ISLAMIC BANKING CHALLENGES LIE IN THE GROWTH OF ISLAMIC ECONOMY DESPITE OF THE FREE INTEREST LOANS POLICY: EVIDENCES FROM SUPPORT VECTOR MACHINE APPROACH

Nesrin Benhayoun[1], Ikram Chairi[1], Amina El Gonnouni[1], Abdelouahid Lyhyaoui[1]
[1]Laboratory of Innovative Technologies, Abdelmaklek Essaadi University, Tangier 90000, Morocco

Abstract. The last decade has seen an unprecedented growth in the practice of Islamic banking and finance which has now been recognized as a viable alternative and hopefully it will be the only financial system needed to get out from the current crisis, with the expectation that it will play an increasingly more important role in the years to come; as such, the appeal of this type of finance stems mainly from its underlying fundamental concept of justice as well as from the sharing of risk and prohibition of interest.

We intend in this paper to examine the practice of Islamic Finance and its impact on the financial health of companies. Given that a company forms a micro financial system, its good financial health contributes to building a powerful economic engine; this is why we have a greater focus on companies' financial situation, especially the company's debt situation.

Therefore, we have, over 3 years (2009-2011), selected a sample of 20 firms with considerable conventional bank loans. We have also extracted about 40 financial indicators impacting their debt situation in order to set up an intelligent financial solution to measure the impact of interest on the firm's solvency.

Using Linear regression Model and Support Vector Machine Model (SVM), we have proved the high-impact of interest loans on the financial behavior of companies, and we have concluded through our SVM prediction model that interest loans can highly increase unexpected financial crises.

Keywords: Islamic Finance, Ethical Finance, Challenge, Financial crisis, Support Vector Machine, Linear Regression Model.

Introduction

The financial crisis (U.S. "subprime") that began in the summer of 2007 was spread to a number of other advanced economies, especially because of the recent revolution of scientific and technological developments.

So, during this global financial crisis, the economic world has seen the misdeeds caused by the current financial system which focuses primarily on profits, and began to give importance to ethical finance and to socially responsible economy. This vision noted that profit should not neglect the respect of values--this is exactly the vision of "Islamic finance",

which can be regarded as a compartment of ethical finance, because it is characterized by a moral and socially responsible dimension and, as such, can respond to a need that goes far beyond funding.

The repercussions and negative effects of the global financial crisis on the conventional banks have allowed Islamic banking to flourish the worldwide over the last few decades. This financial trend was born, symbolically, in 1975 with the advent of the first commercial Islamic bank in Dubai, and it has consistently developed and gained real momentum with the establishment of the Jeddah-based Islamic Development Bank and with the initial theoretical model of two-tier Mudarabah and Takaful services. As a result, over 300 Islamic financial institutions are currently operating in more than 75 countries with combined total assets in excess of US$ 250 billion.

As such, we want to focus on the challenges ahead and, in particular, on the idea how the Islamic system of ethics can influence Islamic banking and finance especially in what regards the sharing of risk and the prohibition of interest.

The Islamic financial system is rooted in the rules and norms of Islam and the prohibition of interest is the primary sources of Shariah, i.e. the Holy Qur'an and Sunnah, strongly condemn Riba in Islam and the aspiration of Muslims to see this prohibition practically implemented in their economic reality have led to the establishment of a number of Islamic financial institutions around the world. These financial institutions include Islamic commercial and investment banks, mutual insurance companies, and leasing companies.

In fact, from a historical perspective, taking interest on loans has always been condemned as inherently evil an immoral. Earliest civilizations showed ill feelings toward interest. The prohibition of interest was negatively represented not only all along the Islamic and Christian traditions but also by ancient Greek philosophers. However, the prohibition of interest was not universally observed. Yet, in recent years this moral concept has resurfaced again in the context of Islamic finance as forming what can be considered one of the fundamental pillars of Islamic banking and finance. Interest-free transactions in trade and banking are represented by the proponents of Islamic trade and finance as a key solution to the growing problem of market instability as well as a practical way to help reduce the problems often caused by conventional debt. In many cases, situations of crisis are formed as a result of the higher interest rates applied to delayed payment.

We can therefore conclude that the conventional financial system lacks a great deal of sustainability and allows firms to assume excessive levels of debt and risk, as low interest rates encourage excessive risk-taking; in contrast, the Islamic finance industry allows for risk-sharing instead of risk-shifting; that is why it has been noted to be thriving and gaining more momentum all over the world, and as such their assets have been growing considerably in the last decades.

In essence, Islamic finance is a financial system structured on risk-sharing and the prohibition of transactions that charge interest and shift the entire risk of the transaction to the borrower. Financial intermediation is at the heart of any financial system, and in order for the Islamic finance system to fulfill this mission, it is essential to build a powerful relationship between its financial system and the economic components of the country: companies, investment components, depositors, households, etc.

Given that a company forms a micro financial system, we should not neglect the one-to-one relationship with the Islamic finance system. Unlike the conventional financial system that encourages uncontrolled credit creation, leveraging, interest, and risk-shifting, the Islamic financial system does not allow its credit policy to expand or contract away from the real economic components.

Having said that, this research seeks to prove the high-impact of interest loans on the financial behavior of companies, especially on the firm's solvency through the study of

regression and the Support Vector Machine prediction model based on a selected sample of financial indicators over a period of 3 years (2009-2011) of 20 Moroccan firms with considerable conventional bank loans.

This paper is structured as follows. Section 2 presents an overview of the solvency risk in relation to the conventional financial system. Section 3 provides a brief literature review of the building blocks of the Islamic Finance System. Section 4 shows detailed description of the financial indicators which reflect the solvency of the company. Section 5 presents how interest loans can impact negatively on a firm's solvency using the SPSS (Statistical Package for the Social Sciences) linear regression model. Section 6 reviews how these relevant attributes can be used to asses and predict the firm's solvency risk using the Support Vector Machine Model. Finally, the last section provides some concluding comments.

Conventional default risk

There are many opinions about the ultimate cause of the crisis. However, experts have long been calling for comprehensive reform of the financial system to help prevent chaos and spread of financial crisis, or at least minimize their frequency and severity.

In response, The Basel Committee on Banking Supervision and its oversight body, the Group of Governors and Heads of Supervision seek to improve the banking sector's ability to absorb shocks arising from financial and economic stress by developing a reform programme to address the lessons of the crisis. The new global standards to address both firm-specific and broader risks have been referred to as "Basel III".

The Basel III Committee's comprehensive reform package led to the conclusion that many banks were holding insufficient liquidity buffers. During the most severe episode of the crisis, the market lost confidence in the solvency and liquidity of many banking institutions. The weaknesses in the banking sector were rapidly transmitted to the rest of the financial system and, hence, to the real economy.

A strong and resilient banking system is the foundation for sustainable economic growth, as banks are the center of the credit intermediation process between savers and investors. Moreover, banks provide critical services to consumers, small and medium-sized enterprises, large corporate firms and governments who rely on them to conduct their daily business, both at domestic and international levels.

Through The Basel III reform package which builds on the three pillars of the Basel II framework, the committee aims to improve risk management and governance as well as to strengthen bank's transparency and disclosures; as such, it is intended to provide an extra layer of protection against model risk and measurement of solvency risk [5]. To this end, some Islamic banks have attempted to implement Basel III, but there are those who say that Basel III is a reaction to a banking crisis that Islamic banks would not find themselves in and thus should not apply to Islamic Banks. May be this is the case, but standardization in Islamic banking is still elusive, while it is important that the industry of Islamic financial services be completely integrated into the global financial markets while maintaining at the same time its distinguishing nature and unique services. This industry should also be subject to the same level of supervisory control as other financial institutions. So, prudent supervision of Islamic banks is as important as is the supervision of conventional banks. Solvency risk must be managed, and it must be transparent [4].

Solvency risk is the uncertainty surrounding a firm's ability to service its debts and obligations. Prior to default, there is no way to discriminate unambiguously between firms that will default and those that will not. At best, we can only make probabilistic assessments of the likelihood of default.

Although these risks do not seem large, they are in fact highly significant. First, they can increase quickly and with little warning. Second, the margins in corporate lending are very tight, and even small miscalculation can undermine the profitability of lending.

But most importantly, many lenders are themselves borrowers, with the high level of leverage. Unexpected realizations of solvency risk have destabilized and destroyed lenders. Banks, finance institutions, and insurers: none have escaped unscathed.

Solvency risk cannot be hedged away, or structured away. The government cannot insure it away. It is a reflection of the substantial risk in companies' futures. Various schemes exist, and more are coming, which can shift risk, but in the end, someone must bear this risk. It does not "net out" in the aggregate [6].

The risk of firm's crash affects virtually every financial contract [14]. Therefore the pricing of solvency risk has received much attention; both from lenders who have to ensure its claims and from traders who have a strong interest in pricing transactions accurately. For this purpose, it is extremely important to be able to predict the firm's future financial behavior and to assess the degree of the firm's solvency. Thus; the purpose of this exercise is to find how an extended episode of low interest rates also encouraged excessive solvency risk-taking, since the conventional financial system allows individuals and firms to assume excessive levels of debt and risk [15].

Foundations of the Islamic Finance System

Islamic finance has taken its rules from Shariah law, which emerges out of the Qur'an, and the sayings of Prophet Mohamed (Peace and Blessing Upon Him). The fundamental feature of Islamic economics and finance is socio-economic and distributive justice. It also has a comprehensive system of ethics and moral values. This modern Islamic Finance has taken a while to develop especially the macroeconomic concept of Islam spawned the notion of interest free Islamic banking at micro economic levels. The early appearances of this modern concept began with Malaysia in the mid-1940s and Pakistan in the late 1950s, the first two Islamic states which introduced interest free banking systems. The first Islamic financial tradition probably began in Malaysia in 1963 with the establishment of the Muslim Pilgrims Savings Corporation.

Throughout the 1970's, a number of Islamic banks were founded, mostly in the Arab Middle East with the advent of the first commercial Islamic Bank in Dubai (1975), Faisal Islamic Bank of Sudan (1977), Bahrain Islamic Bank (1979), among others [10].

This new concept seemed to be gaining momentum to such an extent that some countries attempted to set up full Islamic banking systems and disconnect themselves from the conventional financial system. For example, Iran and Pakistan have opted for a gradual Islamization of their financial institutions. This new financial system also found its way into some major cities of Europe such as London and Copenhagen, among others.

Islamic Finance Jurisprudence

In Islam, the law comes from the religion; therefore, the Islamic law or *Shari'ah* as it is called in Arabic is defined as the body of legal rules developed by Muslim scholars as a result of their interpretation of the Qur'an and the *Sunna*, the religious texts of Islam.

Since its inception, Islamic finance has developed into one of the most significant growth areas in international banking. In addition Islamic finance is the most important area for the application of the Islamic contract law. Compliance with *Shari'ah* principles is what makes Islamic financial transactions different from conventional transactions.

In Islamic finance, Islamic legal principles are introduced as a corrective ethical layer, which implies that Islamic law is in effect reduced to its ethical component which is faced with the question of whether to look at "what you are not allowed to do", or, "what you are allowed to do" [3] [11].

When money was invented and came into broad use, the four major Sunni schools of Islamic law (*Hanbali, Hanafi, Maliki* and *Shaf'i)* believed that the prohibition should be construed strictly and the majority have agreed that interest, or *riba* in Arabic, as it is known in Arabic, is forbidden in Islamic jurisprudence according to the broad interpretation of the Qur'anic verses and the Prophet's reports. Also, there are other Islamic legal prohibitions that apply to financial transactions. One is uncertainty (or *gharar* in Arabic). Second is the Islamic prohibition of gambling (*maisir* in Arabic) which disallows dealing in futures and options that are speculative. We can also add the prohibition of transactions that include illegal activities or prohibited items [1].

In sum, the Islamic finance law is the foundation for the practice of Islamic finance through the observance of the tenets, conditions and principles espoused by Shari'ah. Comprehensive compliance with Shari'ah principles would bring confidence to the general public and the financial markets on the credibility of Islamic finance operations.

Basic principals of Islamic Banking

Always, most people are familiar with the Islamic concept of the prohibition of interest charged on loans, but in fact, Islamic banking sustains other key criteria. Essentially, there are four basic axes of Islamic banking:
- The lender does not charge any interest or additional amount over the money lent.
- The borrower shall not bear the entire risk shifting of the transaction; both parties have to share the risk.
- *Gharar* (Uncertainty, Risk or Speculation) is also prohibited.
- Investment loans should only support practices, activities or products that are not forbidden.

In essence, Islamic finance is a financial system structured on risk-sharing and the prohibition of interest [1] [2]. The fundamental reason for the prohibition of interest in Islam is that the depositor should not profit unduly from the hard work and risk bearing of others. Although Islam prohibits interest, it encourages profit and return on investment. It is for this reason that Islamic financial institutions can offer an investor (depositor) a share of their annual profits (and losses) in proportion with the investor's deposit relative to the total assets of the bank.

It is clear today that we must be careful in applying Islamic financial jurisprudence especially that its revival has evolved during a difficult time in history, and it is well accepted that Islamic banks have to be *Shari'ah*-compliant and, therefore, need a *Shari'ah* Supervisory Board of Advisors (of qualified Muslim jurists) which decides (in the form of edicts or *fatwas*) which financial products and services are *Shari'ah*-compliant and which are not.

Within this overall framework, individuals have the right of ownership and freedom of enterprise, and can get return or profit by creating additional value and sharing gains and losses. The government has to undertake an overseeing role so that a closer linkage between real economy and finance can contribute to growth and evenly shared income.

Having said that, this research seeks to prove the impact of interest loans on the financial behavior of companies, especially on the firm's solvency through the study of regression and the Support Vector Machine prediction model based on a selected sample of financial indicators over a period of 3 years (2009-2011) of 20 Moroccan firms with considerable conventional bank loans.

Financial ratios analysis

Within this study, we demonstrate the use of actual financial data for financial ratio analysis in order to show exactly how interest loans can impact the financial behavior of a company and how we can overcome the difficulties in applying the principles of financial ratio analysis when the data are not homogeneous as is the case in our samples.

The financial analysis is the selection and interpretation of financial data to assist in investment and financial decision-making. Financial analysis may be used internally to evaluate issues such as the efficiency of operations, and credit policies, and externally to evaluate potential investments and the creditworthiness of borrowers.

The primary source from which to draw the financial data needed is the data provided by the company itself in its annual report and required disclosures. The annual report includes the income statement, the balance sheet, and the statement of cash flows.

A financial ratio is a comparison between one bit of financial information and another. Ratios can be classified according to their general characteristics; in this study we have chosen the classification as follow:

The Operating ratios: When we assess a company's operating performance, we want to know if it is applying its assets in an efficient and profitable manner. The operating ratios show the efficiency of a company's management to control the expenses of a firm and to measure its profitability and its financial soundness of a firm. We have selected:

Working Capital ratio: Indicates whether a company has enough short term assets to cover its short term debt. It measures both a company's efficiency and its short term financial health.

Working Capital Requirement: Indicates the minimum amount of resources that a company requires to effectively cover the usual costs and expenses necessary to operate the business.

Cash ratio: It is commonly used as a measure of company liquidity. It can therefore determine if, and how quickly, the company can repay its short term debt.

Cash flow ratio: It is the cash resulting from income generating activities minus expenses and investments. It is a key metric for any entity that handles cash, and it can determine if the company can finance its operations through the cash it generates from ongoing activities.

The financial ratios: When we assess a company's financial condition, we want to know if it is able to meet its financial obligations. It can be used to analyze trends and to compare the firm's financial situation to that of the other firms we have selected:

Productivity ratio: It represents the efficiency with which physical inputs are converted to useful outputs. It can be computed by the ratio between the value added and the turnover. This is an indicator of company's ability to harness physical and human resources to maximize its production of goods and services.

Leverage ratio: It measures how much money a company should safely be able to borrow over long periods of time. It does this by comparing the company's total debt and dividing it by the amount of the owner's equity.

Coverage ratio: A measure of a company's ability to meet its financial obligations; it compares a company's total debt to its cash flow and it provides an indication of the company's ability to cover total debt with its yearly cash flow from operations.

Solvency ratio: It provides an assessment of the likelihood of a company to continue congregating its debt obligations. It compares a company's owners equity to its total assets. Generally speaking, the lower a company's solvency ratio, the greater the probability that the company will default on its debt obligations.

The profitability ratios: Compare components of income with sales. They give us an idea of what makes up a company's income and are usually expressed as a portion of each dollar of sales. We distinguish:

Operating Profit Margin: This is a ratio that indicates how much of each dollar of sales is left over after operating expenses and it compares the operating income of a company to its turnover.

Net Profit margin: This is a ratio of net income to turnover, and indicates how much of each dollar of sales is left over after all expenses.

There are hundreds of ratios that can be formed using available financial statement data. The ratios selected for our study depend on the type of our analysis about the creditworthiness and the type of our sample of firms. We will see in the next section, using these ratios, how interest loans can impact negatively on a firm's solvency using the SPSS (Statistical Package for the Social Sciences) linear regression model.

Linear Regression Model

Theoretical Model

The multiple linear regression model is used to study the relationship between a dependent variable and one or more independent variables. The generic form of the linear regression model is

$$y = f(x_1, x_2, ..., x_k) + \varepsilon$$

$$= x_1\beta_1 + x_2\beta_2 + ... + x_k\beta_k + \varepsilon$$

Where y is the dependent or explained variable and $x_1, x_2, ..., x_k$ are the independent or explanatory variables. One's theory will specify $f(x_1, x_2, ..., x_k)$. This function is commonly called the population regression equation of y on $x_1, x_2, ..., x_k$. In this setting, y is the regression and x_k, $k = 1, ...,$ and K are the regressors or covariates. The underlying theory will specify the dependent and independent variables in the model. It is not always obvious which is appropriately defined as each of these.

The term ε is a random disturbance-- so named because it "disturbs" an otherwise stable relationship. The disturbance arises for several reasons, primarily because we cannot hope to capture every influence on an economic variable in a model, no matter how elaborate. The net effect, which can be positive or negative, of these omitted factors is captured in the disturbance. There are many other contributors to the disturbance in an empirical model. Probably the most significant is errors of measurement. It is easy to theorize about the relationships among precisely defined variables; it is quite another to obtain accurate measures of these variables.

We assume that each observation in a sample $(y_i, x_{i1}, x_{i2}, ..., x_{ik}), i = 1, ..., n$, is generated by an underlying process described by

$$y_i = x_{i1}\beta_1 + x_{i2}\beta_2 + ... + x_{ik}\beta_k + \varepsilon_i$$

The observed value of y_i is the sum of two parts, a deterministic part and the random part, ε_i. Our objective is to estimate the unknown parameters of the model, use the data to study the validity of the theoretical propositions, and perhaps use the model to predict the variable y [9].

Impact of interest on firms' solvency: Linear Regression Model

This research investigates financial data over 3 years 2009-2011, which all come from 20 Moroccan companies that belong to different sectors and have different sizes.

Firstly, we have selected 40 variables, over 3 years, impacting their debt situation in order to set up a model to measure the impact of interest loans on the firm's solvency.

Table 1. Selected Indicators.

V0	Interest				
V1	Turnover	V14	Equity / Total assets	V27	Financial costs / Gross operating profit
V2	Net equity	V15	Working capital / Working capital requirement	V28	Financial costs / Operating cash surplus
V3	Net cash	V16	Leverage ratio	V29	Gross operating profit / Turnover
V4	Net profit	V17	Coverage ratio	V30	Net profit margin ratio
V5	Working capital	V18	Change in debts / Cash flow	V31	Net profit / Net equity
V6	Working capital requirement	V19	Rotation net cash	V32	Net profit / Permanent capital
V7	Value added	V20	Inventory turnover	V33	Long term debts / Cash flow
V8	Gross operating margin	V21	Delay of payment of customers	V34	Net profit / Equity
V9	Gross operating profit	V22	Delay of payment to vendors	V35	Staff costs
V10	Operating cash surplus	V23	Gross margin / Turnover	V36	Lenders
V11	Free cash flow	V24	Cash flow / Turnover	V37	State
V12	Cash flow	V25	Productivity ratio	V38	Current operating income
V13	Solvency	V26	Staff costs / Value added	V39	Non-operating income

When we assess a firm's financial behavior, we want to know if a company is solvent, and if it is capable to resolve its debt situation; this is why we have elaborated our linear regression model, using SPSS 10, using our 40 variables involved and the relevant solvency component, in order to detect the variables that influence the most and to measure the negative impact of interest loans on the firms' financial behavior.

The following model presents 4 relevant variables as the number of variables to be retained instead of 40 variables. The regression model based on the data from 2009-2011 can explain 92% of precision, which means the model has a good measuring effect.

Table 2. Linear Regression Model Coefficients.

Model	Unstandardized Coefficients		Standardized Coefficients	t statistic	Significance level.
	(a) Regression Coefficients	(b) Standard Error	Independent variables	(a)/(b)	
1					
(Constant)	,007	,032		,217	,829
Interest (V0)	-1,99E-007	,000	-,141	-2,600	,012
Equity / Total assets (V14)	,912	,066	,894	13,829	,000
Rotation net cash (V19)	,000	,000	,069	1,220	,228
Gross margin / Turnover (V23)	,011	,041	,015	,271	,787
Financial costs / Operating cash surplus (V 28)	-,023	,022	-,058	-1,039	,303

So, we can conclude our model equation like:

$$Solvency = -1{,}99 \times 10^{-7} \times V0 + 0{,}912 \times V14 + 0{,}011 \times V23 - 0{,}023 \times V28 + 0{,}007$$

Having said that, the interest loans negatively affect the solvency of the company and the risk of large loans becomes increasingly higher. That is why money is not considered a commodity in Islamic economics but rather a bearer of risk. The interpretation of Riba(usury) is that it is one and the same with the concept of Usury, and is therefore unlawful and forbidden. Instead of Riba the concept of profit and loss sharing is practiced; essentially the concept of sharing risk, as opposed to transferring it.

Thus, when it comes to measuring solvency risk in its entirety, the question is more complicated due to the lack of sufficient historical data as required for analysis; yet, we can use our regression model to reduce our Support Vector Machine input factors dimension to four factors to predict the solvency risk and to help businesses improve solvency as well as assist the financial institution in decision-making.

Support Vector Machine Model

Theoretical Model

Support Vector Machine (SVM) is a powerful method for pattern recognition and classification introduced by Vapink [7]. The SVM maps the input data into a higher dimensional feature space via a nonlinear map and construct a separating hyperplane with maximum margin. It has been proposed as a technique in times series prediction. The key characteristic of SVM is that a nonlinear function is learned by a linear learning machine in a kernel induced feature space while the capacity of the system is controlled by a parameter that does not depend on the dimensionality of the space. The following shows the SVM algorithm [8]:

Consider a given training set $\{x_i, y_i : i = 1, \cdots l\}$ randomly and independently generated from an unknown function, where $x_i \in X \subseteq R^n, y \in Y \subseteq R$ and l is the total number of training data.

The SVM approximates the unknown function using the following form:

$$f(x) = \langle w, \Phi(x) \rangle + b \qquad (1)$$

Where $\langle , \rangle$ is the dot product, w and b are the estimated parameters and Φ is a non linear function is used to map the original input space R^n to high dimensional feature space. So, the nonlinear function estimation in original space becomes linear in feature space.
The optimization goal of standard SVM is formulated as:

$$\text{Minimize} \frac{1}{2}\|w\|^2 + C\sum_{i=1}^{l}(\xi_i + \xi_i^*) \quad (2)$$

Subject to:

$$y_i - \langle w, \phi(x_i) \rangle - b \le \varepsilon + \xi_i,$$

$$\langle w, \phi(x_i) \rangle + b - y_i \le \varepsilon + \xi_i^*,$$

$$\xi_i^*, \xi_i \ge 0, i = 1, \ldots, l.$$

Where the constant $C > 0$ determines the trade off between the flatness of f and the amount up to which deviations larger than are ε tolerated and ξ_i^*, ξ_i are slack variables and they are introduced to accommodate, respectively, the positive and the negative errors on the training data. The formulation above corresponds to dealing with the so called ε-insensitive cost function:

$$|\xi|_\varepsilon := \begin{cases} 0 & \text{if } |\xi| < \varepsilon \\ |\xi| - \varepsilon & \text{otherwise} \end{cases}$$

This constrained optimization problem is dealt with by introducing Lagrange multiplier $\alpha_i, \alpha_i^*, \beta_i, \beta_i^*$:

$$L_P(w, \xi, \xi^*, \alpha, \alpha^*, \beta, \beta^*) = \frac{1}{2}\langle w.w \rangle + C.\sum_{i=1}^{l}(\xi_i + \xi_i^*) - \sum_{i=1}^{l}\alpha_i.\langle w, \phi(x_i)\rangle - y_i + b + \varepsilon + \xi_i)$$

$$- \sum_{i=1}^{l}\alpha_i^*.(y_i - \langle w, \phi(x_i)\rangle) - b + \varepsilon + \xi_i^*) - \sum_{i=1}^{l}(\beta_i.\xi_i + \beta_i^*.\xi_i^*) \qquad (3)$$

By minimization the Lagrangian with respect to the primal variables we obtain:

$$w = \sum_{i=1}^{l}(\alpha_i - \alpha_i^*).\phi(x_i) \qquad\qquad (3.1)$$

And $\sum_{i=1}^{l}(\alpha_i - \alpha_i^*) = 0, \quad 0 \le \alpha_i \le C, \ 0 \le \alpha_i^* \le C, \ i = 1, \ldots\ldots, l$

The dual problem is obtained by introducing (3.1) in (3) and it is expressed as:

$$\text{maximize } -\frac{1}{2}\sum_{i,j=1}^{l}(\alpha_i - \alpha_i^*).(\alpha_j - \alpha_j^*).K(x, x_i) + \sum_{i=1}^{l}(\alpha_i - \alpha_i^*).y_i - \sum_{i=1}^{l}(\alpha_i - \alpha_i^*).\varepsilon \qquad (4)$$

Subject to constraints:

$$\sum_{i=1}^{l}(\alpha_i - \alpha_i^*) = 0, \ 0 \le \alpha_i \le C, \ 0 \le \alpha_i^* \le C, \ i = 1, \ldots\ldots, l$$

Finally, the nonlinear function is obtained as:

$$f(x) = \sum_{i=1}^{l}(\alpha_i - \alpha_i^*)K(x, x_i) + b \qquad\qquad (5)$$

Where $K(x_i, x_j) = \langle \phi(x_i), \phi(x_j)\rangle$ is defined as the kernel function. The elegance of using the kernel function is that one can deal with feature spaces of arbitrary dimensionality without having to compute the map Φ. Any function that satisfies Mercer's condition can be used as the kernel function.

SVM simulation for default risk prediction

SVM is a new technique used for regression and classification data, but its efficiency depends in practice on an optimal selection of hyper-parameters. This hyper-parameter estimation is often called the model selection problem [16].

If it is applied to a large data set, however, it requires a long time for training so its performance can be degraded a long time. To speed up training thereby shortening the time

for model selection, several methods have been proposed, one of which is to reduce the training set size. That is why we perform our model selection for SVM on the training data selected that is involved on the 4 factors as mentioned above.

To obtain a good performance, we have carefully chosen some parameters that include the regularization parameter C, which determines the trade-off between minimizing the training error and minimizing model complexity, and parameters of the Kernel function.

In this simulation we test the classification using the kernel function RBF so two parameters need to be chosen; they are the γ width of the RBF function and the soft margin parameter C of SVM.

One method often used to select the parameters is grid search on the log ratio of the parameters associated with cross-validation. Value pairs (C, γ), respectively was assessed using cross-validation and then we have chosen the pair with highest precision: (C, γ) = (100, 0.1).

According to the architecture of the support vector machine, only the training data near the boundaries are necessary. In addition, because the training time becomes longer as the number of training data increases, the training time is shortened if the data far from the boundary are deleted. Therefore, we have implemented a leave one out method in order to use a single observation from the original sample as the validation data, and the remaining observations as the training data. Then we have applied our SVM model over the training set on a new sample of 20 Moroccan companies whose financial data is selected over (2009-2010), with the purpose to measure the precision of creditworthiness risk prediction as compared to the actual data of 2011 as follows.

Figure 1. Solvency risk prediction.
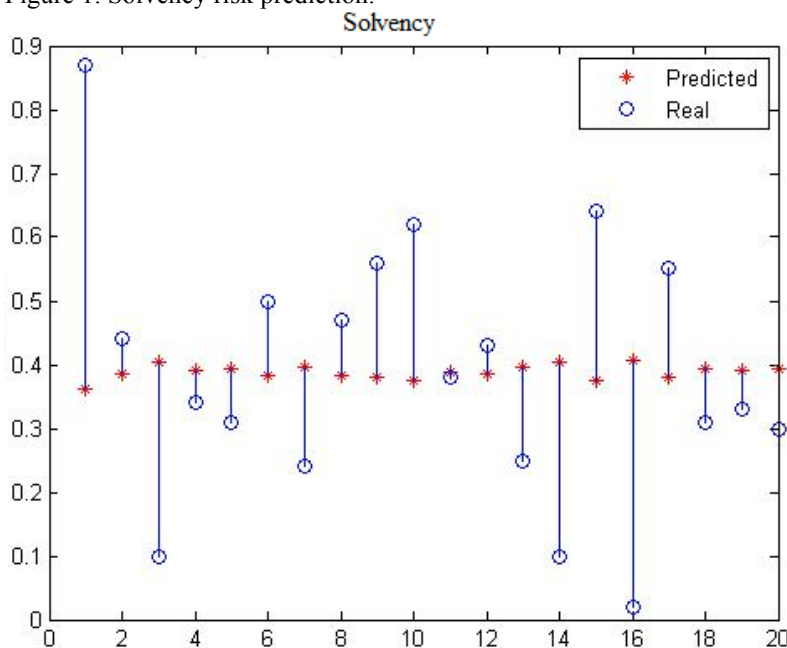
The aim is to approximate the prediction performance based on the knowledge of the training set, as proved by the results above; the fact that the precision of the creditworthiness risk prediction is about 80% with an error range [0.01, 0.1], means that the model has a good measuring effect even the lack of sufficient historical and training data.

Conclusion and suggestion

This study has selected a sample of financial data of 20 companies between 2009 and 2011 to measure the impact of interest loans on the firm's solvency. We have used a linear regression model in order to build our Support Vector Machine (SVM) Model that includes four relevant factors used as input factors to forecast the Creditworthiness risk of a company.

The simulation results show that if policymakers want to improve firms' solvency and eliminate recurring financial crises, they must discourage excessive borrowing, interest loans, and risk-shifting, and instead encourage risk-sharing and free interest loans. Islamic finance offers a system that prohibits all interest loans, and therefore if properly applied, it can lead to a significant reduction in debt financing in favour of risk-sharing-- thus providing a tool to reduce, if not entirely eliminate, financial crises. Therefore, the current financial and economic crisis may ironically give a boost to Islamic banking, and hence open doors wide open for further expansion in the finance industry.

In this regard, financial scholars and economists in the Muslim world should cooperate in partnership with all organizations and governments to make a plan to solve the late economic crisis and to present a solution based on Islamic principles.

We believe that this research discarded a number of indicators which present difficulties in acquisition or differences in the method of calculation. For example, besides the information that companies are required to disclose through financial statements, other types of information such as Islamic financial statements, corporate case studies of Islamic bank loans, the financial data of securities market prices of publicly-traded corporations…, all will have a certain degree of precision constraints for measuring interest impact and solvency risk which will require further improvements.

References

[1] Siddiqi, M. N. (1983a). Banking without Interest (Islamic Foundation, Leicester).

[2] Micaela, R., and K. Womack. (1999). "Conflict of Interest and the Credibility of Underwriter Analyst Recommendations," Review of Financial Studies, 12(4).

[3] Agaoglu, E. (1994). "A CAMEL-wise Comparative Financial and Market Share Analysis of the Islamic Banks Currently Operating in Turkey," Middle East Technical University Studies in Development, 21(4).

[4] Basel Committee on Banking Supervision, Working Paper No. 13, Bank Failures in Mature Economies (April 2004), Bank for International Settlements: 1-5.

[5] Basel Committee on Banking Supervision, Basel III International framework for liquidity risk measurement, standard and monitoring (December 2010), Bank for International Settlements: 3-38

[6] Crosbie.P, Bohn.J, Modeling Default Risk, Modeling Methodology, 2003 Moody's KMV Company: 10-30.

[7] Bartholomew D. (1984): The Foundation of Factor Analysis, Biometrika 71: 221-32.

[8] Marcelo N. Kapp, Robert Sabourin, Patrick Maupin, A PSO-Based Framework for Dynamic SVM Model Selection, GECCO'09, Montréal Québec, Canada, 2009.

[9] Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, Second Edition: 215-330.

[10] Aggarwal, R., and T. Yousef. (2000). "Islamic Banks and Investment Financing," Journal of Money, Credit and Banking, 32(1).

[11] Al-Deehani T., R. A. Abdelkarim, and V. Murinde. (1999). "The Capital Structure of Islamic Banks under the Contractual Obligation of Profit Sharing," International Journal of Theoretical and Applied Finance, 2(3).

[12] Culp, Christopher and Miller, Merton, Risk Management Lessons from Metallgesellschaft, Journal of Applied Corporate Finance, 1994.

Kolman, Joe, 1999, LTCM Speaks, Derivatives Strategy (April): 12-17

[13] Pacelle, Mitchell, Randall Smith, and Anita Raghavan, 1999, Investors May See LTCM, the Sequel, Wall Steet Journal (May 20): C1.

[14] Allen, F., A. Babus, and E. Carletti (2009), Financial Crises: Theory and Evidence, Annual review of Financial Economics 1, forthcoming.

[15] Grahman, John R. and Campbell R Harvey. The Theory and Practice of Corporate Finance: Evidence from the Field, Journal of Financial Economics, 60 2001:187-243.

[16] Nonliear Prediction of Chaotic Times Series Using Support Vector Machines, Sayan Mukherjee, Edgar Osunam, Federico Girosi,
Proceedings of the IEEE, NNSP'97, Sep 1997.