“Sectorial evaluation of Islamic banking contracts: a fuzzy multi-criteria-decision-making approach”

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SECTORIAL EVALUATION OF ISLAMIC BANKING CONTRACTS: A FUZZY MULTI-CRITERIA-DECISION-MAKING APPROACH

Abstract

Improving the efficiency and performance of microfinance investments is essential to achieve its objectives in terms of economic and social development. One parameter that influences such a performance is the kind of the activity exercised by the micro-entrepreneurs. The aim of this paper is to provide a decision-making guide to help both microfinance institutions and investors to choose the appropriate Islamic banking contract with respect to each sector of activity. To attain this goal, an Intuitionistic Fuzzy TOPSIS evaluation is conducted in collaboration with Moroccan Islamic finance experts and practitioners. The proposed approach has the advantage to deal with the lack of quantitative historical data, as well as the uncertainty of the decision makers' judgments. The suggested work will be helpful for the Moroccan participative banks and for the future Islamic microfinance institutions as well.

Keywords activity sectors, Islamic banking contracts, performance evaluation, microfinance sector, Intuitionistic Fuzzy TOPSIS

JEL Classification D04, D81, G21

INTRODUCTION

Microfinance refers to providing financial and sometimes non-financial services to the unbanked poor with the aim of reducing their poverty (Alaoui & Tkiouat, 2017). The microfinance products can include, credit, saving, insurance, skill training and other many services. Over the years, several studies have highlighted the positive impact of microfinance in terms of financial inclusion and poverty reduction. However, in the last decades, especially after 2007 crisis, many studies have confirmed that the real impact of microfinance is not yet clear (Do & Chen, 2013). Indeed, microfinance industry is still facing lots of issues and challenges (Obaidullah, 2008). It is found that microfinance institutions focus more on credit over the other products, furthermore, they impose a high interest rate, which can harm the interest of their customers (Bourhime & Tkiouat, 2016). In that context, Mohammad Yunus (2008) explained that the fight against poverty and the elimination of socio-economic ecards in the world requires more than financial resources. He announces also that even charity does not serve poor, because they can miss opportunities, so it can only perpetuate poverty (Bourhime & Tkiouat, 2016). Banerjee, Duflo, Glennerster, and Kinnan (2015) confirmed that to eradicate poverty, we cannot succeed based solely on microcredit.

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According to Nabi et al. (2018), financial exclusion is a real concern of all developing countries. Nevertheless, it is too severe in Muslim majority countries (Nabi et al., 2018). Beside the external exclusion due to the lack of collateral, information asymmetry and the complexity of procedures, the Muslim micro-entrepreneurs are voluntarily excluded from conventional microfinance programs due to their religious backgrounds. Muslim micro-entrepreneurs need appropriate products and services that conform to their beliefs and cultures (Obaidullah, 2008).

Islamic microfinance proposes different financing instruments, which are able to promote financial inclusion among poor people, especially in Muslim majority countries. The Islamic microfinance adopts the Islamic approach of financial inclusion based on the risk sharing, and the redistribution of wealth (Mirakhor & Iqbal, 2012).

According to Abdirizak (2015), various studies have been conducted to assess the impacts of Islamic financing instruments on the performance of Islamic banking Institutions.

Ahmed and Zakaria (2011) proved that in Malayzia, Al-Ijarah Thumma Al-Bai' product, which combines ijarah (lease) contract and bai' (sale) contract in one trading document, influences significantly the banks' profits. Such as any increase in Al-Ijarah Thumma Al-Bai' financing contract will also increase the profitability of Islamic banks.

Zulkifli (2007) reported that in Malaysia, Al-Bai Islamic contracts' are the most beneficial in terms of profit and growth of Islamic banks.

According to the International Trade Center (2009), the Murabaha contract is recommended for financing commercial operations or for obtaining working capital. while the Mudarabah can be used for equity investments, but it is also often used when customers deposit money at a bank. When used for deposits, the bank brings its knowledge and skills to identify appropriate investment opportunities. As for the Musharakah contract, the rapport did not detail his use, it means sharing and it is used in the field of finance to define joint ventures or partnerships. For a Salam contract, it can finance the production, construction and harvesting of agricultural products in the short term. However, the financing by an Istisna contract must relate to a property that must be manufactured, constructed or transformed, be of significant size and involve significant capital expenditure.

We noticed that the classification of Islamic contracts is generally deduced from their definitions and terms. However, the performance of a contract differs according to the type of activity exercised and its execution's conditions.

The purpose of this work is to evaluate the performance of Islamic banking instruments taking into account both their characteristics and the specificities of the market. Thereby we had the idea to evaluate Islamic banking contracts in different activity's sectors in Morocco and try to identify the best performing contract in each sector, based on the opinions of experts in Islamic finance's field.

The results of this study will facilitate the decision-making for investors interested in Islamic finance contracts, as well as for the Moroccan participative banks. We suggest that the optimization of the use of Islamic banking contracts according to the sector of activity will improve the project profitability.

Collecting quantitative data to realize this study was very difficult due to the infancy of the Islamic banking system and the non-marketing of some contracts in Morocco. To tackle these challenges, we have adopted an expert driven approach. We managed to implement an Intuitionistic Fuzzy TOPSIS evaluation. This approach takes into account the unavailability of statistical data and the subjectivity and uncertainty that characterize the decision-makers knowledge.

This paper is organized as follows: the first section presents a theoretical background of the Intuitionistic Fuzzy TOPSIS (IFT) method. The second section presents the application of IFT to the sectorial evaluation of Islamic banking contracts in microfinance, the third section discusses the obtained results, and the final section presents the finding.

1. THEORETICAL BACKGROUND OF THE INTUITIONISTIC FUZZY TOPSIS (IFT) APPROACH

Many real world problems are affected by insufficient or imprecise information, as well as the subjective nature of decision makers' preferences (Kahraman, 2008; Skalna et al., 2015). For many years, probability theory was considered as the only tool to represent uncertainty (Basiura et al., 2015). However, for various decision-making cases, uncertainty is not probabilistic (random) in nature, but it results from incomplete or imprecise data.

In many situations, it is difficult to gather the exact assessment data; the assessment is based mainly on the decision makers' knowledge and their past experiences using linguistic terms that is words or sentences in a natural or artificial language (Xu & Cai, 2012). For instance, when judging the quality of a service, linguistic labels like "very good", "good" and "bad" are usually used. Dohnal (1983) highlights that "the key elements in human thinking are not numbers but words". Therefore, how to make a scientific decision with linguistic information is gaining more importance in the literature. Fuzzy set theory developed by Zadeh (1965) is considered as a successful way to handle such a kind of information. The idea is to transform the linguistic variables into fuzzy sets using appropriate membership functions (Dohnal, 1983; Arfi, 2005).

Definition 1: Let X be a set of the universe, the fuzzy set A is defined as $A=\left\{\left(x,\mu_A(x)\right)\middle|x\in X\right\}$, where $\mu_A: X\to[0,1]$ represents the degree of membership of the element x to the fuzzy set A (Lamrani & Tkiouat, 2018).

Velasquez and Hester (2013) confirm that determining a precise value of the degree of membership for an element can be difficult; there is often an hesitation degree between the membership and non-membership. To tackle this challenge, Atanassov (1986) introduces the intuitionistic fuzzy set (IFSs) as another extension of fuzzy set.

The IFS is a generalization of the ordinary fuzzy set that allows better representation of the uncertainty (Atanassov, 1986; Zadeh, 1965). It is characterized by a membership degree, non-membership degree and an hesitation index. The IFS theory has been used in various fields such as management, economics and social science (Lamrani & Tkiouat, 2018; Velasquez & Hester, 2013; Behzadian et al., 2012).

Definition 2: For a set X, the IFS is defined by:

$$A=\left\{\left(x,\mu_A(x),\nu_A(x)\right)\middle|x\in X\right\},$$

where $\mu_A: X\to[0,1]$ and $\nu_A: X\to[0,1]$ satisfy the condition $0\le\mu_A(x)+\nu_A(x)\le 1$ for any $x\in X$, $\mu_A(x)\in[0,1]$ and $\nu_A(x)\in[0,1]$ are the degree of membership and non-membership of the element x to the set A, respectively. The hesitation degree is given by this formula: $\pi_A(x)=1-\left(\mu_A(x)+\nu_A(x)\right)$ (Lamrani & Tkiouat, 2018).

Based on the intuitionistic fuzzy set, the intuitionistic fuzzy number is defined as follows: $a=(\mu_a,\nu_a)$, where $\mu_a,\nu_a\in[0,1]$ and $\mu_a+\nu_a\le 1$.

Let a_1, a_2 and a be three intuitionistic fuzzy numbers, some operational laws are also developed (Xu, 2007; Xu & Yager, 2006):

- $a_1+a_2=\left(\mu_{a_1}+\mu_{a_2}-\mu_{a_1}\mu_{a_2},\nu_{a_1}\nu_{a_2}\right)$;
- $a_1\cdot a_2=\left(\mu_{a_1}\mu_{a_2},\nu_{a_1}+\nu_{a_2}-\nu_{a_1}\nu_{a_2}\right)$;
- $\lambda a_1=\left(1-\left(1-\mu_a\right)^{\lambda},\nu_a\right),\ \lambda>0$;
- $a^{\lambda}=\left(\mu_a{}^{\lambda},1-\left(1-\nu_a\right)^{\lambda}\right),\ \lambda>0.$

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To support decision making, several Multi-Criteria-Decision-Making (MCDM) techniques were developed. The MCDM main idea is that breaking a problem down into its principal parts (alternatives, criteria…), and then establish priority among choices is a comprehensive way to understand it mathematically. One such well known example of MCDM is the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) (Boran et al., 2009; Behzadian et al., 2012; Hwang & Yoon, 1981).

According to Basiura et al. (2015), despite their undeniable advantages, the classical MCDM techniques face many difficulties in real-life problems, since they assume that criteria and their corresponding weights are expressed by exact numbers. However, in several practical cases, the available information may be incomplete or vague. The judgment about criteria is generally subjective in nature; it cannot be expressed crisply, but only as fuzzy sets.

Kahraman (2008) notes that the diffusion of the fuzzy set theory into MCDM techniques can successfully take into account the uncertainty during the evaluation process. The existing literature reveals several suggestions on how to incorporate the fuzziness related to the decision maker's judgments into the MCDM models using both the classical fuzzy sets and their generalizations (Vasant, Bhattacharya, & Abraham, 2008; Skalna et al., 2015).

As per Chang and Cheng (2010), the description of the Intuitionistic Fuzzy TOPSIS can be summarized in 8 steps:

1. Identify the evaluation criteria, alternatives and decision makers.

- Let $A=\{A_1, A_2, A_3, ..., A_n\}$ be a set of n alternatives and $C=\{C_1, C_2, ..., C_m\}$ be a set of m criteria.
- Let $D=\{D_1, D_2, ..., D_l\}$ be the set of l decision makers.

The performance of an alternative $A_i\,(i=1,...,n)$ is measured with respect to criteria $C_j\,(j=1,...,m)$ using the opinions of decision makers $D_k\,(k=1,...,1)$.

2. Construct the decision matrices.

To estimate their judgment on alternatives, the decision makers' $k\,(k=1,\ 2\ldots\ l)$, use an intuitionistic fuzzy number

$$\alpha_{ij}^k=\left(\mu_{ij}^k,\upsilon_{ij}^k\right),$$

where μ_{ij}^k refers to the degree to which the alternative A_i satisfies the criterion C_j according to the decision maker number k, υ_{ij}^k represents the degree to which the alternative A_i dose not satisfy the criterion C_j according to the some decision maker.

The intuitionistic fuzzy matrix associated to decision maker k is expressed as follows:

$$D^k=\begin{array}{c} \\ A_1 \\ A_2 \\ \ldots \\ \ldots \\ A_n \end{array}\begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \ldots & C_m \end{array} \\ \begin{bmatrix} \alpha_{11}^k & \alpha_{12}^k & \ldots & \alpha_{1m}^k \\ \alpha_{21}^k & \alpha_{22}^k & \ldots & \alpha_{2m}^k \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \alpha_{n1}^k & \alpha_{n2}^k & \ldots & \alpha_{nm}^k \end{bmatrix} \end{array}.$$

3. Aggregate the decision matrices of all decision makers.

Let $\sigma=\{\sigma_1,\sigma_2,....\sigma_l\}$ be the weight vector for all decision makers, where:

$$\sum_{k=1}^{l}\sigma_k=1,\ \sigma_1\in[0,1].$$

To aggregate the decision makers' opinions, the intuitionist fuzzy weighted averaging (IFWA) operator is used.

Let $D=\left(a_{ij}\right)_{n\cdot m}$ be the aggregated matrix, the IFWA operator is defined by

$$\alpha_{ij}=IFWA_\sigma\left(\alpha_{ij}^1,\alpha_{ij}^2,...,\alpha_{ij}^l\right)=$$
$$=\left(1-\prod_{k=1}^{l}\left(1-\mu_{ij}^k\right)^{\sigma_k},\prod_{k=1}^{l}\left(\upsilon_{ij}^k\right)^{\sigma_k}\right),$$
$$k=1,2,...,1.$$

Therefore, the matrix D can be defined as follows:

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ \dots \\ \dots \\ A_n \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \dots & C_m \end{array} \\ \begin{bmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1m} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2m} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \alpha_{n1} & \alpha_{n2} & \dots & \alpha_{nm} \end{bmatrix} \end{array}.$$

4. Assign the weights for criteria.

Let $w_j^k = \left(\mu_j^k, \upsilon_j^k\right)$ the intuitionistic fuzzy weight assigned to the j^{th} criterion by the k^{th} decision maker. The aggregated opinion of all decision makers about the j^{th} criterion is calculated using the IFWA operator. So

$$w_j = IFWA_\sigma\left(w_{ij}^1, w_{ij}^2, ..., w_{ij}^l\right) =$$
$$= \left(1 - \prod_{k=1}^{l}\left(1-\mu_j\right)^{\sigma_k}, \prod_{k=1}^{n}\left(\upsilon_{ij}^k\right)^{\sigma_k}\right),$$
$$k = 1, 2, ..., 1.$$

The weights set W of all criteria can be given as follows: $W = \left[w_1, w_2, ...w_m\right)$.

5. Establish the aggregated weighted decision matrix.

The aggregated weighted decision matrix is defined as follows:

$$D' = D \otimes W = \left(a'_{ij}\right)_{n \cdot m},$$

where $a'_{ij} = a_{ij} \otimes w_j = \left(\mu_{D_i w}\left(c_j\right), \upsilon_{D_i w}\left(c_j\right)\right)$,

so,

$$D' = \begin{bmatrix} \alpha_{11} \otimes w_1 & \alpha_{12} \otimes w_2 & \dots & \alpha_{1m} \otimes w_m \\ \alpha_{21} \otimes w_1 & \alpha_{22} \otimes w_2 & \dots & \alpha_{2m} \otimes w_m \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \alpha_{n1} \otimes w_1 & \alpha_{n2} \otimes w_2 & \dots & \alpha_{nm} \otimes w_m \end{bmatrix} =$$
$$= \begin{bmatrix} \alpha_{11}' & \alpha_{12}' & \dots & \alpha_{1m}' \\ \alpha_{21}' & \alpha_{22}' & \dots & \alpha_{2m}' \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \alpha_{n1}' & \alpha_{n2}' & \dots & \alpha_{nm}' \end{bmatrix}.$$

6. Determine the IF-PIS and the IF-NIS.

Let J_1 be the benefit criteria and J_2 be the cost criteria, the intuitionistic fuzzy-positive ideal solution (IF-PIS) denoted I^+ and the intuitionistic fuzzy-negative ideal solution (IF-NIS) denoted I^- is given as follows:

$$I^+ = \left(\mu_{I^+w}\left(c_j\right), \upsilon_{I^+w}\left(c_j\right)\right) \text{ and}$$

$$I^- = \left(\mu_{I^-w}\left(c_j\right), \upsilon_{I^-w}\left(c_j\right)\right),$$

where:

$$\mu_{I^+w}\left(c_j\right) = \left(\max_i \mu_{D_i w}\left(c_j\right) \middle| j \in J_1\right),$$
$$\left(\min_i \mu_{D_i w}\left(c_j\right) \middle| j \in J_2\right),$$

$$\upsilon_{I^+w}\left(c_j\right) = \left(\min_i \nu_{D_i w}\left(c_j\right) \middle| j \in J_1\right),$$
$$\left(\max_i \upsilon_{D_i w}\left(c_j\right) \middle| j \in J_2\right),$$

$$\mu_{I^-w}\left(c_j\right) = \left(\min_i \mu_{D_i w}\left(c_j\right) \middle| j \in J_1\right),$$
$$\left(\max_i \mu_{D_i w}\left(c_j\right) \middle| j \in J_2\right),$$

$$\upsilon_{I^-w}\left(c_j\right) = \left(\max_i \upsilon_{D_i w}\left(c_j\right) \middle| j \in J_1\right),$$
$$\left(\min_i \upsilon_{D_i w}\left(c_j\right) \middle| j \in J_2\right).$$

7. Calculate the separation measures.

To estimate distances between intuitionistic fuzzy sets, several measures have been suggested in recent years (Boran et al., 2009), which include the Hamming distance, the Euclidean distance, the normalized Hamming distance and the normalized Euclidean distance.

In this study, the separation of each alternative from the IF-PIS and the IF-NIS are given using the normalized Euclidean distance as follows:

$$s_i^+\left(A_i, I^+\right) = \left\{\frac{1}{2m}\sum_{j=1}^{m}\left[\left(\mu_{D_i w}\left(c_j\right) - \mu_{I^+w}\left(c_j\right)\right)^2 + \right.\right.$$
$$\left.\left. + \left(\upsilon_{D_i w}\left(c_j\right) - \upsilon_{I^+w}\left(c_j\right)\right)^2 + \left(\pi_{D_i w}\left(c_j\right) - \pi_{I^+w}\left(c_j\right)\right)^2\right]\right\}^{\frac{1}{2}},$$

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$$s_i^-(A_i, I^-) = \left\{ \frac{1}{2m} \sum_{j=1}^{m} \left[\left(\mu_{D_i w}(c_j) - \mu_{I^- w}(c_j) \right)^2 + \right. \right.$$

$$\left. \left. + \left(\upsilon_{D_i w}(c_j) - \upsilon_{I^- w}(c_j) \right)^2 + \left(\pi_{D_i w}(c_j) - \pi_{I^- w}(c_j) \right)^2 \right] \right\}^{\frac{1}{2}}.$$

8. Calculate the closeness coefficients and rank the alternatives.

The closeness coefficient of an alternative A_i is defined by:

$$C_i = \frac{s_i^-}{s_i^- + s_i^+},$$

where $0 \le C_i \le 1$.

The alternatives are classified according to their C_i, the contract with highest C_i is the most preferred.

2. SECTORIAL EVALUATION OF ISLAMIC BANKING CONTRACTS IN MOROCCAN MICROFINANCE USING IFT APPROACH

The microfinance sector in Morocco finances small income-generating activities in several areas; we quote: trade, agriculture, handicrafts, services and others, with the aim of fighting against poverty and improve the standard of living of a large part of the Moroccan population (Bennouna & Tkiouat, 2016). According to Medias (2016), "The notion of social responsibility is in the DNA of micro finance! It is to finance activities generating income, from micro-projects, presented by a population Excluded from the mainstream financial system: Addressing this excluded population means that we are, from the start, in social responsibility".

In 2015, 920,000 Moroccan customers have benefited of microfinance services, with a loan portfolio exceeding MAD 6 billion (Medias, 2016). The sectorial distribution of the various activities financed by microcredit is as follows: trade activities represent 58% of loans granted, and then come handcrafts (21%), services (15%) and finally agriculture and breeding with 6% (Medias, 2016) (see summary diagram in Figure 1).

As mentioned before, the aim of this study is to perform a sectorial evaluation of the Islamic banking contracts, especially for the small activities (Figure 1).

In this work, each activity title includes several sub-activities (see Table 1).

We have chosen to treat two categories of Islamic banking contracts:

1) profit-and-loss sharing (PLS) financing products: PLS financing is closest to the spirit of Islamic finance. Their basic principles are those of equity, participation and sharing,

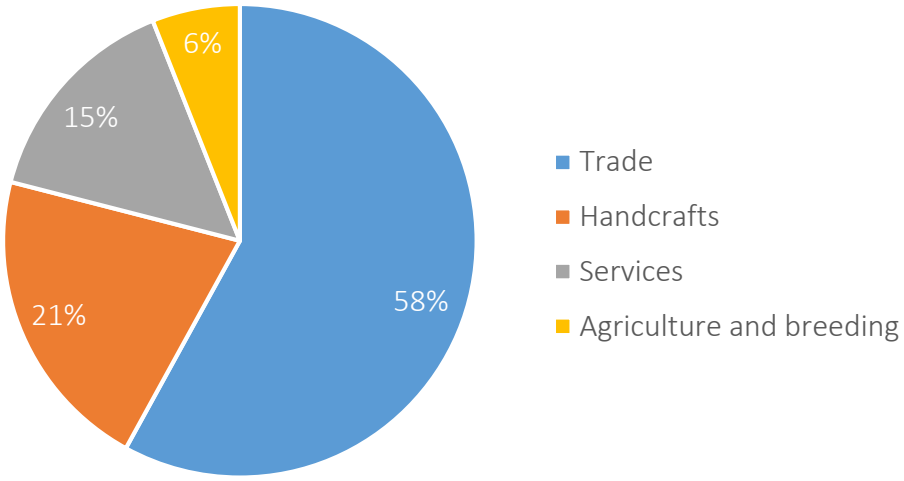

Figure 1. Sectorial distribution of activities financed by microcredit

Table 1. Sectors' activities financed by microfinance in Morocco

Source: Adapted from Bennouna and Tkiouat (2016).

Sectors	Trade	Handicrafts and crafts	Services	Agriculture and breeding
Detailed activities	• Clothing sale • Various article sales, sale of cattle • Selling fruits and vegetables • Other jobs of trade	• Embroider • Dressmaker • Joiner • Upholsterer • Other jobs of crafts	• Mechanic • Builder • Taxi man • Pastry chef • Hairdresser • Cargo carrier • Restorer • Other services	• Breeding of cattle and sheep • Breeding of dairy cows • Fishing and aquaculture • Other rural and breeding activities

they are known by their utility in several economic activities. PLS financing products are of two types: Musharakah and Mudarabah (Mumtaz, Asghar, & Turk, 2015):

- Musharakah: It refers to a partnership structure established under a contract in Islamic finance in which partners share in the profits and losses. Islamic bank lends money to the partner who can also participate in financing the project to achieve a return, which is distributed among the partners according to a predetermined ratio. For the losses, they are borne by all partners in a pro rata basis.

- Mudarabah: This type of financing means that one partner dispose of funds and the other use its expertise to realize a positive income and share it on a pre-agreed basis. In the case of losses, the owner of funds loses his money.

2) non-PLS financing products: This financing contracts are generally used in consumption and corporate credit. There are four non-PLS financing products (Mumtaz, Asghar, & Turk, 2015):

- Murabaha: It is a sale contract. It is used when a client asks the bank to buy a good, for him, while the bank calculate her cost and profit and declare the selling price;

- Salam: it is a sale contract, the buyer pays in advance for a specified good which is delivered by the seller in a future date;

- Istisna is a contract for manufacturing goods and commodities, for the payment and the delivery it is possible to apply the same procedures of Salam contract, or both the payment and the delivery can take place in a future date;

- Ijarah is an agreement that allows to one party to use or benefit from an asset owned by another party for a fixed price in a specified period.

In this study, Islamic contracts had been evaluated in several activities' sectors by 16 decision makers considered with equal expertise and selected from different Moroccan participative banks. In each sector, the contracts are evaluated according to six indicators: the profitability, the risk occurrence, commitments honoring, job creation, wealth creation and economic development.

As we had explained before, experts give their opinions based on real results if they dispose of it or their forecasts until some Islamic contracts were not yet be launched.

In each sector, the decision maker is asked to give his opinion first about the importance of each criterion: and then to evaluate each contract according to all criteria using the linguistic scales (see Appendix Table A1 and Table A2). The experts' evaluation is then converted into their corresponding intuitionistic fuzzy numbers.

3. RESULTS AND DISCUSSION

Firstly, once the IF decision matrices for all decision makers, as well as the weight corresponding to each criterion are filled, we calculate the aggregated IF decision matrix (see Appendix: Table A3, Table A4, Table A5, Table A6). Secondly, we calculate the aggregated IF weights (Table 2) for all sectors.

Then, we deduce the aggregated weighted intuitionistic fuzzy decision matrix (see Appendix: Table A7, Table A8, Table A9, Table A10), using the IFWA operator.

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Table 2. The aggregated IFT weights

Criteria	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Weights	[0.68; 0.16]	[0.62; 0.19]	[0.64; 0.17]	[0.38; 0.30]	[0.55; 0.23]	[0.62; 0.19]

Table 3. The IF-PIS and the IF-NIS

Sectors		Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Trade	I+	[0.43; 0.31]	[0.40; 0.34]	[0.42; 0.32]	[0.22; 0.44]	[0.37; 0.36]	[0.40; 0.33]
	I–	[0.30; 0.39]	[0.16; 0.47]	[0.28; 0.41]	[0.09; 0.56]	[0.23; 0.45]	[0.22; 0.44]
Handicrafts and crafts	I+	[0.34; 0.36]	[0.39; 0.35]	[0.42; 0.31]	[0.23; 0.44]	[0.34; 0.37]	[0.42; 0.32]
	I–	[0.26; 0.43]	[0.19; 0.47]	[0.31; 0.39]	[0.10; 0.54]	[0.15; 0.50]	[0.25; 0.43]
Services	I+	[0.40; 0.34]	[0.39; 0.34]	[0.38; 0.34]	[0.21; 0.46]	[0.30; 0.40]	[0.37; 0.35]
	I–	[0.24; 0.45]	[0.24; 0.45]	[0.24; 0.44]	[0.13; 0.53]	[0.19; 0.49]	[0.23; 0.46]
Agriculture	I+	[0.32; 0.39]	[0.24; 0.45]	[0.23; 0.44]	[0.13; 0.52]	[0.24; 0.44]	[0.27; 0.42]
	I–	[0.42; 0.32]	[0.39; 0.35]	[0.38; 0.34]	[0.25; 0.42]	[0.35; 0.37]	[0.40; 0.33]

Table 4. The separation measures and the closeness coefficient

Contracts	Trade				Handicraft and crafts				Services				Agriculture			
	S_i^+	S_i^-	C_i	R_i	S_i^+	S_i^-	C_i	R_i	S_i^+	S_i^-	C_i	R_i	S_i^+	S_i^-	C_i	R_i
Murabaha	0.20	0.11	0.36	3	0.08	0.31	0.20	5	0,13	0,09	0,41	4	0.16	0.08	0.32	5
Musharakah	0.09	0.09	0.51	1	0.09	0.07	0.54	2	0,06	0,08	0,59	2	0.05	0.08	0.59	1
Mudarabah	0.09	0.09	0.49	2	0.10	0.07	0.57	1	0,06	0,08	0,56	3	0.07	0.07	0.47	3
Ijarah	0.27	0.09	0.25	6	0.06	0.24	0.20	6	0,06	0,09	0,60	1	0.13	0.06	0.33	4
Istisna	0.15	0.07	0.34	4	0.07	0.12	0.38	3	0,18	0,04	0,20	5	0.22	0.04	0.16	6
Salam	0.14	0.06	0.31	5	0.08	0.13	0.36	4	0,24	0,04	0,15	6	0.07	0.07	0.49	2

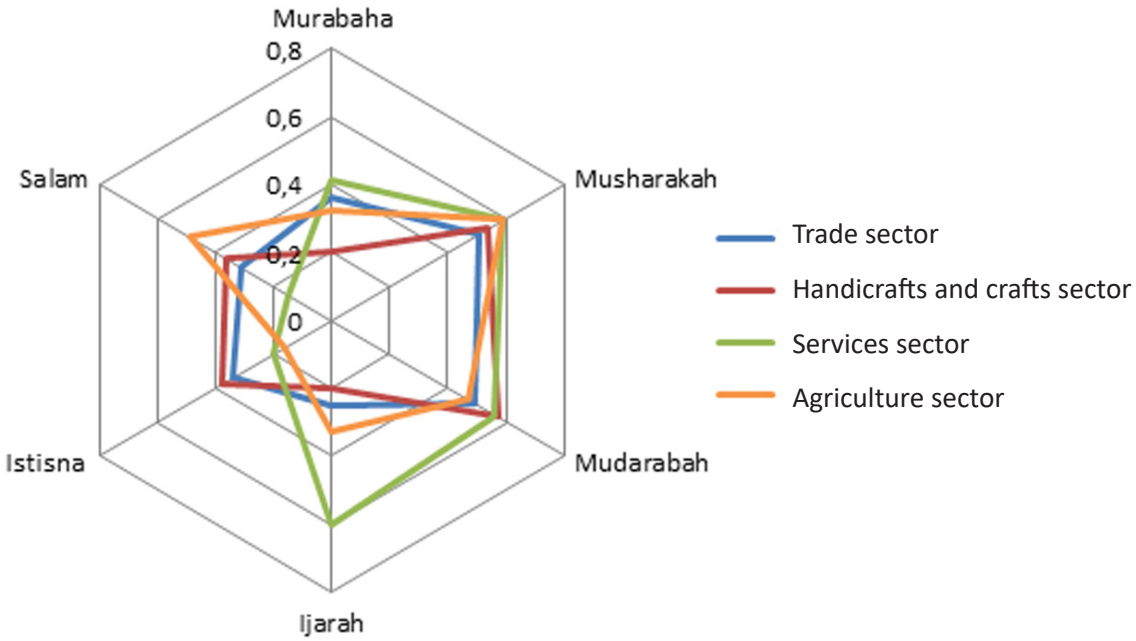

Figure 2. Closeness coefficient of all contracts in different sectors

After that, we calculate the IF-PIS, the IF-NIS (Table 3), the separation measures and the closeness coefficient (Table 4) for all sectors.

The closeness coefficient indicates that in each sector of activity, the ranking of Islamic banking contracts denoted by R_i, in other words, it determines which is the most appropriate contract for each of the sectors treated.

The representation of the closeness coefficients of all contracts in the four sectors is highlighted in Figure 2 in order to facilitate the comparison of the obtained results.

We observe that the profit and loss sharing (PLS) contracts (Mudarabah and Musharakah) are the most recommended and are considered among the most adequate contracts by the experts of Islamic finance, since in the various sectors, they are found to be ranked first, second or third.

For the non-PLS contracts, we find that Ijara is ranked the first in the services sector, then, Istisna is ranked third in handicrafts and craft sectors, Salam was the second in the agriculture sector and finally Murabaha is ranked the third in trade sector.

We conclude that despites of the preference of the PLS contracts, the results obtained affirm the consistency between the contract's ranking and the characteristics of each activity sector.

The results of this study were validated qualitatively, indeed many domain experts have expressed their agreement, especially given the infancy of the participative banking system in Morocco.

CONCLUSION

It is essential to dispose of a decision support system for banks and microfinance institutions to finance micro-activities. That will help them improve their investments and protect both themselves and their customers against unpredicted risks.

This paper gives a clear picture about the appropriateness of Islamic banking contracts to small activities exercised in Morocco. The finding results will be very helpful for participative banks and Islamic MFIs not only to invest fund effectively, but also to promote the financial inclusion in a sustainable way.

We suggested that the Intuitionistic Fuzzy TOPSIS approach is able to deal with the unavailability of sufficient statistical data and take into account the subjectivity and fuzziness that characterize the experts' judgments about the real world phenomena.

This study can be extended to include a sensitivity analysis to show the effect of the criteria's weights on the final results.

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APPENDIX A

Table A1. Linguistic scale for importance of criteria, rentability, honoring of commitments, job creation, wealth creation and economic development

Source: Adapted from Lamrani and Tkiouat (2018).

Number	Linguistic term	IFNs
1	Very unimportant	(0; 0,5)
2	Unimportant	(0,1; 0,4)
3	Meduim	(0,5; 0,3)
4	Important	(0,6; 0,2)
5	Very important	(0,8; 0,1)

Table A2. Linguistic scale for the risk's occurrence

Source: Adapted from Lamrani and Tkiouat (2018).

Number	Linguistic term	IFNs
1	Extremely hight	(0; 0,5)
2	Hight	(0,1; 0,4)
3	Meduim	(0,5; 0,3)
4	Low	(0,6; 0,2)
5	Nearly impossible	(0,8; 0,1)

Table A3. The aggregated IF decision matrix of trade sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.63; 0.18]	[0.63; 0.18]	[0.65; 0.17]	[0.23; 0.37]	[0.42; 0.29]	[0.52; 0.23]
Musharakah	[0.51; 0.26]	[0.26; 0.34]	[0.52; 0.25]	[0.58; 0.21]	[0.66; 0.17]	[0.64; 0.17]
Mudarabah	[0.52; 0.25]	[0.31; 0.32]	[0.48; 0.27]	[0.57; 0.22]	[0.62; 0.19]	[0.62; 0.18]
Ijarah	[0.58; 0.22]	[0.62; 0.20]	[0.57; 0.21]	[0.25; 0.36]	[0.46; 0.28]	[0.36; 0.31]
Istisna	[0.44; 0.28]	[0.51; 0.24]	[0.49; 0.25]	[0.43; 0.27]	[0.56; 0.22]	[0.50; 0.24]
Salam	[0.49; 0.27]	[0.43; 0.28]	[0.44; 0.28]	[0.38; 0.31]	[0.54; 0.24]	[0.54; 0.23]

Table A4. The aggregated IF decision matrix of handicrafts and crafts sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.47; 0.25]	[0.62; 0.19]	[0.65; 0.17]	[0.27; 0.35]	[0.27; 0.35]	[0.40; 0.30]
Musharakah	[0.48; 0.26]	[0.35; 0.33]	[0.48; 0.26]	[0.59; 0.21]	[0.58; 0.20]	[0.64; 0.17]
Mudarabah	[0.51; 0.24]	[0.30; 0.34]	[0.49; 0.26]	[0.60; 0.20]	[0.61; 0.19]	[0.66; 0.16]
Ijarah	[0.39; 0.32]	[0.52; 0.24]	[0.61; 0.20]	[0.34; 0.33]	[0.38; 0.33]	[0.45; 0.27]
Istisna	[0.50; 0.25]	[0.44; 0.28]	[0.49; 0.26]	[0.49; 0.24]	[0.50; 0.25]	[0.56; 0.21]
Salam	[0.48; 0.26]	[0.51; 0.25]	[0.48; 0.26]	[0.48; 0.27]	[0.48; 0.27]	[0.56; 0.22]

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Table A5. The aggregated IF decision matrix of services sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.56; 0.22]	[0.62; 0.18]	[0.60; 0.20]	[0.41; 0.29]	[0.37; 0.31]	[0.51; 0.24]
Musharakah	[0.55; 0.22]	[0.39; 0.31]	[0.48; 0.26]	[0.52; 0.24]	[0.55; 0.23]	[0.58; 0.20]
Mudarabah	[0.53; 0.23]	[0.39; 0.31]	[0.46; 0.29]	[0.54; 0.23]	[0.53; 0.23]	[0.58; 0.21]
Ijarah	[0.58; 0.22]	[0.56; 0.22]	[0.55; 0.23]	[0.46; 0.27]	[0.47; 0.27]	[0.55; 0.23]
Istisna	[0.39; 0.31]	[0.56; 0.22]	[0.42; 0.28]	[0.46; 0.27]	[0.39; 0.31]	[0.42; 0.30]
Salam	[0.36; 0.34]	[0.59; 0.21]	[0.37; 0.32]	[0.35; 0.33]	[0.35; 0.34]	[0.37; 0.33]

Table A6. The aggregated IF decision matrix of agriculture sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.55; 0.22]	[0.62; 0.19]	[0.59; 0.20]	[0.34; 0.32]	[0.48; 0.26]	[0.50; 0.26]
Musharakah	[0.61; 0.19]	[0.38; 0.31]	[0.49; 0.27]	[0.65; 0.17]	[0.63; 0.19]	[0.64; 0.18]
Mudarabah	[0.58; 0.21]	[0.42; 0.29]	[0.42; 0.30]	[0.62; 0.19]	[0.56; 0.21]	[0.61; 0.19]
Ijarah	[0.53; 0.24]	[0.58; 0.21]	[0.53; 0.24]	[0.43; 0.29]	[0.54; 0.25]	[0.51; 0.25]
Istisna	[0.47; 0.27]	[0.56; 0.23]	[0.36; 0.2]	[0.49; 0.25]	[0.43; 0.28]	[0.43; 0.28]
Salam	[0.62; 0.19]	[0.45; 0.28]	[0.39; 0.31]	[0.60; 0.20]	[0.58; 0.21]	[0.61; 0.19]

Table A7. The aggregated weighted intuitionistic fuzzy decision matrix of trade sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.43; 0.31]	[0.40; 0.34]	[0.42; 0.32]	[0.09; 0.56]	[0.23; 0.45]	[0.32; 0.38]
Musharakah	[0.34; 0.37]	[0.16; 0.47]	[0.34; 0.38]	[0.22; 0.44]	[0.37; 0.36]	[0.40; 0.33]
Mudarabah	[0.35; 0.37]	[0.20; 0.46]	[0.31; 0.40]	[0.22; 0.45]	[0.34; 0.38]	[0.39; 0.34]
Ijarah	[0.39; 0.34]	[0.39; 0.35]	[0.37; 0.35]	[0.09; 0.55]	[0.25; 0.45]	[0.22; 0.44]
Istisna	[0.30; 0.39]	[0.32; 0.39]	[0.32; 0.38]	[0.16; 0.49]	[0.31; 0.40]	[0.31; 0.39]
Salam	[0.33; 0.39]	[0.27; 0.43]	[0.28; 0.41]	[0.14; 0.51]	[0.30; 0.41]	[0.34; 0.38]

Table A8. The aggregated weighted intuitionistic fuzzy decision matrix for handicraft sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.32; 0.37]	[0.39; 0.35]	[0.42; 0.31]	[0.10; 0.54]	[0.15; 0.50]	[0.25; 0.43]
Musharakah	[0.32; 0.37]	[0.22; 0.46]	[0.31; 0.39]	[0.23; 0.45]	[0.32; 0.39]	[0.40; 0.33]
Mudarabah	[0.34; 0.36]	[0.19; 0.47]	[0.32; 0.39]	[0.23; 0.44]	[0.34; 0.37]	[0.42; 0.32]
Ijarah	[0.26; 0.43]	[0.33; 0.39]	[0.40; 0.34]	[0.13; 0.53]	[0.21; 0.48]	[0.28; 0.41]
Istisna	[0.34; 0.37]	[0.28; 0.42]	[0.32; 0.39]	[0.19; 0.47]	[0.28; 0.42]	[0.35; 0.36]
Salam	[0.32; 0.38]	[0.32; 0.40]	[0.31; 0.39]	[0.18; 0.49]	[0.27; 0.47]	[0.35; 0.37]

Table A9. The aggregated weighted intuitionistic fuzzy decision matrix of services sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.38; 0.35]	[0.40; 0.35]	[0.39; 0.35]	[0.16; 0.50]	[0.21; 0.47]	[0.32; 0.39]
Musharakah	[0.38; 0.35]	[0.25; 0.45]	[0.31; 0.40]	[0.20; 0.47]	[0.31; 0.41]	[0.37; 0.36]
Mudarabah	[0.37; 0.36]	[0.25; 0.45]	[0.30; 0.42]	[0.21; 0.46]	[0.30; 0.41]	[0.37; 0.36]
Ijarah	[0.40; 0.35]	[0.36; 0.38]	[0.36; 0.37]	[0.18; 0.49]	[0.27; 0.44]	[0.35; 0.38]
Istisna	[0.27; 0.42]	[0.35; 0.38]	[0.28; 0.41]	[0.18; 0.49]	[0.22; 0.47]	[0.26; 0.44]
Salam	[0.25; 0.45]	[0.37; 0.37]	[0.24; 0.44]	[0.14; 0.54]	[0.20; 0.49]	[0.23; 0.46]

Table A10. The aggregated weighted intuitionistic fuzzy decision matrix of agriculture sector

Contracts	Profitability	Risk occurrence	Commitments honoring	Job creation	Wealth creation	Economic development
Murabaha	[0.38; 0.34]	[0.39; 0.35]	[0.38; 0.34]	[0.13; 0.52]	[0.26; 0.43]	[0.31; 0.40]
Musharakah	[0.42; 0.32]	[0.24; 0.45]	[0.31; 0.40]	[0.25; 0.42]	[0.35; 0.37]	[0.40; 0.33]
Mudarabah	[0.40; 0.34]	[0.26; 0.43]	[0.27; 0.42]	[0.24; 0.43]	[0.31; 0.39]	[0.38; 0.35]
Ijarah	[0.36; 0.36]	[0.36; 0.37]	[0.34; 0.37]	[0.16; 0.50]	[0.30; 0.42]	[0.32; 0.39]
Istisna'	[0.32; 0.39]	[0.35; 0.38]	[0.23; 0.44]	[0.19; 0.48]	[0.24; 0.44]	[0.27; 0.42]
Salam	[0.42; 0.32]	[0.28; 0.42]	[0.25; 0.43]	[0.23; 0.44]	[0.32; 0.39]	[0.38; 0.34]

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