

Leveraging Ethics to Expand Islamic Banks' Customer Base: A Fuzzy Agent-Based Modeling Approach

Mohamed Wail Aminou^{1*} and Rajae Aboulaich²

¹ Islamic Financial Engineering Laboratory (IFE LAB), Laboratoire d'Etude et de Recherche en Mathématiques Appliquées (LERMA), Ecole Mohammadia d'Ingénieurs, Mohammed V University (Rabat, Morocco)

² Islamic Financial Engineering Laboratory (IFE LAB), Laboratoire d'Etude et de Recherche en Mathématiques Appliquées (LERMA), Ecole Mohammadia d'Ingénieurs, Mohammed V University (Rabat, Morocco)

*Corresponding author's email : Mohamed.wail [AT] gmail.com

ABSTRACT— *This paper aims to model the dynamics of a banking market featuring two Islamic and one conventional bank. Both Islamic banks opt to differentiate by focusing on Corporate Social Responsibility (CSR) as a lever to attract clients sensitive to ethics. One of them pursues a genuine CSR strategy by investing in serious CSR programs while the other does not honor its CSR engagement by pursuing actions with no or negative societal impact and by taking advantage of information asymmetry. To build the consumers' decision function, we use fuzzy logic, a diffusion model to capture information spread amongst agents, and learning and contagion models to simulate peers' influence on the decision making process. We run simulations on Netlogo and analyze results. Our findings indicate that while the "rhetoric" bank can thrive in markets characterized by information asymmetry and by clients with heterogeneous attitudes towards ethics, the genuinely engaged bank needs not only to educate consumers about its ethical involvement, but also to heavily leverage communication as a means to increase market share.*

Keywords--- Islamic Banks; Multi-Agent Simulation; Fuzzy logic; Ethics; information asymmetry

1. INTRODUCTION

Islamic finance assets exceed USD 1,650 billion (Reuters, 2014) with more than 15% annual growth (Nazim and Bennie, 2012). Islamic finance services are provided by more than 251 banks, 281 insurance companies and 791 investment funds (Reuters, 2014). Islamic banks are for-profit financing companies. Like conventional banks, they are financial intermediaries that collect deposits and finance retail and corporate customers (Guéranger, 2009). However, Islamic banks rely on specific principles based on Islamic law or *sharia*. The main principles are the prohibition of interests, the prohibition of excessive uncertainty (*gharar*) and the entitlement to profit only with a certain amount of risk (Ayub, 2009). These principles are described below:

- **Prohibition of interest:** As explained by Chong and Liu (2009), Islamic banks do not offer a fixed rate of return on deposits and do not charge interests on loans. Money is viewed strictly as a medium of exchange (Marimuthu et al., 2010), and Islamic banking products are based on profit and loss sharing, leasing or trading contracts (Ayub, 2009).
- **Prohibition of excessive uncertainty (*Gharar*):** Ayub (2009) defines *Gharar* as uncertainty or hazard caused by lack of clarity regarding the subject matter or the price in a contract or exchange. Ayub (2009) supports this definition by examples such as selling a good not owned or whose characteristics are not clearly specified. Al-Suwailem (2012) includes in *Gharar* all zero-sum game transactions with uncertain payoffs. Gambling and derivatives such as futures and options are often cited as instances of *Gharar* (Chong and Liu, 2009). While definitions and examples of this concept are multiple, there is no consensus among jurists on what exactly constitutes “excessive uncertainty”. (El-Gamal, 2001)
- **Entitlement to profit only with business risk:** This concept is based on the “assumption that business risk is a precondition for entitlement to any profit over the principal” (Ayub, 2009). Money has, indeed, to be associated with a real economic activity to justify a return. A real economic activity can be conducted through leasing, buying and selling, and profit and loss sharing instruments.

Based on the above principles, Islamic banks' products can be classified into three categories: Debt, Quasi-debt and Profit-and-loss-sharing instruments (El Qorchi, 2005): **Debt instruments** are predominantly defined through *Murabaha* or mark-up financing (Farooq, 2011) which consists of a purchase and resale contract by which a tangible asset is purchased by a bank at the request of its customer from a supplier and sent to the client with a differed payment. The resale price is determined based on the purchasing price plus a profit markup (El Qorchi, 2005). **Quasi-debt instruments** are defined through *Ijara* which involves leasing an asset and receiving rentals. As long as the asset is on lease, the lessor owns the asset along with the risk and reward of its ownership (Ayub, 2009). **Profit-and-loss-sharing instruments** are defined by either *Musharaka* or *Mudharaba*. *Musharaka* is a partnership arrangement in which both the bank and the partner finance and manage a business activity. Profits and losses are shared by both parties. In *Mudharaba*, one party provides capital and the other management. Any loss is borne by the financier; profit is shared by the partners according to a pre-agreed ratio (Ayub, 2009).

Although Islamic finance pioneers stressed the importance of profit-and-loss-sharing instruments as a distinctive feature of Islamic banks, in practice, Islamic banking products rely heavily on debt based instruments which are often perceived as very similar to conventional banking products (Ayub, 2009). Moreover, the usually smaller Islamic banks' size relative to their conventional counterparts (Reuters, 2014) makes leveraging branches' density and pricing as competitive advantages hard to achieve. Consequently, Islamic banks are left only with sharia compliance as a distinctive feature, which makes attracting customers on non religious ground challenging (Haniffa and Hudaib, 2007).

Historically, Islamic banks' socially responsible initiatives have been rather weak or poor (Asutay, 2007, Maali et al., 2006). Islamic banks' performance in this field is even lower than conventional banks' (Mohd Nor, 2012). Rahman and Saimi (2015) also point out to the low levels of disclosures for Islamic banks with respect to ethics and the concept of Corporate Social Responsibility (CSR). This CSR failure (Asutay, 2012) seems paradoxical because Islamic law, a cornerstone of Islamic banks' identity, strongly emphasizes, among others, the principles of social justice and beneficence (Maali et al., 2006). Islamic banks' attitude vis-à-vis CSR also contradicts the demands of customers who expect those banks to be more active on this front (Maali et al., 2006, Wajdi Dusuki and Irwani Abdullah, 2007).

Hence, can an ethics "endogenization" (Asutay, 2007) strategy attract new customer profiles and thereby strengthen Islamic banks' competitive position? In other words, as suggested by Hassan and Salma Binti Abdul Latiff (2009), should CSR be seen as a benefit rather than a cost for Islamic banks?

A significant array of research work supports this strategic orientation. For example, Lee and Shin (2010) demonstrate the positive relationship between consumers awareness of CSR activities and their purchase intentions. Some empirical studies explored the drivers of consumer loyalty with regards to CSR activities, and have shown, for instance, that loyalty is indirectly affected by perceived CSR, via the mediation of trust, identification and satisfaction (Martínez and del Bosque, 2013), and that the perceived fit between consumer lifestyle and CSR activities influences on consumer perception of CSR, and consequently on consumer-company identification and loyalty (Lee et al., 2012).

The "ethics positioning" strategy, however, has to tackle two challenges: Firstly, some Islamic banks may opt for "green washing" rather than conducting genuine initiatives. Indeed, banks can benefit from information asymmetry because customers do not know about the real motives and social practices of the firm. In addition, conducting genuine large scale social initiatives implies investments and expenditures that increase the bank's costs and further weaknesses its position with regards to pricing. Secondly, customers may free ride on the positive externalities of CSR by taking advantage of initiatives that benefit the community without being a customer of the Islamic bank.

This paper seeks to model the dynamics of a market where Islamic banks are seeking to attract new customers by emphasizing ethics and social orientation. Using multi-agent simulation and fuzzy logic, the objective of this work is to bring to light the market evolution under such a strategy in the presence of information asymmetry and peer pressure.

This paper is organized as follows: In **Section 2**, we describe the problem, then we detail in **Section 3** our model conception. Implementation results are discussed in **Section 4**, followed in **Section 5** by some conclusions and research perspectives.

2. PROBLEM DESCRIPTION

We consider a game where an Islamic bank *IB* claims to undertake CSR programs to attract customers sensitive to ethics. *IB* might engage in genuine actions with real impact on stakeholders and the environment, such as building schools, alleviating poverty...etc, or might not honor its CSR engagement by pursuing actions with no or negative societal impact, which will be referred to as rhetoric. On the other side, we consider end consumers *C* who can opt to buy or not to buy *IB*'s products. Since *IB* is investing in CSR, this comes at a cost, thus it would be fair to assume that *IB*'s products sell at a premium p as compared with competitive banking products in the market place. For the sake of clarity, we adopt the following annotations:

Islamic Bank's moves:

- $\left\{ \begin{array}{l} C_{IB}: IB \text{ cooperates by pursuing genuine actions} \\ D_{IB}: IB \text{ defects by pursuing mere rhetoric} \end{array} \right.$

Consumer's moves:

- $\left\{ \begin{array}{l} C_C: C \text{ cooperates by buying } IB\text{'s products} \\ D_C: C \text{ defects by not buying } IB\text{'s products} \end{array} \right.$

b : the benefit that C gets when IB plays C_{IB}
 p : the premium paid by C when he plays C_C
 π : the profit earned by IB when C plays C_C
 I : the investment incurred by IB when it plays C_{IB}
 where b, p, π, I are positive numbers.

In each period, agents engage in social interactions featuring the classical Prisoner's Dilemma game (Axelrod and Hamilton, 1981). The following normal form can be drawn with the agents' respective marginal payoffs (Figure 1):



		 Islamic Bank (IB)	
		C_{IB}	D_{IB}
 Consumer (C)	C_C	$b-p, \pi-I$	$-p, \pi$
	D_C	$b, -I$	$0, 0$

Figure 1. Payoff Matrix in the CSR Prisoner's Dilemma Game

where $-I < 0 < \pi - I < \pi$ and $-p < 0 < b - p < b$. In addition: $b - p > (-p + b)/2$

In this game, when IB chooses to cooperate (C_{IB}), it earns profit π from consumers who opt to buy its products. However, IB may be tempted to save on investments, and opt for merely marketing its CSR image without engaging in really impactful actions (D_{IB}) (Prasad and Holzinger, 2013). Similarly, a consumer C can either cooperate (C_C) or defect and still free-ride on the positive externalities of CSR. The one-shot stage-game leads to a *Defect* strategy on both sides (D_C, D_{IB}) since this option constitutes a dominant strategy for each agent.

If the game is played repetitively over a finite number of periods, the *Defect* (D_C, D_{IB}) strategy described earlier is also a Nash equilibrium based on the backward induction (Morgenstern and Von Neumann, 1953) principle. However, this reasoning holds in the present game only under two assumptions: 1) each consumer is a “rational” agent making decisions independently from his environment and peers, and 2) consumers are presented with full information on the firm's CSR strategies.

In reality, both assumptions are false. Firstly, when it comes to decision making, it has been proven that humans can base their decisions on emotional factors (Ariely and Jones, 2010, Ariely and Jones, 2008), and can be significantly influenced by familial and peer-based groups (Childers and Rao, 1992). Secondly, as mentioned earlier (Rahman and Saimi, 2015), Islamic banks' CSR communication is not always transparent, creating thereby significant room for asymmetry of information.

In addition, recent research on CSR market dynamics presents empirical evidence that consumers' perception of the CSR orientation of a firm impacts their green trust, and therefore their loyalty and their intention to buy (Chen and Chang, 2012, Castaldo et al., 2009). More precisely, if consumers hold high ethical expectations from a firm and that the latter turns out to be viewed as unethical –following an ethical scandal for example, consumers backfire by lowering the price they are willing to pay for the firm's products, and the punishment exacted is greater than the premium they are willing to pay (Trudel and Cotte, 2009). In fact, while researchers found that the impact of morally good behavior was easily eliminated by new information about immoral behavior, the opposite has not been proven (Skowronski and Carlston, 1989).

Therefore, we are presented with interactions where consumers can make irrational decisions based on peer pressure, and can hold severe punishment attitudes towards any unethical conduct on the bank's side, all this in an environment marked with asymmetric information on the CSR actions pursued by the banks. To solve this problem, we should consider a model where consumers' decisions have an irrational component based on peer pressure and where bank's defection is punished by definitive loss of loyalty. In addition, the model needs to incorporate a channel for relaxing or highlighting asymmetry of information to help appraise the extent to which this factor impacts upon the game. Given these data, we can fairly assert that we are faced with a setting with adaptive agents, who dynamically vary their behavior from a period to

another based on past experience and on other players' moves. While it is possible to solve for the problem analytically, it has been commonly agreed upon that simulation remains the preferred method for treating evolutionary models with mutation (Axelrod, 2000). In effect, the large-scale aggregated outcome of multiple agents interacting locally with one another following some simple rules could prove hardly predictable and could yield what are known as "emergent properties" of the system (Axelrod, 2000). To overcome the above intricacies, we propose to address the problem using multi-agent simulation approach. Furthermore, we propose to incorporate fuzzy logic in the decision making function of consumers in order to more adequately reflect the complexities pertaining to human decision making.

3. MODEL CONCEPTION

In our paper, we build a model which allows simulating the dynamics of a banking market in a multi-agent environment. Our simulation model features two Islamic banks pursuing CSR strategies to attract the conventional bank's customers that are sensitive to ethics and social orientation. The first Islamic bank (the ethical bank) is genuinely involved in CSR. The second Islamic bank pretends to undertake genuine CSR activities but does not honor its commitment in order to save costs (the Rhetoric bank). The latter bank takes advantage of information asymmetry in the market. Our proposed model reflects realistic human behavioral factors in relation with product adoption: heterogeneity of consumers, peer influence, and fuzzy decision-making based on multiple attributes.

3.1 Agent based modeling

3.1.1 The concept

Agent-based modeling (ABM) is the computational study of social agents as evolving systems of autonomous interacting agents (Janssen and Ostrom, 2006). The key feature of ABM is that it involves a bottom-up approach to understanding a system's behavior. The Segregation model (Schelling, 1971) is a typical ABM implementation case. In this model, individuals' small preferences to live next to similar neighbors (eg. based on ethnicity or on income) could lead to total city segregation.

According to Macal and North (2010), an agent based model is composed of the Agents, the Environment, and the Interactions. **Agents** are self-contained and uniquely identifiable individuals. An agent can function independently and has attributes (e.g. age, gender, preferences) and a decision making process (e.g. utility maximization). In Schelling's model, every individual is either "Red" or "Blue" (attributes) and move from or stay in a given neighborhood depending on the percentage of similar neighbors (decision making). The **Environment** represents the setting in which the modeling (market, geographic area...) takes place. In Schelling's segregation case, the city environment is modeled as a grid where inhabitants, or agents, are located each within a separate cell. An inhabitant's neighbors are the ones located in immediate surrounding boxes. Finally, **Interactions** take place among the different agents, and between the agents and the environment. In Schelling's model, individuals move in the city (from a cell to another) and have neighborhood relationships with other inhabitants. Agent-based modeling can be programmed using either general, generic software, or programming languages (Java, C++, Matlab...), or specially designed software and toolkits that address the special requirements of agent modeling such as Netlogo, Repast, and Swarm.

3.1.2 The application

- **The agents**

Four types of agents are defined in this simulation. They are:

- Islamic bank 1: Genuinely involved in ethics
- Islamic Bank 2: Rhetorically involved in ethics (rhetoric bank)
- A conventional bank
- 1 681 consumers: We assume that all the consumers represented in the model are sensitive to ethics in a differentiated manner. We chose not to represent consumers that are not sensitive to ethics because their behavior –staying with the conventional bank for cost and convenience purposes– will not impact upon the game. All of represented consumers are initially clients of the conventional bank.
-

- **The interactions**

Agents' interactions with the environment and with one another are defined based on a few decision functions:

- For every time period, a group of customers is defined using a selection process. These customers have to decide on whether to stay with the conventional bank or switch to one of the Islamic banks (the ethical or the rhetoric). Once the decision is made, customers do not change their choice in the next period except for those who chose the rhetoric bank.

- When information asymmetry is eliminated, a rhetoric bank’s customer gets unhappy and leaves the bank.
- An unhappy rhetoric bank’s customer informs his/her neighbors about the rhetoric bank’s practices, and never returns back to this bank.

3.2 Decision making under fuzzy logic

3.2.1 The concept

Fuzzy Logic Systems (FLS) have been broadly applied in many fields due to their similarity to human reasoning, their intuitiveness and their simplicity (Georgoulas et al., 2012). Indeed, FLS deal with imprecise inputs and rely on inference rules using imprecise linguistic terms, such as “very high” or “slightly low” (Griffiths et al., 2006). FLS provide a nonlinear mapping of crisp inputs into crisp outputs. The mapping has four components: Fuzzy logic rules, fuzzifier, an inference engine, and defuzzifier (Mendel, 1995) (figure 2).

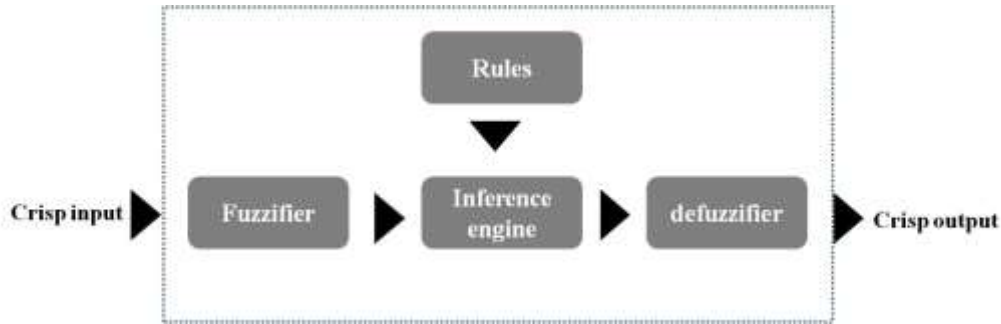


Figure 2. Fuzzy logic system (adapted from (Mendel, 1995))

In FLS, the level to which a fuzzy variable is a member of a set is defined through membership functions (MFs). One represents full membership, whereas zero represents no membership (Griffiths et al., 2006). A MF provides a measure of the level of similarity of a fuzzy variable to a fuzzy subset. Thereby, in fuzzy logic, a variable can belong to more than one set with varying levels of association. Triangular, trapezoidal, piecewise linear and Gaussian, are shape examples of MFs (Mendel, 1995).

Fuzzy rules are represented as a collection of IF-THEN statements to capture the relationship between the model's inputs and its outputs. MFs map input values into the interval [0,1] by the process known as “fuzzification” (Griffiths et al., 2006). The fuzzifier maps crisp inputs into fuzzy sets. Fuzzy logic rules define the relationship between inputs and outputs. The inference engine, handles the way in which rules are combined. The conclusion membership levels are aggregated by superimposing the resulting membership curves. The defuzzifier maps output sets into crisp numbers (Mendel, 1995). More details on fuzzy logic theory can be found in Zimmermann (2001).

Table 1 : Examples of Aggregation methods (adapted from (Izquierdo et al., 2015))

Aggregation method	Details
Maximum	Max (a,b)
Probabilistic Sum	ProbabilisticSum(a,b) = a + b – a·b
Sum Clipped at 1	ClippedSum (a,b) = min(1, a + b)

Table 2 : Defuzzification methods most commonly used (adapted from (Izquierdo et al., 2015))

Defuzzification method	Details
Centre of Gravity (COG)	Returns the projection (on the horizontal axis) of the centre of gravity of the area under the membership function
First of Maxima (FOM)	Returns the infimum of the values of the base variable for which the membership function is maximal
Last of Maxima (LOM)	Returns the supremum of the values of the base variable for which the membership function is maximal.
Middle of Maxima (MOM).	Returns the average of the FOM and the LOM
Mean of Maxima (MeOM)	Returns the mean of the values for which the membership function is maximal

3.2.2 The application

- The membership functions

The following fuzzy sets are defined in the simulation:

Table 3: Membership functions applied in the simulation

Fuzzy sets	Details	Shapes
Satisfactory ethics and Non Satisfactory ethics	<p>For every consumer, we define ethics satisfaction fuzzy sets. The fuzzy sets determine consumer' satisfaction levels with respect to the ethical and the rhetoric banks given their respective ethics scores (cf. section 3.3.2). The fuzzy sets are created using a Gaussian function. The membership functions (MF) are as follows :</p> $MF_satisfactory(x) = e^{-\frac{(x-m)^2}{2S^2}}$ <p>Where x is the bank's ethical score (in the range [0 ,10]), m = 10 and S = 2 + \overline{Noise}</p> $MF_nonsatisfactory(x) = e^{-\frac{(x-m)^2}{2S^2}}$ <p>Where x is the bank's ethical score (in the range [0 ,10]), m = 0 and S = 2 + \overline{Noise}</p> <p>\overline{Noise} captures the diversity of consumers with regards to ethics. \overline{Noise} is a uniform distribution in the range [0, p] where 0 < p <= 3</p>	
Likely and unlikely choices	<p>We define likely and unlikely choice fuzzy sets. The fuzzy sets determine the likelihood of choosing a bank given a set of rules (cf. "If-then" rules). The fuzzy sets are created using a Gaussian function. The membership functions (MF) are as follows :</p> $MF_likely(x) = e^{-\frac{(x-m)^2}{2S^2}}$ <p>Where x is the bank's ethical score (in the range [0 10]), m = 10 and S = 1</p> $MF_unlikely(x) = e^{-\frac{(x-m)^2}{2S^2}}$ <p>Where x is the bank's ethical score (in the range [0 10]), m = 0 and S = 1</p>	
Very likely and very unlikely choices	<p>To represent the linguistic hedge "very", we use new fuzzy sets "very likely" and "very unlikely" whose membership functions are the same as "likely" and "unlikely", but raised to the power of 2 as long as the value is in the interval [0,1]; otherwise, it is clipped.</p> $MF_verylikely(x) = \left(e^{-\frac{(x-m)^2}{2S^2}} \right)^2$ <p>Where x is the bank's ethical score (in the range [0 10]), m = 10 and S =1</p> $MF_unveryunlikely(x) = \left(e^{-\frac{(x-m)^2}{2S^2}} \right)^2$ <p>Where x is the bank's ethical score (in the range [0 10]), m = 0 and S = 1</p>	

- *If-Then Rules*

The following “If-then rules” are defined in the simulation. They are based on the CSR profiles of the ethical and the rhetoric banks as perceived by customers. Concerning the third rule, when a consumer assesses the CSR profiles of both Islamic banks as satisfactory, the rhetoric bank is likely to be chosen because it has a cost advantage relative to the ethical bank.

Table 4: If-then rules applied in the simulation

	Perceived CSR profile: Ethical Bank		Perceived CSR profile: Rhetoric Bank	Rule (choosing a bank)
1	Satisfactory	AND	None satisfactory	Ethical Bank : Very likely Rhetoric Bank : Very unlikely Conventional Bank : Very unlikely
2	None satisfactory	AND	Satisfactory	Ethical Bank : Very unlikely Rhetoric Bank : Very likely Conventional Bank : Very unlikely
3	Satisfactory	AND	Satisfactory	Ethical Bank : Unlikely Rhetoric Bank : Likely Conventional Bank : Very unlikely
4	None satisfactory	AND	None satisfactory	Ethical Bank : Very unlikely Rhetoric Bank : Very unlikely Conventional Bank : Very likely

- *Aggregation of all the reshaped consequents*

In this step, the reshaped consequents are aggregated to provide one single fuzzy set. In our case, we use the Maximum as an aggregation operator (by default method). Other methods are also supported (cf. table 1).

- *Defuzzification of the aggregated fuzzy set*

Many methods are supported by the simulation, we use the *Centre of Gravity (COG)* as the by default method. Other methods are also supported in this simulation (cf. table 2). Figure 3 summarizes the Fuzzy logic scheme applied in the simulation.

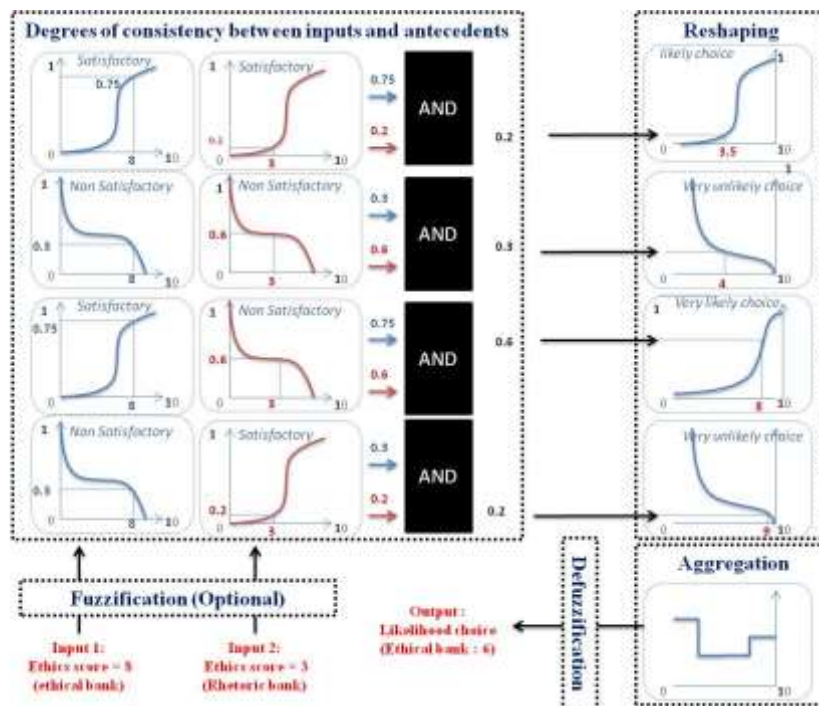


Figure3. Fuzzy logic scheme applied in the simulation (adapted from (Izquierdo et al., 2015))

3.3 Information asymmetry : The spatial model

3.3.1 The concept

A spatial model relies on the physical location of agents within an environment. In economics, examples include Hotelling (1929) and Salop (1979) spatial competition models which respectively model agents in a line and circle.

3.3.2 The application

We model information asymmetry using a spatial model. The ethical and the rhetoric banks are placed on the simulation grid. The closer the consumer is to one bank, the lesser the asymmetry. The ethics score of the ethical and rhetoric banks for each consumer at period t is defined respectively as:

$$score_ethicalbank(t) = max_score - asymmetry_coef(t) * distance_EB^2$$

$$score_rhetoricbank(t) = asymmetry_coef(t) * distance_RB^2$$

Where max_score is the maximum ethical score of a bank (in the simulation this score equals 10), $asymmetry_coef(t)$ the level of asymmetry at iteration t . The asymmetry coefficient is comprised between 0 and 1, $distance_EB$ and $distance_RB$ are respectively the distances between the consumer and the ethical bank, and between the consumer and the rhetoric bank in the grid. Clearly, the ethical bank is disadvantaged by asymmetry and distance unlike the rhetoric bank.

At the beginning of the simulation, the asymmetry coefficient is set to 1 and declines with learning. Indeed, when a consumer is a client of the rhetoric bank, throughout the interaction with the bank, information asymmetry is reduced. When the customer discovers the rhetoric bank's real CSR practices, he/she leaves the bank and influences his/her neighbors to behave in the same way. Peers' influence is implemented through the Linear Threshold model discussed in Section 3.4.

The learning function is defined in the simulation as:

$$asymmetry_coef(t) = asymmetry_coef(t - 1) - \frac{1}{speed_of_learning * distance}$$

Where $speed_of_learning$ takes three discrete values in the simulation:

- Slow : 20
- Fast : 5
- Regular : 10

The intuition behind the above equation is that clients located far from a bank take more time to learn about the bank's real CSR practices.

3.4 Network contagion : The linear threshold model

3.4.1 The concept

The Linear Threshold Model (LTM) is used to model contagion within a network. In the LTM model, each edge has a weight and each node has a threshold chosen uniformly at random. A node becomes activated if the weighted sum of its active neighbors exceeds its threshold (Kempe et al., 2003).

More specifically, given a choice of all nodes' thresholds, and an initial set of active nodes N_0 (with all other nodes inactive), the diffusion process converges deterministically in discrete steps: In step t , all nodes that were active in step $t - 1$ remain active; furthermore, each currently inactive node i becomes active if and only if the total weight of its active neighbors is at least T_i

$$\sum_{\text{active neighbors}} W_i \geq T_i$$

Where W_i represent the weights of active neighbors and T_i the activation threshold for node i . LTM intuitively represents the tendencies of nodes to mimic their neighbors' behaviors.

3.4.2 The application

In our model, LTM is used to simulate peers pressure regarding the rhetoric bank selection. In this simulation, Netlogo grid is modeled as a directed graph $G = (C, E, W)$ where C are the nodes, E the edges and W the weights.

In Netlogo grid every consumer C_i is located in a cell and is directly related to 8 neighbor consumers via edges (figure 4). To simplify, we assume that edges have the same weights. Hence, $w_{ij} = 1/8$, where w_{ij} is the edge linking node i with node j .

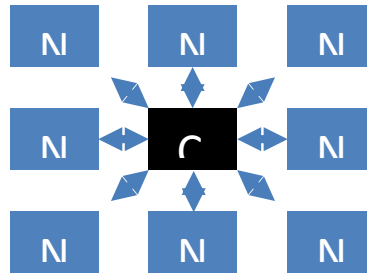


Figure 4. Grid modeling in Netlogo

The diffusion process works one step at a time and is progressive, that is, an “activated” node cannot be changed. To illustrate, if at time t , neighbors N_2 , N_3 and N_5 are unhappy consumers of the rhetoric bank, the threshold is set to 2, and C_i is a rhetoric bank consumer, then C_i is unhappy. Unhappy customers keep the same status until the end of the simulation.

3.5 Selecting new customers : The diffusion model

3.6 The concept

The Bass model (Bass, 1969) has been used in modeling product diffusion within a market. This model is based on the idea that the diffusion of new products is driven by two means of communication: Mass media (external influence) and word of mouth (internal influence). Product adopters are, thus, classified into two groups: Innovators (external influence only) and imitators (internal influence only) (Mahajan et al., 1990).

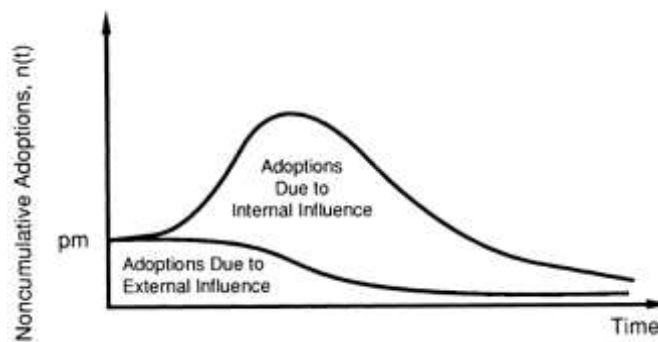


Figure 5. Non cumulative adoptions in the bass model (Mahajan et al., 1990)

The discrete form of the Bass equation is as follows:

$$C(t) = M * \frac{1 - pe^{-(p+q)t}}{1 + \frac{p}{q}e^{-(p+q)t}}$$

Where: M is the market size, $C(t)$ the total number of customers at time t , p the external influence coefficient, and q the internal influence coefficient (Mahajan et al., 1990).

3.6.1 The application

Before customers make the decision of choosing a bank, they get informed about the rhetoric and the ethical bank's positioning. Like the Bass model, we assume that potential clients are informed through either mass media or word of month. In every period of this simulation, a group of customers is selected to decide whether to opt for the ethical or the rhetoric bank. We use the Bass equation to select, for every period, N potential customers:

$$\text{At } t = 1, \quad N(t) = M * \frac{1 - pe^{-(p+q)t}}{1 + \frac{p}{q}e^{-(p+q)t}}$$

$$\text{At } t > 1, \quad N(t) = M \left(\frac{1-pe^{-(p+q)t}}{1+\frac{p}{q}e^{-(p+q)t}} - \frac{1-pe^{-(p+q)(t-1)}}{1+\frac{p}{q}e^{-(p+q)(t-1)}} \right)$$

Where: M is the market size, $N(t)$ the number of customers selected at time t , p the external influence coefficient, and q the internal influence coefficient.

3.7 The simulation algorithm

The general algorithm is described in the flow chart below (Figure 6):

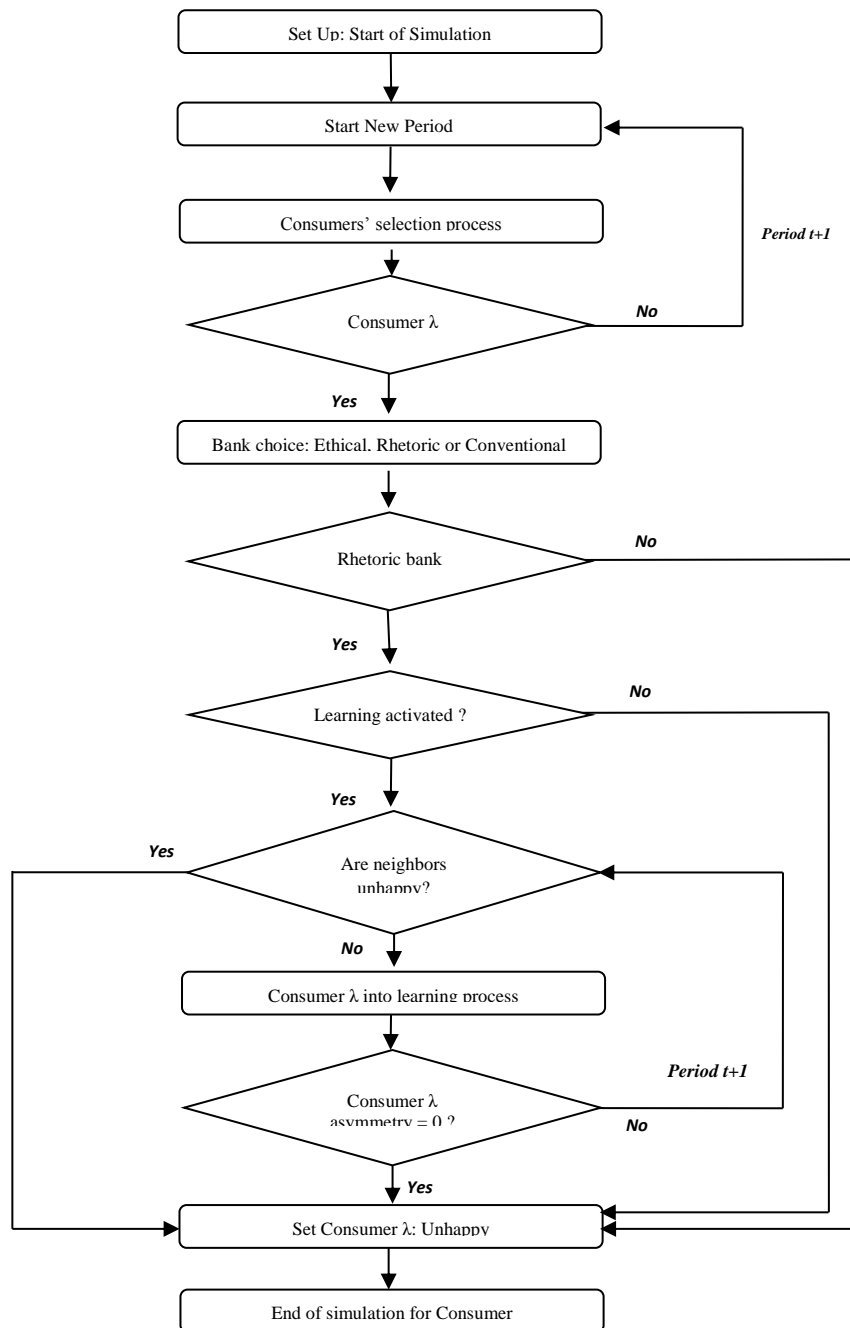


Figure 6. Algorithm flow chart

4. RESULTS

The simulation interface is as follows (figure 7), table 5 presents the inputs, the grid and results.

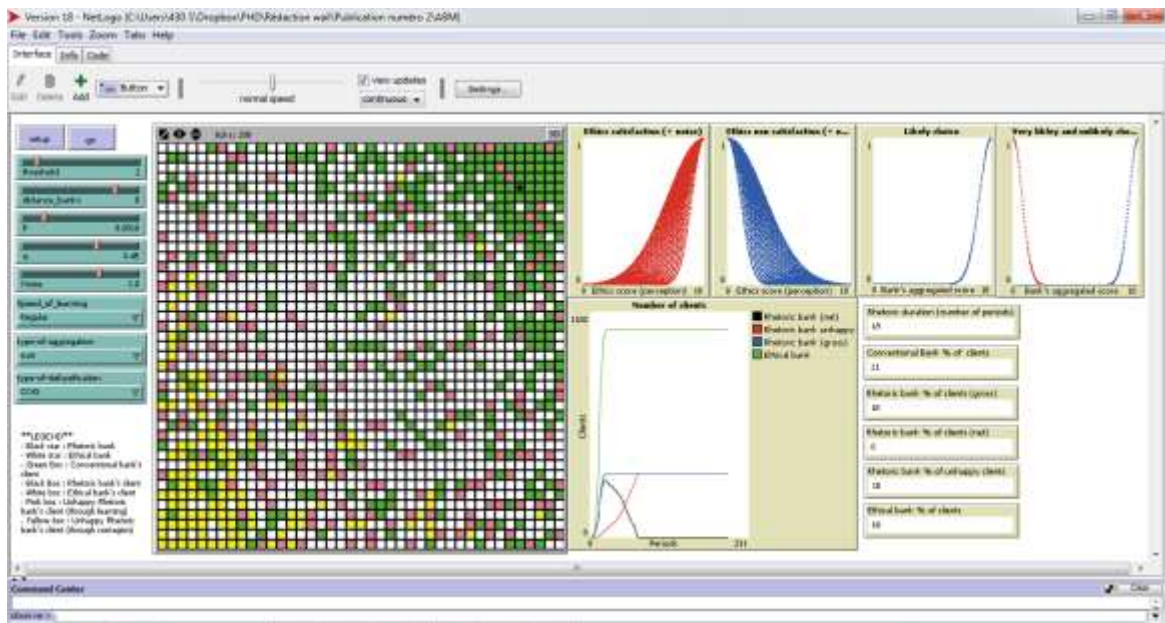


Figure 7. Simulation interface

Table 5: Simulation inputs, grid and outputs

	Details
The inputs	<ul style="list-style-type: none"> • Threshold in the range [1,5]. Used in the contagion model (peer effect). • p in the range [0.001, 0.01] and q in the range [0.1, 0.7]. Used in the consumers' selection model. • Noise in the range [0,3]. Used to differentiate between consumers' preferences for ethics. • Speed of learning takes three values (slow, regular or fast). Used for rhetoric bank's consumers. • Type of aggregation takes the values "Sum" and "Max" (cf. table 1). • Type of defuzzification takes the values "COG", "FOM", "LOM", "MOM" and "MeOM" (cf. table 2).
The grid	<ul style="list-style-type: none"> • 1681 consumers that are either clients of the Ethical bank (white cells), the rhetoric bank (black cells) or the conventional bank (green cells). • Rhetoric bank's clients who turn unhappy through learning and peer effect are represented by yellow cells and pink cells respectively.
The outputs	<ul style="list-style-type: none"> • Conventional bank : Number of clients • Ethical bank : Number of clients • Rhetoric bank : <ul style="list-style-type: none"> *Net number of clients excluding unhappy clients *Number of unhappy clients *Duration : Number of periods for the bank to get out of the market

4.1 THE BASIC MODEL WITH NO LEARNING

In the basic model, information asymmetry is constant. Therefore, rhetoric bank's consumers do not get unhappy. Figures 8 and 9 present consumers' distribution in the grid when the rhetoric bank (top right) is far from the ethical bank (bottom left) and when both banks are located in the same area (center). The ethical, rhetoric and conventional bank's clients are represented by white, black and green cells respectively.

The first case features clear market segregation where the rhetoric bank addresses bottom left clients that are the furthest (with high asymmetry levels). Even though, these clients are close to the ethical bank, rhetoric bank benefits from a cost advantage coupled with strong information asymmetry.

The ethical bank attracts clients located at the center and the conventional bank keeps top right clients that are satisfied with neither the rhetoric bank (which is too close and hence features little asymmetry) nor the ethical bank (which is too far and hence suffers from too much asymmetry).

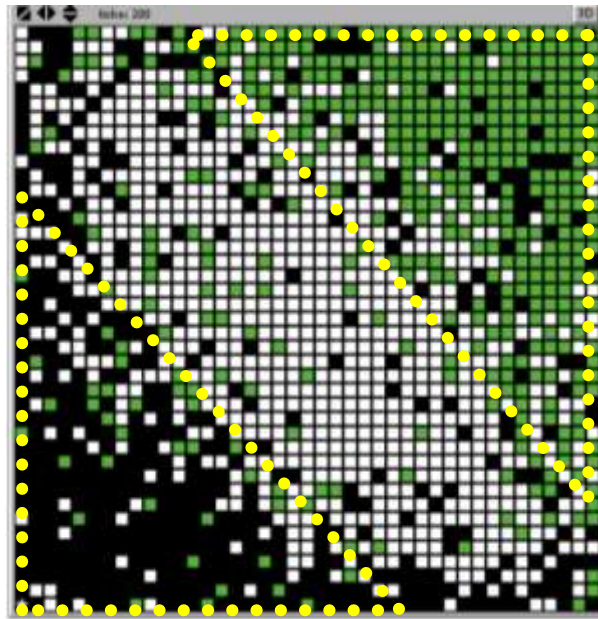


Figure 8. Segregated clients: Rhetoric bank (black star) far from ethical bank (white star)

When the rhetoric and the ethical bank are located in the same area, no segregated pattern emerges in the simulation. In this setting, most clients choose the ethical bank because the rhetoric bank does not leverage information asymmetry as clients are within the same distance of both banks (Figure 9).

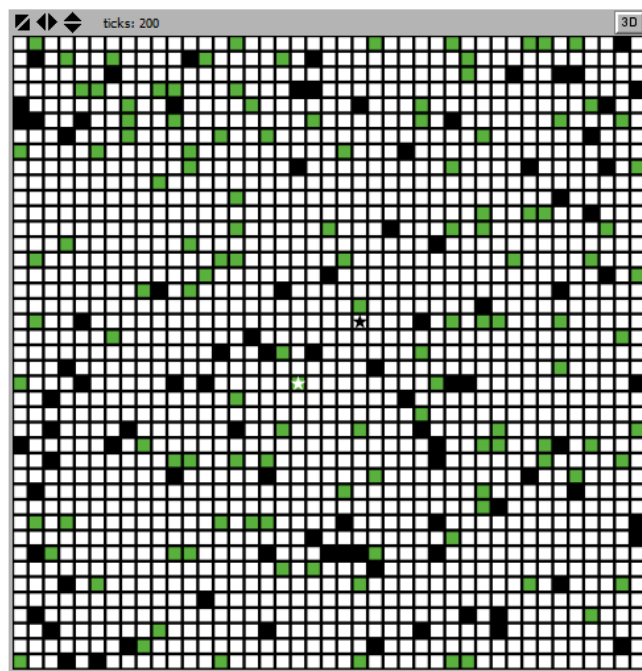


Figure 9. Mixed clients: Rhetoric bank (black star) close to ethical bank (white star)

In the following graphs (Figures 10 - 12), we compare the performance of the three banks in attracting clients with respect to the variation in ethical attitudes among customers (Noise) and the distance between the two Islamic banks (Distance). The simulations below are based on the following inputs: $p=0.001$, $q=0.5$, type of aggregation = “Sum”, type of defuzzification = “COG”.

Clients' heterogeneity regarding ethics and distance from the ethical bank serves the rhetoric bank (Figure 10). Clearly, the rhetoric bank has an incentive to address markets where the ethical bank is not present and where clients display heterogenous behavior with regards to ethics.

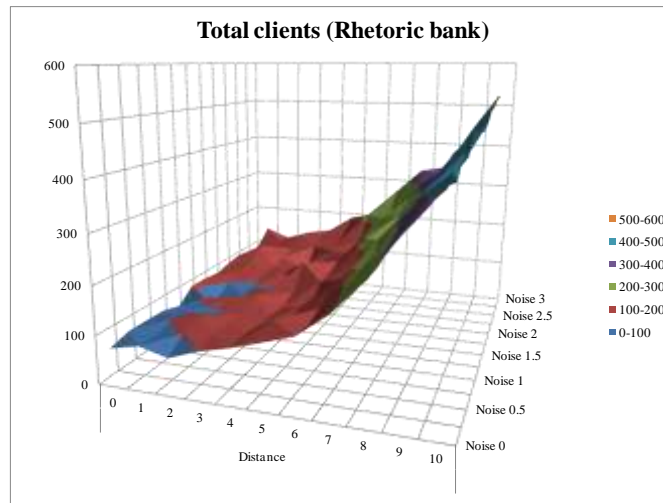


Figure 10. Total clients (rhetoric bank)

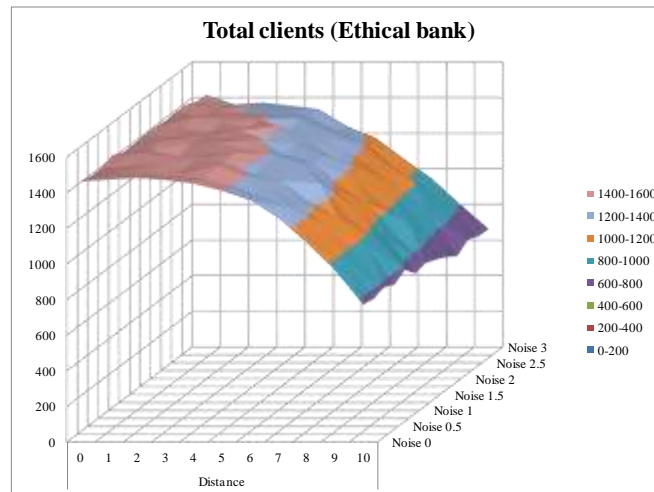


Figure 11. Total clients (Ethical bank)

The ethical bank thrives in markets where information asymmetry is minimal (distance=0). To a lesser extent, the bank also benefits where clients display homogeneous behavior with regards to ethics (Figure 11).

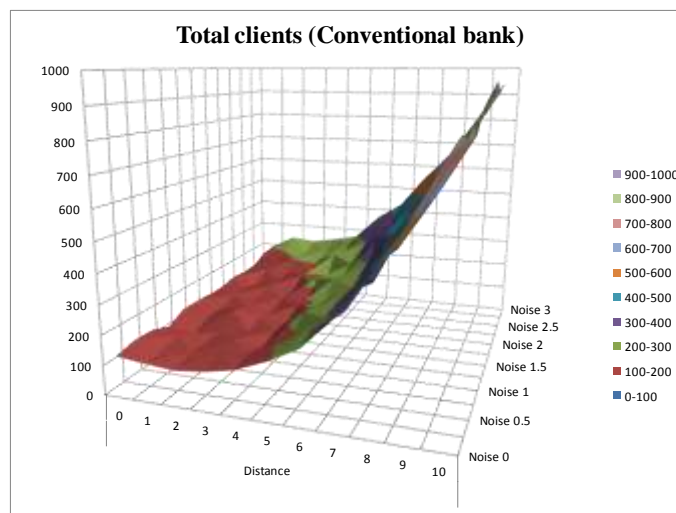


Figure12. Total clients (Conventional bank)

As presented earlier (Figure 8), the conventional bank attracts clients that are satisfied with neither the rhetoric bank (too close) nor the ethical bank (too far). Consequently, the conventional bank thrives when distance between the rhetoric and the ethical bank is large (Figure 12).

4.2 THE EXTENDED MODEL WITH LEARNING AND CONTAGION

In this model, rhetoric bank's consumers learn more about their bank's CSR practices throughout time. When information asymmetry is eliminated, these consumers are unhappy, leave the bank and inform their neighbors who are rhetoric bank clients.

Since the learning and the contagion processes are deterministic, the rhetoric bank will end-up losing all its clients. "Rhetoric Duration" measures the number of periods for the rhetoric bank to get out of the market. The simulations in figures 13 and 14 analyze this indicator by varying Distance, Noise and the contagion threshold. The simulations are based on the following inputs: $p=0.001$, $q=0.5$, type of aggregation = "Sum", type of defuzzification = "COG".

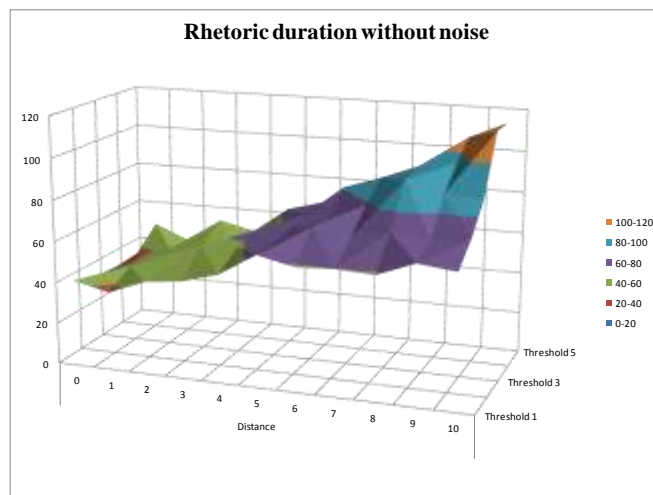


Figure 13. Number of periods for the rhetoric bank to lose all its clients (noise = 0)

As expected, Rhetoric Duration increases with distance (which implies more clients) and threshold (slow contagion). Interestingly, the Rhetoric Duration's sensitivity to threshold is more important when the distance between the banks is large (Figure 13). This is explained by the fact that the relatively low density of the rhetoric bank's clients when distance is close (see figure 9) makes the contagion less effective especially when the threshold is high.

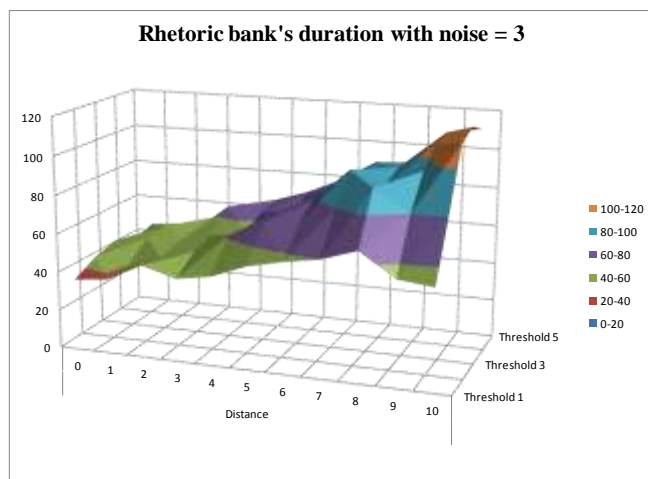


Figure 14. Number of periods for the rhetoric bank to lose all its clients (noise = 3)

Figure 14 presents the same pattern as figure 13. However, when distance is large, noise amplifies the duration spread. Finally, we assess the evolution of Rhetoric Duration by simultaneously varying p and q (Figure 15). The rhetoric bank is advantaged when both p and q are low, that is, reduced mass media communication and low word of mouth. We note that the bank's duration is more sensitive to q than p , and that p 's variation plays an important role only when q is minimal. In other words, when social media and word of mouth are quasi absent, mass media plays a major role in spreading information about the banks' intentions and actions. However, the more word of mouth is used, the less the importance of standard mass

media in channeling information on the banks' ethical conduct, which can be fairly explained by the viral feature of word of mouth, especially social media.

Consequently, in order to offset the rhetoric bank's strategy, the ethical bank can leverage communication to its advantage by initially investing in all possible mass media channels, and then exploiting the viral characteristic of social media to increase virtual word of mouth.

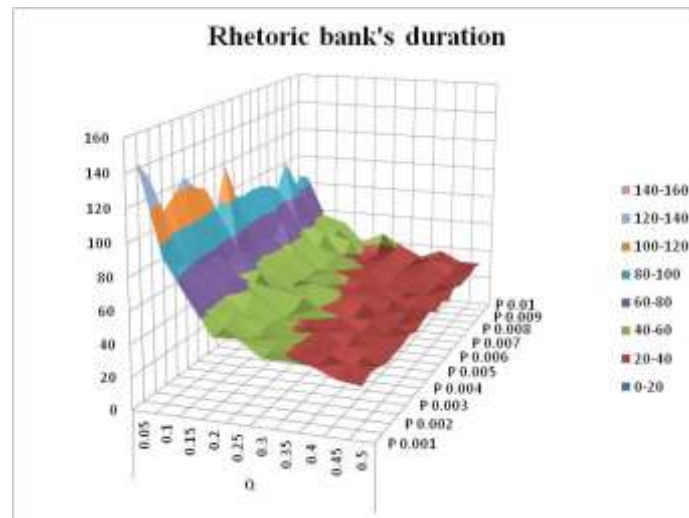


Figure15. Rhetoric duration by varying p and q

5. CONCLUSION, LIMITS AND PERSPECTIVES

This paper aims to model the dynamics of a banking market characterized by the presence of a conventional bank, an Islamic bank genuinely involved in ethical and societal practices, and an Islamic bank only partially or not involved in such practices, but claiming the opposite (rhetoric bank). Both Islamic banks seek to attract customers that are sensitive to ethical involvement.

To adequately capture the market characteristics, we use fuzzy logic coupled with diffusion models and learning and contagion models. Then we run simulations under various levels of information asymmetry, attitudes towards ethics, and geographic distances between the Islamic banks in order to track the resulting banks' performances. Results show that the rhetoric bank can more or less thrive in markets with large information asymmetry, with clients featuring heterogeneous ethical behavior, and in the absence of a nearby competitor with genuine ethical positioning. However, such a bank will end-up out of the market as soon as information asymmetry is reduced and with more consumers influencing their peers' attitudes.

Results also show that Islamic banks intending to pursue a genuine CSR strategy to attract customers need to strongly invest in communication by using diverse mass media channels and by leveraging social media capabilities. In addition, such banks have to educate consumers about their activities in general and their ethical involvement in particular.

As in every simulation, our methodology has several limits. Firstly, the fuzzy decision model parameters have to be calibrated using primary or secondary data. Secondly, our model assumes that banks follow static strategies. In reality, the rhetoric bank might switch to genuine CSR actions when faced with clients' exodus. The conventional bank might also adopt a CSR strategy to be aligned with market offerings. Thirdly, it is assumed that consumers adopt the same learning algorithm in the simulation; in fact the learning capabilities across a population might be heterogeneous. Fourthly, our contagion model is limited to the rhetoric bank's clients, whereas it can be applied as well to the rhetoric bank's prospects. Finally and more importantly, our model assumes that the Islamic bank pursues the ethical positioning keeping everything else constant. In reality, such a strategy would be more effective if coupled with an added value proposition at the product and the business model levels that go beyond "sharia compliance" and differentiates the bank from existing conventional practices. These limits open the door to many perspectives to this research.

6. REFERENCES

- AL-SUWAILEM, S. 2012. Towards an objective measure of gharar in exchange. *Journal of Islamic Business and Management*, 2.
- ARIELY, D. & JONES, S. 2008. *Predictably irrational*, HarperCollins New York.
- ARIELY, D. & JONES, S. 2010. *The upside of irrationality: The unexpected benefits of defying logic at work and at home*, Harper New York.
- ASUTAY, M. 2007. Conceptualisation of the second best solution in overcoming the social failure of Islamic finance: Examining the overpowering of homoislamicus by homoeconomicus. *IJUM Journal in Economics and Management*, 15, 167-195.
- ASUTAY, M. 2012. Conceptualising and locating the social failure of Islamic Finance: aspirations of Islamic moral economy vs. the realities of Islamic finance. *Asian and African Area Studies*, 11, 93-113.
- AXELROD, R. 2000. On six advances in cooperation theory. *Analyse & Kritik*, 22, 130-151.
- AXELROD, R. & HAMILTON, W. D. 1981. The evolution of cooperation. *Science*, 211, 1390-1396.
- AYUB, M. 2009. *Understanding Islamic Finance*, John Wiley & Sons.
- BASS, F. 1969. A New Product Growth Model for Consumer Durables. *Management Sciences. Institute for Operations Research and the Management Sciences. Evanston, XV (5)*.
- CASTALDO, S., PERRINI, F., MISANI, N. & TENCATI, A. 2009. The missing link between corporate social responsibility and consumer trust: The case of fair trade products. *Journal of Business Ethics*, 84, 1-15.
- CHEN, Y.-S. & CHANG, C.-H. 2012. Enhance green purchase intentions: The roles of green perceived value, green perceived risk, and green trust. *Management Decision*, 50, 502-520.
- CHILDERS, T. L. & RAO, A. R. 1992. The influence of familial and peer-based reference groups on consumer decisions. *Journal of consumer research*, 198-211.
- CHONG, B. S. & LIU, M.-H. 2009. Islamic banking: interest-free or interest-based? *Pacific-Basin Finance Journal*, 17, 125-144.
- EL-GAMAL, M. A. 2001. An economic explication of the prohibition of gharar in classical Islamic jurisprudence. *Islamic Economic Studies*, 8, 29-58.
- EL QORCHI, M. 2005. Islamic finance gears up. *Finance and Development*, 42, 46.
- FAROOQ, M. O. 2011. Self-Interest, Homo Islamicus and Some Behavioral Assumptions in Islamic Economics and Finance. *International Journal of Excellence in Islamic Banking and Finance*, 1, 52-79.
- GEORGOULAS, S., MOESSNER, K., MANSOUR, A., PISSARIDES, M. & SPAPIS, P. 2012. A fuzzy reinforcement learning approach for pre-congestion notification based admission control. *Dependable Networks and Services*. Springer.
- GRIFFITHS, N., CHAO, K.-M. & YOUNAS, M. Fuzzy trust for peer-to-peer systems. *Distributed Computing Systems Workshops, 2006. ICDCS Workshops 2006. 26th IEEE International Conference on, 2006. IEEE*, 73-73.
- GUÉRANGER, F. 2009. *Finance islamique: une illustration de la finance éthique*, Dunod.
- HANIFFA, R. & HUDAIB, M. 2007. Exploring the ethical identity of Islamic banks via communication in annual reports. *Journal of Business Ethics*, 76, 97-116.
- HASSAN, A. & SALMA BINTI ABDUL LATIFF, H. 2009. Corporate social responsibility of Islamic financial institutions and businesses: Optimizing charity value. *Humanomics*, 25, 177-188.
- HOTELLING, H. 1929. *Stability in competition*, Economic Journal.
- IZQUIERDO, L. R., OLARU, D., IZQUIERDO, S. S., PURCHASE, S. & SOUTAR, G. N. 2015. Fuzzy Logic for Social Simulation using NetLogo. *Journal of Artificial Societies and Social Simulation*.
- JANSSEN, M. A. & OSTROM, E. 2006. Empirically based, agent-based models. *Ecology and Society*, 11, 37.
- KEMPE, D., KLEINBERG, J. & TARDOS, É. Maximizing the spread of influence through a social network. *Proceedings of the ninth ACM SIGKDD international conference on Knowledge discovery and data mining, 2003. ACM*, 137-146.
- LEE, E. M., PARK, S.-Y., RAPERT, M. I. & NEWMAN, C. L. 2012. Does perceived consumer fit matter in corporate social responsibility issues? *Journal of Business Research*, 65, 1558–1564.
- LEE, K.-H. & SHIN, D. 2010. Consumers' responses to CSR activities: The linkage between increased awareness and purchase intention. *Public Relations Review*, 36, 193-195.
- MAALI, B., CASSON, P. & NAPIER, C. 2006. Social reporting by Islamic banks. *Abacus*, 42, 266-289.
- MACAL, C. M. & NORTH, M. J. 2010. Tutorial on agent-based modelling and simulation. *Journal of Simulation*, 4, 151-162.
- MAHAJAN, V., MULLER, E. & BASS, F. M. 1990. New product diffusion models in marketing: A review and directions for research. *The journal of marketing*, 1-26.
- MARIMUTHU, M., WAI JING, C., PHEI GIE, L., PEY MUN, L. & YEW PING, T. 2010. Islamic banking: selection criteria and implications. *Global Journal of Human-Social Science Research*, 10.

- MARTÍNEZ, P. & DEL BOSQUE, I. R. 2013. CSR and customer loyalty: The roles of trust, customer identification with the company and satisfaction. *International Journal of Hospitality Management*, 35, 89-99.
- MENDEL, J. M. 1995. Fuzzy logic systems for engineering: a tutorial. *Proceedings of the IEEE*, 83, 345-377.
- MOHD NOR, S. 2012. Integrating moral in a dynamic model of corporate social responsibility in Islamic Economics and Finance.
- MORGENSTERN, O. & VON NEUMANN, J. 1953. Theory of games and economic behavior.
- NAZIM, A. & BENNIE, G. 2012. World Islamic Banking Competitiveness Report 2012–2013. *Ernst & Young 2012, (December)*.
- PRASAD, A. & HOLZINGER, I. 2013. Seeing through smoke and mirrors: A critical analysis of marketing CSR. *Journal of Business Research*, 66, 1915-1921.
- RAHMAN, R. A. & SAIMI, N. S. 2015. Determinants of ethical identity disclosure among Malaysian and Bahrain Islamic banks. *Ethics, Governance and Regulation in Islamic Finance*, 9.
- REUTERS, T. 2014. State of the global Islamic economy. *Thomson Reuters 2014 Report*.
- SALOP, S. C. 1979. Monopolistic competition with outside goods. *The Bell Journal of Economics*, 141-156.
- SCHELLING, T. C. 1971. Dynamic models of segregation†. *Journal of mathematical sociology*, 1, 143-186.
- SKOWRONSKI, J. J. & CARLSTON, D. E. 1989. Negativity and extremity biases in impression formation: A review of explanations. *Psychological bulletin*, 105, 131.
- TRUDEL, R. & COTTE, J. 2009. Does it pay to be good. *MIT Sloan Management Review*, 50, 61-68.
- WAJDI DUSUKI, A. & IRWANI ABDULLAH, N. 2007. Why do Malaysian customers patronise Islamic banks? *International Journal of Bank Marketing*, 25, 142-160.
- ZIMMERMANN, H.-J. 2001. *Fuzzy set theory—and its applications*, Springer Science & Business Media.