts. These techniques will be a good alternative to actual risk management tools. Some of the techniques used are not Shari'ah compliant as they lack transparency. The features of FINTECH will be a good example of trust between parties. The present study aims to link the digital tools to Islamic finance. This study is significant in terms it is the most recent research on how Islamic finance could benefit from Blockchain and Smart contracts.

The success of banks and the health of the financial system depend critically on how banks take risks. A bank's ability to measure and manage risks creates value for shareholders.

1. Shari'ah incompliance risk arises from non-compliance with Shari'ah law. Please see detail definition under section: Types of risk



2. Literature Review

The literature on blockchain and smart contracts and its use in risk management is inexistent due to the recent trend of FINTECH in Islamic finance. Lacasse et al. (2017) used the agency theory to study the relationship between Islamic bank and borrowers; their objective was to consider whether agents act in the best interests of the stakeholders. The study wanted to answer the question: Can blockchain technology and smart contracts support and enhance the transparency feature? Their research was pure qualitative.

Lacaster et al. (2017) discussed the agency theory as original theory to explain the transparency feature. Their methodology consists of using the relationship between principal and agent (Islamic banks and borrowers) to show that FINTECH could be a good tool for risk management. This FINTECH will reduce the agency costs and enhance the relationship between agent and principal.

Abu-Bakar (2017) found that Shariah opinions must become more informed and conclusive as cryptocurrency is better understood. He also argued that blockchain can serve to enhance the notions of trust in exchange transactions and transfers.

Abu-Bakar (2017) shows that cryptocurrency when introduced in Islamic finance will of great importance. As Islamic finance is based on trust and transparency and doesn't require a third party in order to minimize the hidden costs, this digital currency will play a role of managing the risks arising from different parties. In this study, the author discussed the exchange as an example to argue that cryptocurrency is the recent tool for risk management and could be an alternative to Islamic finance.

Evans (2015) analyzed the compliance of virtual currencies with the requirements of Islamic Banking and Finance and concluded that bitcoin or a similar system might be a more appropriate medium of exchange in Islamic Banking and Finance than riba-backed central bank fiat currency, especially among the unbanked and in small-scale cross-border trade. This research paper, tried to focus on the notion of interest rate (riba) to explain the importance of FINTECH in Islamic finance. The methodology used consists of comparing the situation of banked and unbanked situations and the role of central bank to avoid financial risks. The role of central bank for Evans (2015) is not only an intermediary between banks but in the presence of bitcoin, the central bank is losing its main role as regulator. The presence of cryptocurrency will manage the exchange between participants in the financial market and hence manages the relevant risks.

3. Blockchain

Blockchain is a peer-to-peer public ledger maintained by a distributed network of computers that does not require central authority or third-party intermediaries. It is a growing list of records, called blocks, which are linked using cryptography. First introduced in 2009, it was invented in 2008 by Satoshi Nakamoto, Blockchain is the foundation of cryptocurrency such as bitcoin. The scope of blockchain technology is much wider and has the potential to improve the overall financial system efficiencies. Smart contract is one of blockchain applications in financial services industry.

In terms of participation and rights there are two types of blockchains: permissionless and permission. In a permissionless blockchain everyone is completely free to participate (anonymously). Public and private keys are used for to be performed a transaction. All transactions and all information in a particular blockchain are public. Bitcoin and ethereum are the most well-known permissionless blockchains.

The successful adoption and operation of any new technology is dependent on the appropriate management of the risks associated with that technology. This is especially true when that technology is more than an application and is part of the organization's core infrastructure.



4. Smart Contract

Smart contract is a computer programme that can execute contract terms. Fully automated, smart contract can either complement or fully substitute typical legal contracts. The terms of the contracts are coded in computer algorithm as a set of instructions that will be executed based on the conditions specified. Upon meeting the preconditions in each step, the smart contract programme will automatically execute the next step until the entire transaction cycle completes. In fact, the advantage of smart contract is beyond automatic executions of contract terms. Leveraging on blockchain technology, smart contract programmes allow immutable, verifiable and secure record of all contracts and transactions which are fully auditable.

As per ethereum founders: smart contracts that runs on the decentralized platform ethereum, are applications that runs exactly as programmed without any possibility of downtime, censorship, fraud or third-party interference. These apps run on a custom built blockchain, an enormously powerful shared global infrastructure that can move value around and represent the ownership of property.²

In summary, Islamic finance products are structured based on underlying Shari'ah contracts. The terms and conditions of these contracts are specified in legal documents and these documents must be executed in the correct order to ensure the compliance of Shari'ah. At the moment, the controls are manual and the processes are time consuming and costly. Blockchain smart contract can automatically execute contract terms and has the potential to significantly improve the overall process.

5. Risk management in FINTECH era

Most commonly risk is defined as the volatility of returns leading to “unexpected losses” with higher volatility associated with higher risk. Risk is postulated to be inevitable part of Islamic finance transactions. Shari'ah specifies it with the principle: “Al Ghunm Bil Ghurm” that the size of the profit should correspond to the level of risk involved. The core of this maxim is that the bank is likely to realize profit as it is likely to incur loss. It is worth mentioning that Islam does not aim through this principle the exposure to risk as a mere risk. For this reason Shari'ah sets the impermissibility of gharar. Gharar arises when a transaction comprises specific elements of risks or uncertainty and incompleteness. The volatility of returns is directly or indirectly influenced by numerous risk factors, and the correlation between them. These risk factors can be broadly grouped together into the following major categories: market risk, credit risk, liquidity risk, operational risk, regulatory risk, business risk, strategic risk, reputation risk³ and specifically for IFIs displaced commercial risk. For the purpose of our paper we will look further into: market risk, credit risk, liquidity risk, operational risk and displaced commercial risk (Diagram 1).

2. <https://www.ethereum.org/#community>

3. Board of Governors of the Federal Reserve System, Trading and Capital Markets Activities Manual, Washington D.C., April 2007



Figure 1 Risk factors DCR- displaced commercial risk

5.1. Market risk is the risk that changes in financial market prices and rates will reduce the value of a security or a portfolio; which includes: equity price risk, interest rate risk, foreign exchange risk and commodity price risk.

As can be shown from diagram 2, there is a high volatility in bitcoin measured in terms of bitcoin/ usd exchange rate. For example, for the period June 2013 - September 2018 the lowest closing price was 68.67510 and the highest was 19,447.68573⁴. As the debt-like financing in IFI is mainly long-term it needs to be taken precise measures against the cryptocurrency volatility, which will be used in the smart contracts. Measures like the cryptocurrency to be backed up, for eliminating the volatility and future losses due to it, for example “new gold-crypto standard” or crypto-pegged exchange rates.

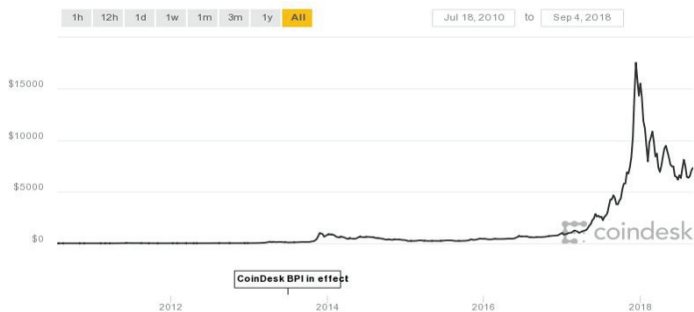


Figure 2 Bitcoin/USD Exchange Rate

Source: <https://www.coindesk.com/price>

5.2. Credit risk is the risk of an economic loss from the failure of a counterparty to fulfill its contractual obligations, or from the increased risk of default during the term of the transaction. Credit risk can be further decomposed into: default risk, bankruptcy risk, downgrade risk, and settlement risk. Credit risk exposures in Islamic financing arise in connection with accounts receivables in Murabahah contracts, counterparty risk in Salam contracts, accounts receivable and counterparty risk in Istisna contracts, lease payments receivables in Ijarah contracts, and Sukuk held in the banking book⁵.

4. <https://www.xe.com/currencycharts/?from=XBT&to=USD&view=10Y>

5. “Banking book” assets are any assets held by an IIFS that it does not intend to trade and which will in principle be held to maturity.



5.3. Liquidity risk relates to a firm's inability to raise the necessary cash to roll over its debt; to meet the cash margin, and collateral requirements of counterparties; to satisfy capital withdrawals or the inability of an institution to execute a transaction at the prevailing market price. It comprises both "funding liquidity risk" and "trading liquidity risk".

The Bank for International Settlements warned that the adoption of distributed ledger technology (DLT), such as blockchain, may introduce new liquidity risk constraints due to the possibility of faster lending processing.⁶

5.4. Operational risk is defined as the risk of losses resulting from inadequate or failed internal processes and systems, people failures including fraud, or from external events, which includes, but is not limited to, legal risk and Shari'ah non-compliance risk in the case of IFIs.

5.4.1. Shari'ah non-compliance risk is the risk of non-compliance resulting from the failure of an IFIs Shari'ah governance mechanism (systems and personnel) to ensure its compliance with Shari'ah rules and principles. This risk can lead to non-recognition of IFIs income and consequent losses.

The risk can take two broad forms in IFIs:

- (i) risks relating to potential non-compliance with Shari'ah rules and principles in the IIFS' operations, including the risk of non-permissible income being recognized; and
- (ii) the risk associated with the IFIs fiduciary responsibilities as Mudarib towards funds providers under the Mudarabah form of contract, in the case of misconduct or negligence by the Mudarib, the funds provided by the fund providers become a liability of the Mudarib.⁷

5.5. It is worth mentioning specifically related to IFIs a displaced commercial risk. This is the risk arising from assets managed on behalf of Investment accounts holders (IAH) that are commingled with the IFIs own capital. IFI may forego part or all of its Mudarib share of profit on such funds, when it considers this necessary as a result of commercial pressure in order to increase the return that would otherwise be payable to the IAH.⁸

6. Measurement

Risks in their nature are not static, but very dynamic and showing high correlations especially in downturns. This leads to a conclusion that they cannot be managed separately. Today's volatile environment requires financial institutions to adopt enterprise risk management approach. Before 2007-2008 financial institutions managed their risks in decentralized way. Besides, the high inter-dependency between the risk factors, the problem is that individual risk functions measure and report their specific risks using different methodologies and formats. As a consequence the senior management and the board of directors receive incomplete information. The consequences of the crisis led to an integrated approach to handling all aspects of risk—enterprise risk management (ERM). ERM could be define as a comprehensive and integrated framework for managing key risks in order to achieve business objectives, minimize unexpected earnings volatility, and maximize firm value. An ERM approach takes a portfolio view of all types of risk within an organization and rationalizes the use of derivatives, insurance, and alternative risk transfer products to hedge only the residual risk deemed undesirable by management.⁹ The increase in risk could have two sides effect on a bank; on one hand it can enable

6. Distributed ledger technology in payment, clearing and settlement <https://www.bis.org/cpmi/publ/d157.pdf>

7. ifsb -15 revised capital adequacy standard for institutions offering islamic financial services [excluding islamic insurance (takāful) institutions and islamic collective investment schemes]

8. ifsb – 2 capital adequacy standard for institutions (other than insurance institutions) offering only islamic financial services

9. Enterprise Risk Management: From Incentives to Controls, Second Edition, by James Lam.



a bank to invest in more risky assets and projects that could increase bank's income, but on the other hand it can also lead to a loss in value because of adverse scenarios. This leads to the idea that there is an optimal amount of risk for a bank from the shareholders' perspective. A well-governed bank would have systems in place to identify the optimal amount of risk and make sure that its actual risk does not differ too much from this optimal amount.

There are different approaches for measuring risk at the bank. Value at Risk (VaR) is one of the most popular tools used in financial risk measurement. VaR is a statistic that measures and quantifies the level of risk over a specific time frame. The concept of VaR has been incorporated in the Basel II Capital Accord. In measuring risk at institution's level, the resulting VaR is not likely to account for all risks, especially for operational. Many banks earn non-interest income (e.g. service charges, set-up fees); such an income is variable in nature and is typically low if there are loan losses incurred by the bank. Therefore, non-interest income must be specifically modeled in obtaining a more accurate measure of firmwide VaR. Interest rate risks pertaining to a bank's liabilities are usually not included in firmwide VaR measures. Additionally, credit VaR measures do not consistently take into account the risks pertaining to unexpected interest rate and credit spread changes. Finally, firmwide VaR measures often do not consider funding liquidity risk. The aggregation of market, credit, and operational risks in arriving at a firmwide risk measure needs to consider the correlation estimates between such risks; the higher the correlations, the higher the firmwide VaR (and vice versa).

Risk management is simply what you do to prepare for the unexpected.¹⁰ Unknown risks become an issue if VaR is estimated at an extremely low level such as 0.06%. Losses at such a low VaR level would be due to extremely rare events. In that case, analyzing historical data is insufficient because there would not be enough historical data extend over a long enough period to determine an accurate measure of extreme losses that have a 0.06% chance of occurring. Different types of risk have different statistical distributions. While market risk generally has a fat-tailed symmetric distribution but can often be well-approximated by the normal distribution, the distributions for credit risk and operational risk are both fat-tailed and highly skewed. Risks that are normally distributed can be summed up in a straightforward way. However, it is not straight-forward to add risks that follow different distributions.

As per Islamic Financial Services Board Standard-13 (IFSB 13), stress testing is a key risk management tool within financial institutions. Stress testing alerts management to adverse unexpected outcomes related to a variety of risks and, among other things, provides an indication of how much capital might be needed to absorb losses if large shocks should occur.¹¹ Stress tests can reveal the bank's financial performance under downside scenarios. As a forward-looking measure, it is also a key risk management tool during periods of expansion, when innovation leads to new products that grow rapidly and for which limited or no loss data is available, as the blockchain technology.

7. Methodology

We used Alinma bank as a case study, for to answer the research question: Can blockchain and smart contracts bring value in risk management of Islamic financial institutions. As credit risk being the most predominant one in IFIs; we review the most important credit risk management tools. In our case study we analyzed Alinma's bank main sources of credit risk and how blockchain and smart contracts could decrease it and bring value for the bank.

As the credit risk is the primary one in IFIs improving its measuring and reducing it would bring value not only for IFIs' shareholders but for all stakeholders. Credit risk is presented in all types of

10. <https://riskychronicles.wordpress.com/2011/06/03/knowns-and-unknowns-the-core-of-risk-management/>
11. file:///C:/Documents%20and%20Settings/DOMxpBG/My%20Documents/Downloads/IFSB-13%20(March%202012)_En%20(2).pdf



debt like transactions (i.e. Murabahah, Salam, Istisna and Ijara), as Murabahah being the predominant one. For example, 2016 Annual Report of Bahrain Islamic Bank shows that out of 526,637BD ('000) in financing assets, 417,098BD are in Murabahah facilities, or 79%.¹² The management of credit risk is a key driver for the profitability of IFIs. Financial claims are characterized by limited upside return and large downside risk. Reducing credit losses with the help of blockchain and more particular smart contracts can improve returns to shareholders.

It could be stated that the assessment of credit risk to some extent is similar to that of market risk or more precisely in the calculation of expected and unexpected losses through estimating the distribution of loss over some horizon. Despite this the techniques used for measuring exposure are different due to some reasons as: 1) lack of data; 2) highly skewed credit loss distribution; 3) non-tradability of some of debt-like facilities; 4) risk modeling errors

The biggest challenge of measuring credit risk in case of private company is the lack of data about the business, which is under the control of the customer and could be shaded. In addition, skewed loss distribution poses challenges to the methods used for measuring. As well, as per most Shari'ah scholars the Murabahah debt cannot be traded. Adding the longer time horizon in most credit risk exposures, a small difference in credit risk modeling could lead to significant differences in credit loss estimation.

On the ground of this sound credit risk measurement is an essential part of the risk management process. The accurate measuring of credit risk could bring to the bank: 1) better assessment on financing facilities; 2) improve risk adjusted returns; 3) adequate provisions for expected losses and capital adequacy as per newest Basel III post crisis requirements.

Basel Committee permits banks to choose between two broad methodologies for calculating their risk-based capital requirements for credit risk. The first, the standardised approach, assigns standardised risk weights to exposures. To determine the risk weights in the standardised approach for certain exposure classes, in jurisdictions that allow the use of external ratings for regulatory purposes, banks may use assessments by external credit assessment institutions that are recognised as eligible for capital purposes by national supervisors. The second risk-weighted capital treatment for measuring credit risk, the internal ratings-based (IRB) approach, allows banks to use their internal rating systems for credit risk, subject to the explicit approval of the bank's supervisor¹³. As per Alinma's Basel III Pillar 3 Disclosure of December 2017, the bank is using an internal rating system.¹⁴ The credit rating is an essential building block of the IFI's credit and underwriting process and is used as a basis in the risk appetite determination and credit decision process.

There are four risk components within the IRB approach to corporate, bank, and sovereign exposures, which build off the structure of banks' rating systems. These are:

- Probability of Default (PD) of a borrower: is the likelihood that counterparty will fail to meet its debt obligations; each estimate of PD must represent a conservative view of a long-run average PD¹⁵ ;
- Loss Given Default (LGD) of a transaction: measures the loss the bank could suffer in case of counterparty default on their debt. It's estimation is not a simple task due to the need of measuring of probability of a lot of inputs as timing, recovered amounts, incurred legal and administrative costs in collecting the debt in case of collateral and the value of the collateral by itself for recovering the default. The contribution of collateral in reducing LGD depends on the nature and value of

12. <https://bisb.com/en/document-center/>

13. Basel III: Finalizing post-crisis reforms, Bank for international settlement, December 2017

14. <https://www.alinma.com/wps/wcm/connect/alinma/cd503d18-9f1b-4fcc-8b9c-7f0ea92c8678/Basel+III%2C+Pillar+3-Qualitative+and+Quantitative+disclosure-December+2017->

15. <https://www.bis.org/publ/bcbsca05.pdf>



collateral. This leads to the conclusion that good collateral management can significantly reduce LGD;

- Exposure at Default (EAD) of a transaction: is the total amount outstanding at the time of default; and
- Maturity (M) of the transaction. Maturity is shown to be a material driver of credit risk¹⁶

Expected loss (EL) should be calculated for every credit exposure in the book. Calculating expected loss requires estimating the above first three parameters: expected exposure at the time of default (EAD), probability of default (PD) and the loss given default (LGD)

$$EL = EAD \times PD \times LGD \quad 17$$

7.1. Alinma bank case study

Alinma bank, a joint stock Saudi company, was established in 2006. The bank is authorized to engage in all aspects of Shari'ah-compliant banking and investment services. Alinma shows outstanding 2017 year end results with 34% increase in the net profit to SAR 2, 011 million and 10% increased in the bank assets to SAR 115 billion.

Based on Credit risk Basel III Pillar 3 2017 general disclosures:

- 95% of the credit portfolio comprises in Saudi Arabia
- 58% of the credit portfolio is in corporate sector, 96% of it is in Saudi Arabia
- 30% of the corporate credit portfolio consists of building, construction and real estate sector
- 17% of the corporate credit portfolios is with maturity longer than 5 years
- 25% of the past due over 360 are in building and construction sector; with the highest percent in consumer loans and credit cards – 30%

As a whole, the bank shows good financial presence. The bank should pay an attention to the building, construction and real estate sector comprising 18% of the portfolio, as the sector is characterized with notorious cyclicalities. And more importantly that 25% of the past due over 360 are in building and construction sector.

As per its 2017 Annual report the bank has a robust Credit Risk Stress Testing process used to evaluate the potential impact of negative factors on asset quality, risk ratings, profitability and capital allocations.¹⁸ The following are its key risk indicators:

- Asset quality – increase/decrease in non-performing assets measured in terms of ratio to financing assets
- Profitability - increase/decrease in the accounting profit/loss
- Capital adequacy – measured in terms of change in total amount of capital and the Capital Adequacy ratio (CAR)
- Liquidity position – measured in terms of changes in key liquidity indicators.¹⁹

16. <https://www.bis.org/publ/bcbsca05.pdf>

17. https://en.wikipedia.org/wiki/Expected_loss

18. https://www.alinma.com/wps/wcm/connect/alinma/b1855cba-808a-4eb4-9ebf-25788bd0e194/Alinma+Annual+RE+2017+-low.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE.Z18_MA161940L0OG50AQAK1OKV30K7-b1855cba-808a-4eb4-9ebf-25788bd0e194-mpdadlj

19. https://www.alinma.com/wps/wcm/connect/alinma/cd503d18-9f1b-4fcc-8b9c-7f0ea92c8678/Basel+III%2C+Pillar+3-Qualitative+and+Quantitative+disclosure-December+2017-1.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE.Z18_MA161940L0OG50AQAK1OKV30K7-cd503d18-9f1b-4fcc-8b9c-7f0ea92c8678-md9nHRb

**Table 1: Alinma's default loans²⁰ growth rate**

	2014	2015	2016	2017
Default loans at year end of	350,320.00	428,790.00	563,692.00	1,076,438.00
Default loan growth rate (y-o-y)	N/A	22.40%	31.46%	90.96%

Source: Alinma's Basel III Pillar 3 Disclosures for 2014-2017

As shown from the data in Table 1, the default loan rate in 3 years period is growing rapidly. This requires the bank to include in its robust stress testing in asset quality a test based on default loans as a whole. Usually the probability of default can depend on the health of the economy, in addition to company-specific balance sheet considerations. The default rate increased significantly in the second half of 2017. At the same time the macroeconomic data for Saudi Arabia shows a slighter growth in GDP in the second half of 2017 (Diagram 3). As well, the oil prices during 2017 showed growth in comparison to the previous year. We believe that if Alinma bank implements blockchain and smart contracts would help to discover earlier such a negative tendency and sufficiently reduce it by taking appropriate measures.

**Figure 3 Saudi Arabia GDP Growth Rate**

Source: <https://tradingeconomics.com/saudi-arabia/gdp-growth>

As per Annual report for 2017, Alinma bank has SAR 814,007,000 non-performing loans. As percentage of the total financing assets is just 1 %. What gives an attention in particular is the non-performing exposure of SAR 267,037,000 in commerce in comparison to SAR 0 for the previous year.²¹ A forward-looking stress test, should be made for to be discovered is this a forward-looking trend or just particular exposures, as nowadays e-commerce plays a significant role in the Saudi Arabian economy.

As per Islamic Financial Services Board Standard-15 (IFSB 15), IFIs may secure a pledge of the sold asset or another tangible asset as collateral for the Murabahah receivables (“collateralized Murabahah”). Collateralisation is not automatically provided in a Murabahah contract but must be explicitly stated or must be documented in a separate security agreement at or before the time of signing

20. Default exposure comprises of non-performing financing exposures and past due more than 90days, but not yet impaired (source: Alinma's Basel III Pillar 3 Disclosures, December 2017)

21. https://www.alinma.com/wps/wcm/connect/alinma/b1855cba-808a-4eb4-9ebf-25788bd0e194/Alinma+Annual+RE+2017+-ow.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE.Z18_MA161940L0OG50AQAK1OKV30K7-b1855cba-808a-4eb4-9ebf-25788bd0e194-mpdad1j



the Murabahah contract.²² In adopting blockchain technology and more particular smart contract an IFI needs to pre-set codes for approving the Murabahah facility after having in hands valuable collateral. The value of collateral can be quite volatile. The value of some very specialized or illiquid collaterals in times of downturn could be substantially decrease or very hard to find another purchaser. As per Basel III, when taking collateral, banks must calculate their adjusted exposure to counterparty in order to take account of the risk mitigating effect of that collateral. Banks must use the applicable supervisory haircuts to adjust both the amount of the exposure to the counterparty and the value of any collateral received in support of that counterparty to take account of possible future fluctuations in the value of either, as occasioned by market movements.²³ To optimize its earnings IFI needs to accurately price its credit risk exposures. A credit spread for covering expected losses should be added to the cost of funding when pricing a Murabahah facility. The markup in Murabahah sale should account for the expected loss of the exposure together with some other costs.

Alinma bank, in the ordinary course of business holds collaterals as security to mitigate credit risk. These collaterals mostly include customers' deposits, financial guarantees, equities, real estates and other fixed assets.²⁴

As per our opinion the implementation of blockchain and specifically smart contracts could lead to the following improvements in terms of credit risk:

In case of using external ratings in standardised approach for credit assessment and adopting blockchain ledger technology from both the IFI and the rating agency it would help for

faster and more transparent updates of any changes in a credit rating of a borrow and timely adjustment of required capital requirements and in case of some significant downgrade taking an earlier actions for reducing expected losses due to it. This could lead to lessen capital burden for the IFIs and improved shareholders value.

As well if the big public companies would use the blockchain system for posting their financial results, this could steer more transparent, timely and accurate data which on the other hand could lead to more accurate credit ratings. And actions as "cooking the books" would be just a part from the history.

In case of using IRB approach for credit assessment the adoption of blockchain would help in timely amendments of internal based risk ratings of the obligors. Because the Alinma's internal risk ratings indicates the one year probability of credit default²⁵ improving the process through blockchain could produce faster and keep up-to-date internal ratings and produce more reliable forward-looking data.

In case of posting collateral: a smart contract can be only activated after the system proving that all the needed requirements are fully satisfied. Which means that contract will be executed only after the appropriate collateral is in place. As well the administrative costs of posting the collateral will be reduced through the activating of pre-embedded programmed keys.

22. ifsb -15 revised capital adequacy standard for institutions offering islamic financial services [excluding islamic insurance (takāful) institutions and islamic collective investment schemes]

23. Basel III: Finalizing post-crisis reforms, Bank for international settlement, December 2017

24. <https://www.alinma.com/wps/wcm/connect/alinma/cd503d18-9f1b-4fcc-8b9c-7f0ea92c8678/Basel+III%2C+Pillar+3-Qualitative+and+Quantitative+disclosure-December+2017->

25. https://www.alinma.com/wps/wcm/connect/alinma/b1855cba-808a-4eb4-9ebf-25788bd0e194/Alinma+Annual+RE+2017+-ow.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE.Z18_MA161940L0OG50AQAK1OKV30K7-b1855cba-808a-4eb4-9ebf-25788bd0e194-mpdad1j



With the blockchain system allowing more transparency, one of the biggest challenges for credit risk measuring: lack of data should be minimized which could lead to a better risk assessment.

8. Conclusion and recommendations

The paper discussed the research question of: can blockchain and smart contracts bring value in risk management of Islamic financial institutions. Using Alinma bank as a case study and with the help of Blockchain and Smart contracts features, we tried to make conclusion on using these FINTECH as tool for risk management. The conclusion is argued by the IFSB standards and the understanding of the risk management used by the bank.

Risk management has evolved over time to keep up with changing realities and organizational needs. Greater uncertainty and complexity in the operating environment demand a stronger focus on risk management. Traditional risk assessment techniques prioritize risks based on impact and likelihood. In uncertain environments, surprises catch financial institutions unprepared exactly because the focus is mostly on high-likelihood risks.

Risk is inevitable part of IFI's business. The Shari'ah emphasises risk sharing as a salient characteristic of Islamic financial transactions. This is not only exemplified in equity-based contracts, like musharakah and mudarabah, but even in exchange contracts, such as sales and leasing, whereby risk is shared by virtue of possession.²⁶ Abiding to the principle: "Al Ghunm Bil Ghurm", avoiding gharar and implementing the new blockchain technologies and their smart contracts; has the potential to significantly improve the financial industry credit processes and profitable levels.

Blockchain system is still in its early stage of life. It requires some years for to be fully adopted and the old back-end systems to be fully replaced. During these years it needs to be made enough tests for to prove the new technology is robust enough for to be completely switched on. As well, the mistakes from the past should be taken into account for avoiding future failures. Failure to mitigate the risks posed by adopting the new technology might undermine all the benefits. We strongly believe that blockchain and smart contracts once implemented will bring value for IFIs.

In order to achieve a thriving economy, with its 2030 vision, Saudi Arabia will diversify its economy. The Kingdom is refocusing on small and medium-sized enterprises (SMEs) by encouraging financial assistance; increasing the contribution of SMEs to GDP from 20 to 35 percent by 2030.²⁷ This 2030 Saudi vision would help Alinma bank to continue increasing its profits and to reduce default loans growth if it takes the right direction using the advantage of the new technologies and making appropriate forward looking stress testing for it.

During our research process we e-mailed to some experts in Islamic finance and some outstanding organizations for their valuable opinion on the topic. Unfortunately we did not receive any feedback from them. As a new and very important topic we believe sharing knowledge, information and expertise is very important to bring Islamic finance as the outperforming financial platform worldwide. Abiding to Shari'ah prudent principles from both sides of the deal could lead to healthier and more transparent economy and financial strength.

Our recommendation to IFIs is to include FINTECH in their strategic risk management strategies and believe in blockchain and smart contracts in adding value to the institution. These products are very important in point view of Sharia'h as they guarantee the transparency and facilitate the transaction and then offset gharar concept.

26. <https://islamicmarkets.com/articles/is-islamic-finance-a-profit-and-loss-sharing-system>

27. <https://www.saudiembassy.net/vision-2030>



Next researches will focus on implementing these technologies in product pricing and risk forecasting to support IFIs and especially SMEs to overcome the traditional risks and the new risks as well.

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