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# Proposing a Multidimensional Bankruptcy Prediction Model: An Approach for Sustainable Islamic Banking

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Received: 30 January 2020; Accepted: 27 February 2020; Published: 16 April 2020



**Abstract:** The main purpose of this study is to conceptualize a sustainable banking model for Islamic banking by blending three essential business aspects namely financial performance, Islamic corporate governance, and sustainability practices dimension. In the case of Islamic banking, evidence shows that a Shariah-based bankruptcy prediction model for apprehending the true bankruptcy prediction is over-sighted. This study offers an efficient Shariah-based bankruptcy prediction model by first, reviewing the previously applied conventional bankruptcy prediction models; secondly, by developing and proposing a robust, multidimensional model for predicting bankruptcy in Islamic banking. This framework may have profound implications on the existing bankruptcy evaluation structure of the Islamic banking industry and may provide a strong sustainability management guideline to the global Islamic banking industry.

**Keywords:** bankruptcy prediction; financial performance; Islamic banking; sustainability; Shariah governance

## 1. Introduction

The Islamic banking system is relatively new in the banking industry and it is still at the growing stage. Significant efforts are required for sustainability [1]. According to the Islamic Financial Services industry report 2018, Islamic banking assets retain around 76 percent share in the global Islamic financial assets. In case of any deterioration, it will affect the entire Islamic financial industry. For this purpose, the financial position of Islamic banks must be understood, therefore there is a need to understand the details of the financial attributes of Islamic banking as this may lead to financial distress. The prediction techniques used for the banking sector were developed 5 decades ago notably by [2,3]. These models contain only the financial attributes which support only the financial aspect of the firms [4]. In opposition, currently, the organizations are operating in a more complex era, where they are not only required to grow financially but also operationally and socially as well [5].

Different rating agencies also determine the rating for companies based on a combination of ratio analysis, qualitative factors, strategic decisions, and management plans, industry health. Nowadays financialists and consultants preferably utilize the blended models of financial and non-financial attributes such as considering sustainability as well instead of the more traditional models. Secondly, the traditional models used for bankruptcy prediction of banks were originally designed for manufacturing firms and were later on applied to the conventional banks with minor modifications. The same models are now used for bankruptcy prediction in Islamic banks as well.

However, Islamic banks have some specific Shariah attributes that are different from conventional banks [5]. For this purpose, there is a dire need to develop a robust model that has a combination of multiple dimensions such as financial and non-financial (Shariah governance and social attributes).

The primary reason for the development of a separate Islamic based bankruptcy forecasting model lies in the deteriorations of the key performance indicators of the Islamic banking share. It is because evidence shows that the banking sector grasps a significant share in the world financial system. In case of any financial deterioration in the banking industry, the overall world financial sector will suffer. The facts show that the main key performance financial indicators of the global Islamic banking industry are deteriorating. Table 1 is providing a snapshot of the deterioration in the major financial indicators of the global Islamic banking industry.

**Table 1.** Deterioration of Financial indicators of the global Islamic banking industry.

Financial Indicators	Year 2013	Year 2018	Change
Capital adequacy ratio *	18.2	12.3	−5.9
Tier 1 ratio *	16.2	10.7	−5.5
Nonperforming financing to total Financing	6.0	4.9	−1.1
Return on assets	2.2	3.2	+1.0

Source: Islamic Financial Services Industry Stability Report (2019). \* These Ratios are calculated differently in different countries based on the prevailing regulatory purposes.

Table 1 demonstrates the financial indicators of the Global Islamic banking industry. Capital Adequacy Ratio (CAR) and Tier 1 are considered important measures to check the position of the regulatory capital of banks. These ratios were recorded as 18.2 and 16.2 in 2013, which are decreased to 12.3 and 10.7 respectively. The main reason for this decline is the currency depreciation in Iran against the US dollar which caused a dramatic fall in the overall operational efficiency of all financial institutions in the country. Sudan faced the same depreciation during this time and affected the global Islamic banking performance. Asset quality is mostly measured through non-performing financing divided by total financing. This ratio indicates the efficiency of a bank to manage its finances. A decline of 1.1 is recorded from 2013 to 2018 but the ratio of 4.9 is still alarming and may affect the efficiency and overall rating of Islamic banking in the industry. Table 1 shows an increase in Return on Assets ROA from 2.2 to 3.2, but the increase is just marginally better which can be a hurdle in the long-term financial sustainability of the Islamic banking industry. Broadly, it alludes that, if these financial indicators are not monitored properly, it will disturb the economic sustainability of the Islamic banking industry across the world. Moreover, the top five Islamic banking countries collectively retain around 72 percent share of the global Islamic banking share (Islamic Financial Services Industry Stability Report 2019). Any deterioration in the financial indicators of these top countries may eventually affect the world Islamic banking share. Table 1 shows that the major financial indicators of the Islamic banking sector are deteriorating, against this background, the main objective of this study is to propose a bankruptcy prediction model for Islamic banks. Secondly, this study pioneered the concept of incorporating Islamic corporate governance and sustainability variables in the subjected bankruptcy prediction model. It is because the evidence supports a positive association of these variables on bankruptcy prediction [6,7]. The proposed bankruptcy prediction framework will assure the strong economic sustainability of the Islamic banks in the market-leading Islamic banking countries which accounts for almost 80 percent of the world Islamic banking assets [8]. The surveillance in a way will ensure the strong economic sustainability of the economies where the Islamic banking share is significant in the overall banking industry share of the subjected countries. Hence, achieving the objective of this study will assure sustainable Islamic banking in the market-leading Islamic banking countries.

### *Role of the Banking Industry in the Financial System*

The financial system is considered as the backbone of any economy. It is the only systematic source of financial intermediation and facilitates the funds' circulation between the borrowers, the lenders, and investors. Therefore financial institutions play a vital role in the economic growth and development of the economy [9]. For the growth and expansion of economies, the growth of financial institutions especially the banking industry is vital. It assists the sustainable economic growth and reduces the bankruptcy risks inside the economies. To achieve this, the banking industries are required to present a clear short-term objective and long-term goals.

The banking industry is broadly responsible for financial distress due to its important intermediating role in the economy. The issue of bankruptcy forecasting came into the spotlight after the 2007–2008 financial crises [10]. Banks are required to forecast their financial status by using different prediction models and to make future plans accordingly. They can use the prediction models not only to check their own bank-level sustainability but industry level and even the overall economy as well. By doing so, the banks can foresee whether they are standing in the market, domestically and globally or not [11]? In competitive financial environments, the health of a bank is measured by its financial capacity and standing power, the ability to create cash from its running operations, its flexibility towards the financial shocks and its access to the financial markets. As a bank loses the ability to achieve the above attributes, it moves toward insolvency [12]. The regulatory authorities are required to monitor and control the financial activities of certain industries like the banking sector [13].

The failure of banks affects not only the industry but the households, government, and other stakeholders even the whole economy is directly linked and affected by the banks. One of the main aims of the central bank is to encourage an efficient financial system through the regulation and supervision of financial institutions. Some early warning systems (EWM) are used by the central banks to keep an eye on the financial position and risk of the banks [14]. However, considering the repeated bank's failures in the last two decades provides evidence that maintaining sustainability is "hard to do" and the most important task [15]. Regulatory authorities use different internal and external measures to monitor the ups and downs of the banking industry. The widely used method for monitoring is CAMELS ratings. CAMELS is used as the best monitoring method to predict bankruptcy [12]. In the case of Islamic banking, another widely used external measure is the FSB (Financial Stability Board). FSB provides surveillance to all organizations including banks and monitors their financial performance.

## **2. Literature Review**

The banking industry is considered as a pulse of any economy and it contributes towards the economic growth and financial stability of the country significantly. Hence, monitoring its sustainability is almost as mandatory for the smooth financial operations of the economies. According to IFSB 2018, the Islamic banking industry is experiencing more complex insolvency systems as compared to their conventional rivals. The main reason for the fact is that Islamic banks have practical Shariah regulations and a specified industry different from the conventional banking sector. There are very few specific bankruptcy laws and regulatory authorities normally apply the same laws to conventional and Islamic banks.

### 2.1. The Emergence of Islamic Banking

According to Bank Negara Malaysia Annual report (2017), more than 75 countries are dealing with Islamic finance by running over 300 Islamic financial institutions. Details about the market-leading Islamic banking countries are presented in Table 2 below.

**Table 2.** Share percentage of Islamic banks globally and nationally (2018).

Countries	Global Islamic Banking Share % (Out of Total Banking Assets)	Domestic Islamic Banking Share % (Out of Total Banking Assets)
Iran	32.2	100.0
Saudi Arabia	20.2	51.5
Malaysia	10.8	26.5
UAE	9.8	20.6
Kuwait	6.3	40.6
Qatar	6.2	25.2
Turkey	2.6	5.5
Bangladesh	1.9	20.1
Indonesia	1.9	5.7
Pakistan	1.3	12.9
Sudan	0.7	100
Bahrain	0.7	14.3
Others	5.5	—

Source: Islamic Financial Services Industry Report (2019).

Table 2 shows the share of the top 10 leading Islamic banking countries ranked by global banking assets. For example, the top tier economies in Islamic banking are Iran, Saudi Arabia, Malaysia, and UAE respectively. Iran stands as the market leader in the global Islamic banking by retaining a 34 percent share in the global Islamic banking assets. Iran is followed by Saudi Arabia, Malaysia, UAE, and Kuwait having a share of 20.2 percent, 10.8 percent, 9.8 percent, and 6.3 percent respectively. Qatar, Turkey, Bangladesh, Indonesia, and Bahrain are the second tier significantly contributing countries in Islamic banking assets globally. The above 12 countries collectively account for 94.5 percent share in the global Islamic banking assets. The rest 5.5 percent share is held by the other countries. The largest shareholders are Iran, Saudi Arabia, Malaysia, UAE, Kuwait, and Qatar. In North and Sub-Saharan Africa, many countries are stepping to introduce Islamic banking in their banking industries which will boost up the current global Islamic banking assets in the future (IFSB, 2018).

### 2.2. Bankruptcy Forecasting

Banks and other firms use different techniques to predict bankruptcy. Kumar and Ravi [12] classified these techniques broadly into two categories, (I) statistical techniques and (II) intelligent techniques. The prior includes used univariate analysis, multiple discriminant analysis (MDA), factor analysis, and Logit regression. The second group consisting of neural networks, self-organizing maps, decision trees, operational research techniques like data envelopment analysis (DEA), and linear programming. Literature is augmented with the use and continuous improvement of the above models for finding the bankruptcy of firms. Beaver [3] presented a pioneering study by conducting financial ratios analysis using a univariate model. Later on, [2] applied multiple discriminant analysis MDA and shortlisted liquidity, profitability, solvency, and leverage ratios as the top predictors for bankruptcy forecasting. Ohlson [16] used logistic regression on multiple ratios and found that multiple ratios have the predictive power of bankruptcy using logistic regression. Altman [17] reinvented the earlier Z -core as the ZETA model, while the Hazard model was developed by [18] using the same ratios used by [2]. The above examples support that there are many detection models for the bankruptcy of conventional banks. On the other hand, very limited studies conducted on the detection of bankruptcy for Islamic banks [19].

### 2.3. History of Famous Bankruptcy Forecasting Models

Many bankruptcy detection models have been developed to forecast the bankruptcy of financial and non-financial firms. Beaver [3] pioneered the scope of bankruptcy by developing a univariate analysis with financial ratios. Although Beaver's model was panned by reason of its univariate nature i.e., a single variable could be studied at a time for bankruptcy prediction. Beaver's model was then revised by [2], their study introduced four additional important variables into it. This was the first-ever use of multiple discriminant analysis (MDA) for bankruptcy prediction, the study classified the sample into bankrupt and non-bankrupt groups. The model got great fame because of its accuracy and simplicity i.e., 94 percent accuracy in predicting bankruptcy. Moreover, the model was only developed for public manufacturing firms. Deakin [20] took the same variables which were used by [3], but their study conceptualized a multivariate perspective to achieve higher accuracy and got expected results [21]. Altman et al. [22] introduced a new "Zeta model" for bankruptcy prediction. The researchers used seven important financial ratios in the model on a set of fifty-three failed and fifty-eight non-bankrupt firms. The new Zeta model showed more than 95 percent accuracy overall. Moreover, the Z-score model of [2] and the Zeta model of [22] were also criticized for their limited application in the manufacturing industry only.

Springate [23] developed a bankruptcy evaluation model using multiple discriminant analysis (MDA) techniques famously known as the Springate model. The Springate model was more or less the same as that of the initial model of [2]. However, the cut-off points for the Springate model were difficult from that of Altman's. This model could divide the firm performance into two zones, bankrupt and non-bankrupt. While Altman's model could divide the bank's performance into three zones i.e., bankrupt, non-bankrupt, and safe zone. Ohlson [16] attempted to overcome the confines of the [2,3] and that of [22] by presenting the Logit regression model for bankruptcy prediction. Moreover, Ohlson analyzed the model by considering a sample of 105 insolvent and 2058 sustainable firms. Altman [24], revised the initial bankruptcy model of Altman 1968 by introducing private companies to the prediction model. By doing this, Altman increased the scope of the earlier bankruptcy model from public firms to private firms as well. In this new model, Altman changed the market value of equity to book value of equity, because the market value of private firms is not reliable [11]. Izan [25] carried out pioneering work for developing a bankruptcy model in Australia. The study took ten financial ratios from the Sydney stock exchange. The model was designed in such a way that it can be applied to many sectors. In the University of Quebec Montreal under the supervisor of Jean Legault in the year, 1987 developed a bankruptcy prediction model using MDA techniques. A sample of 173 manufacturing businesses was taken for the purpose. Aziz, et al. [26], developed a cash flow bankruptcy model, which was famously called the CFBM model. The study compared the model with previous models like that of the Zeta model by Altman et.al and reported that the CFBM model had higher accuracy in reporting financial distress 3-5 five years prior to actual bankruptcy. In general, the higher CFBM score means worse performance and vice versa. Some of the above-discussed models were applied in the banking industries over the period. The above-mentioned bankruptcy prediction models designed for conventional banks are applied to the Islamic banking market with minor modifications. Nonetheless, the Islamic banking system has some specific attributes other than conventional banks. These attributes are called Shariah Compliant principles [6]. Against that background, there is a need for a separate and specifically designed model for the Islamic banking industry [5]. Anwar and Ali [27] stated that the best effort is essential to resolve the falling financial condition of Islamic banks. Bankruptcy is not only a step to systematic and financial risk but it is a threat to the reputation of Islamic banking law. Jan, et al. [7] alluded that developing a bankruptcy prediction model using the key performance indicators blended with latest techniques is much needed for Islamic banking. Table 3 shows summary of the studies that applied the famous bankruptcy forecasting model on the banking industry. Details are shown below.

**Table 3.** Studies on bankruptcy forecasting models from the banking industry.

Author/Year	Objective	Variables	Method	Sample	Findings
Martin [28]	Bankruptcy prediction of banks	Asset risk, liquidity, capital adequacy, and earnings	Ratios analysis, Logistic regression, Discriminant analysis	1974 included 23 subsequently failed banks	Found the accuracies of the models almost similar but suggested discriminant analysis better for bankruptcy prediction
Doukas [29]	Comparison of Altman and Springate models	Working capital, EBIT, Sales, Total assets, Total equity, EBT, retained earnings, Total debt, Current liabilities	MDA, Altman, and Springate	25 Canadian chartered banks, counting five large banks, five more indigenous banks, and some foreign-controlled banks	Both Springate and Altman models are not the best predictors as the results gave low prediction accuracy
Čihák and Hesse [30]	Comparative analysis of bankruptcy in Islamic and conventional banks	Loans/Assets, Cost/income ratio, Income diversity, Assets in billion USD	Altman Z-score	77 Islamic banks 397 commercial banks 1993–2004	The results of Z-score supports the stability of Islamic banks more than the conventional ones
Hanif, et al. [9]	Performance comparison of Islamic and conventional banks	Profitability, liquidity, credit, risk, and solvency	Bank-o-meter	5 Islamic banks 22 conventional banks 2005–2009	Performance of Islamic banking is better than the conventional one which shows the reliability of the Islamic Banking sector in Pakistan
Husna and Rahman [19]	Bankruptcy prediction of Islamic and conventional banks	Multiple accounting ratios	Logit regression	Malaysia	Islamic banks are more liquid and less risky than conventional banks, but they have to monitor their performance regularly
Bourkhis and Nabi [31]	To check the consequence of the financial crisis on Islamic and conventional banks	Capital adequacy, Profitability, Asset quality, Earnings and, efficiency	Nonparametric analysis, parametric analysis (MDA)	34 Islamic banks and 34 conventional Banks taken from 16 countries	Soundness found similar in Islamic and conventional banks during financial crises
Jan and Marimuthu [32]	Bankruptcy forecasting from the top five Islamic banking countries	WC/TA, retained earnings/total assets, EBIT/TA, BV of Equity/BV of Total Liabilities	ANOVA and Altman Z score	Sample of 25 Islamic banks from the leading five Islamic banking countries	The difference in performance indicators is the basic reason for the difference in bankruptcy level
Jan and Marimuthu [5]	Bankruptcy forecasting from the five leading Islamic banking states	Profitability, liquidity, insolvency, productivity	ANOVA and Regression	25 banks From Iran Saudi Arabia, UAE, Malaysia, and Kuwait	Banking activities are linked with the success of the financial system. economic sustainability of Islamic banking industry can be efficiently measured by the Altman model developed for the services industry
Jan and Marimuthu [8]	Bankruptcy forecasting from the five leading Islamic banking states	Liquidity, profitability, productivity, solvency ratios	Altman Z score, MDA	Top 5 Islamic banking countries	Saudi Arabian Islamic banks are highly sustainable while Malaysian Islamic banks have the lowest sustainability

Table 3. Cont.

Author/Year	Objective	Variables	Method	Sample	Findings
Jan and Marimuthu [33]	Bankruptcy forecasting for the foreign and domestic Islamic banks in Malaysia	WC/TA, retained earnings/total assets, EBIT/TA, BV of Equity/BV of Total Liabilities	ANOVA and Altman Z score	Foreign and domestic Islamic banks in Malaysia (2009–2013)	Domestic Islamic banks in Malaysia are more at risk while foreign Islamic banks in the country are sustainable overall
Laila and Widihadnanto [34]	Bankruptcy prediction between Islamic and Conventional	Capital to Asset Ratio, Capital Adequacy Ratio, Cost to Income Ratio, Loans to Asset Ratio, Equity to Asset Ratio, Non-Performing Loan Ratio	Bank-o meter S-score	4 full-fledged Islamic banks and 10 conventional banks in Indonesia 2011–2014	No significant difference found in financial distress prediction between Islamic banks and conventional banks.
Halteh, et al. [35]	Comparison between different bankruptcy prediction models with some new variables	(TA), ROE, ROA, Operating income/TA, WC/TA, RE/TA, EBIT, MVE/TL, Revenue/TA, Debt ratio, Current ratio, ROR, Asset turnover, Efficiency ratio, TE/TA, Equity ratio, Total debt/Total equity	Altman Z-Score, and the Standardized Profits	A sample comprising 101 foreign Islamic banks	The used variables are important indicators for predicting bankruptcy accurately
Anwar and Ali [27]	Predicting bankruptcy using a nonparametric technique	Different financial ratios	Artificial Neural Networks	22 Islamic windows and 12 full-fledged Islamic Banks in Indonesia	Artificial Neural Network is suitable for bankruptcy prediction in Indonesian Islamic banks
Affes and Hentati-Kaffel [36]	To model the relationship between ratios and bankruptcy in US banks	Capital Adequacy Liquidity Earnings ability Asset quality	Classification and regression trees (CART) and multivariate adaptive regression splines (MARS)	410 non-active and 1205 active US banks 2008–2013	The nonparametric model gives more accuracy in terms of bankruptcy prediction of US banks
Jan, et al. [14]	Bankruptcy prediction of Islamic and conventional banks in Malaysia	Liquidity, profitability, productivity, solvency ratios	MDA	14 conventional and 14 Islamic banks in Malaysia 2008–2013	Islamic banks are more towards bankruptcy as compared to conventional banks. Profitability is the best measure for bankruptcy prediction.

Table 3 shows the history of famous bankruptcy prediction models from the banking industry in general. Broadly it shows that the extensive bankruptcy forecasting work is carried out on the conventional banking industry with limited studies on the Islamic banking industry. Secondly, it shows that most of the models were developed based on financial ratios. Hence, the literature left a gap to develop bankruptcy forecasting models for the Islamic banks with a more diverse combination of financial ratios and non-financial indicators such as governance and corporate sustainability variables. The subsequent section shows the theoretical review and proposition of this study. It shows the theoretical link of the independent variables with the dependent variable (bankruptcy) in association with different theories. The subsequent section also explains the link of the newly proposed variables (corporate governance and corporate sustainability), which this study is using in the proposed dynamic bankruptcy prediction model for sustainable Islamic banking.

#### 2.4. Theoretical Framework and Proposition Development

The following section shows the theoretical link between the independent and dependent variables in the context of different theories. The model of this study is based on three strands of variables that is financial ratios, corporate governance, and corporate sustainability. Details about each strand in the context of theories are elaborated below. The next sections show the list of journals from which articles were selected for each strand of variables. The articles from these journals were selected on the base of their relevance with the current study i.e., bankruptcy forecasting.

Table 4 shows a list of those journals from which articles were selected for developing a new bankruptcy forecasting model. Overall it shows that the majority of the journals are impact factor journals. The articles related to bankruptcy forecasting were selected starting from 1968 until 2019. It is because the pioneer work on bankruptcy was started in 1968. Over the period, those studies were selected which were relevant to this current study i.e., related to bankruptcy prediction. The subsequent section shows the shortlisting of variables for each strand.

**Table 4.** List of journals selected for each strand of variables.

SN	Journal Name	Rank	No. of Papers Selected from Each Journal
01	Journal of Banking & Finance	Q1/IF 2.2	7
02	International Journal of Islamic and Middle Eastern Finance and Management	Q4/IF 0.75	2
03	Journal of Finance	Q1/IF 6.20	1
04	Journal of Accounting Research	Q1/IF 4.89	3
05	Journal of Credit Risk	Q4/IF 0.41	1
06	Journal of Business Ethics	Q1/IF 3.79	3
07	Journal of Cleaner Production	Q1/IF 6.39	1
08	Managerial Auditing Journal	Q4/IF 1.06	1
09	African Journal of Business Management	Q3/IF 1.10	1
10	Sustainability	Q2/IF 2.59	1
11	International Research Journal of Finance & Economics	Scopus/Q4	1
12	International Journal of Business and Management	ERA	3
13	Economic Change and Restructuring	ISI/ESCI	1
14	Omega	Q1/IF 5.34	1
15	Journal of Management Studies,	Q1/IF 5.83	1
16	Applied economics	Q3/IF 0.96	1
17	Journal of Financial Services Research	Q2/IF 1.66	2
18	Review of Financial Economics	Q1/IF 2.26	1
19	International Journal of Economics & Management	Scopus/Q3	1
20	Managerial Finance	Scopus/Q3	1
21	Annals of Operations Research,	Q2/IF 2.28	1
22	Journal of Accounting, Auditing & Finance	ISI/ESCI	1
23	The Quarterly Review of Economics and Finance	Q4/IF 0.10	1
24	Economic Systems	Q2/IF 1.32	1
25	Journal of Economics and Behavioral Studies	ProQuest	1
26	Journal of Behavioral Finance	Q3/IF 0.77	1
27	Journal of Accounting Research	Q1/IF 4.89	1
28	Academy of Management journal 2	Q1/IF 7.19	2
29	Journal of General Management	ISI/ESCI	1
30	Journal of Financial Economics	Q1/IF 4.6	3
31	Asian Social Science	Scopus/Q3	1
32	Corporate Governance the International Journal of Business in Society	ISI/ESCI	1
33	International Business & Economics Research	ProQuest	1
34	Journal of Financial Reporting and Accounting	ISI/ESCI	1
35	Journal of Islamic Accounting and Business Research	ISI/ESCI	1
36	Global Business & Management Research	ERA	1
37	International Journal of Economics and Finance	ERA	2
38	The journal of business	Jstor	1
39	International Journal of Trade, Economics and Finance	ProQuest	1

### 2.4.1. Nexus of Financial Ratios and Bankruptcy Forecasting: In the Context of the Financial Ratios Theory

In order to choose the top financial ratios used for predicting bankruptcy, the subsequent section is showing the frequency distribution of the top 6 ratios that were used for predicting bankruptcy.

Table 5 shows the frequency distribution of famous ratios that were used for measuring bankruptcy forecasting in the Islamic banking industry. The frequency distribution shows that the top tier ratios used in the past for predicting bankruptcy in the Islamic banks are as follow subsequently. Liquidity ratio with 78 percent, profitability ratio with 67 percent, solvency ratio with 63 percent, productivity ratio with 44 percent, asset quality with 37 percent and capital adequacy ratio was used by 26 percent studies. In line with that, this study selected those variables in which frequency distribution was above 25 percent.

**Table 5.** Top ratios used for bankruptcy forecasting.

Liquidity	Profitability	Solvency	Productivity	Asset Quality	Capital Adequacy
		Ohlson [16] Doukas [29] Altman [17]		Martin [28] Čihák and Hesse [30]	Martin [28]
Martin [28] Ohlson [16] Doukas [29] Altman [17]	Ohlson [16] Doukas [29] Altman [17] Hanif, et al. [9] Darrat, et al. [37]	Čihák and Hesse [30] Darrat, et al. [37] Bourkhis and Nabi [31] Jan and Marimuthu [8] Marimuthu [8] Jan and Marimuthu [8] Mollah and Zaman [39] Jan and Marimuthu [32] Jan and Marimuthu [33] Halteh, et al. [35] Affes and Hentati-Kaffel [36] Alqahtani and Mayes [40] Lassoued [38] Ogechukwu and John [41] Gandhi, et al. [42] Jan, et al. [14]		Hanif, et al. [9] Husna and Rahman [19] Bourkhis and Nabi [31] Nabi [31] Laila and Widihadnanto [34] Halteh, et al. [35] Affes and Hentati-Kaffel [36] Alqahtani and Mayes [40] Lassoued [38] Ogechukwu and John [41]	Husna and Rahman [19] Bourkhis and Nabi [31] Mollah and Zaman [39] Laila and Widihadnanto [34] Halteh, et al. [35] Affes and Hentati-Kaffel [36] Alqahtani and Mayes [40] Lassoued [38] Gandhi, et al. [42]
78 percent	67 percent	63 percent	44 percent	37 percent	26 percent

The author [43] presented the theory of financial ratios as predictors of defaults. This theory states that financial ratios are the best predictors of the firms' financial position. Firms' financial condition can be best identified by looking at the changes in the financial statements. As ratios are derived from the financial statements and are being used to predict the firms' financial position from the pioneering study in the 1960s [3] till present. Financial ratios give a signal to the management of the firm about deteriorations in the firms' financial position [44]. Hence, ratios are the best predictors of financial distress of any firm. This study is consistent with the theory of financial ratios for the first strand of variables that is financial ratios. Moreover, as [2] was the foremost scholar which used ratios in multiple discriminant analyses for predicting bankruptcy and proved that ratios are the best predictors. Hence, the following proposition is developed.

**Hypothesis 1 (H1).** *There is a significant association between financial ratios and bankruptcy prediction.*

#### 2.4.2. Nexus of Corporate Governance and Bankruptcy Forecasting: In the Context of the Agency Theory

Table 6 shows the frequency distribution of corporate governance variables used in Islamic banking. It shows that the variable of board size was used in 80 percent studies, director's independence by 53 percent studies, CEO-duality by 60 percent studies, ownership structure by 40 percent studies, while SSB was used by 27 percent studies. Consistent with the selection criteria of this study only selected those variables in which frequency distribution was above 25 percent.

**Table 6.** Top governance variables used for bankruptcy forecasting.

Board Size	Director Independence/Composition	CEO-Duality	Ownership Structure	Shariah Supervisory Board (SSB)
Daily and Dalton [45]	Daily and Dalton [45]	Daily and Dalton [45]		
Lajili and Zéghal [46]	Lajili and Zéghal [46]	Lajili and Zéghal [46]		
Wintoki, et al. [47]	Wintoki, et al. [47]	Wintoki, et al. [47]	Zouari and Taktak [54]	
Fallatah and Dickins [48]	Li, et al. [49]	Fallatah and Dickins [48]	Jan, et al. [55]	Li, et al. [49]
Li, et al. [49]	Naushad and Malik [50]	Li, et al. [49]	Li, et al. [49]	Nawaz [52]
Naushad and Malik [50]	Mollah and Zaman [39]	Naushad and Malik [50]	Ogechukwu and John [41]	Jan, et al. [55]
Mollah and Zaman [39]	Bansal and Sharma [51]	Mollah and Zaman [39]	Jan, et al. [7]	
Bansal and Sharma [51]	Nawaz [52]	Bansal and Sharma [51]		
Nawaz [52]	Anginer, et al. [53]	Nawaz [52]		
Ogechukwu and John [41]	Ogechukwu and John [41]			
80 percent	53 percent	60 percent	40 percent	27 percent

The second class of variables taken in this study for bankruptcy forecasting deals with corporate governance mechanisms. Agency theory tends to address this issue. Agency theory explains the relationship between the principal and the agent working on behalf of the principle. The main focus of agency theory is to reduce agency costs raised due to the conflict of interest and potential goal between the shareholders and managers [56]. Agency theory highlights the monitoring and controlling role of the board of directors against management using external and internal governance mechanisms. Literature suggests that compared to healthy firms the financially distressed firms have shorter tenure of outside directors and higher director turnover [46]. The strong governance structure includes more effective monitoring which plugs in the loopholes and as a result, the firm performance is improved and subsequently, it reduces the chances of bankruptcy. This study is supported by agency theory for the second strand of variables that is corporate governance variables. Hence, it is alluding that corporate governance tools have a substantial positive influence on bankruptcy prediction. Against that background, the following proposition is developed.

**Hypothesis 2 (H2).** *There is a significant association between corporate governance and bankruptcy prediction.*

#### 2.4.3. Nexus of Sustainability and Bankruptcy Forecasting: In the Context of the Stakeholders' Theory

Table 7 shows the shortlisted sustainability items that were used in the Islamic banking context. This study first divided the items used in the indexes of the Islamic banks into broader themes. Then under each theme, those items were selected which were related to Islamic banking and Shariah principles specifically. The conventional sustainability items used in the previous indexes were ignored by this study. Then with the help of Maqasid-Al-Shariah theory, the items were segregated into the three dimensions of sustainability. A total of 13 Islamic banking sustainability items were shortlisted and then placed into the three dimensions of sustainability.

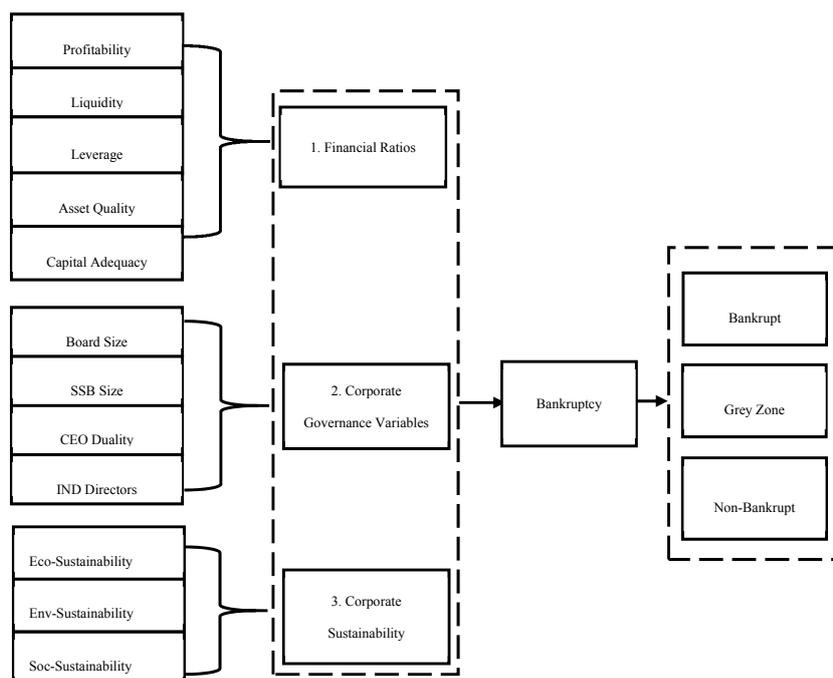
**Table 7.** Shortlisted sustainability items from the Islamic banking industry.

Economic	Environmental	Social
1. Sadaqah, charity, Qard-e-Hassan.	1. Funding to organizations that are not harming the environment	1. Islamic Training and Education to the Staff
2. Disclosure of Earnings Prohibited by Shariah	2. Amount of donation in environmental awareness	2. Offering Scholarships, Conducting Islamic conferences
3. Shariah Screening During the Investment	3. Introduction of green Products	3. Offering New Product and Services (Approved by the Shariah Committee)
4. Allocation of Profit Based on Shariah Principles		
5. Zakat Payment		
6. Charity/Sadaqah		
7. Qard-e-Hassan (benevolent funds)		
References		
Dusuki [57]	Dusuki [57]	Dusuki [57]
Othman and Thani [58]	Amran, et al. [60]	Aribi and Gao [59]
Aribi and Gao [59]	Maali, et al. [61]	Amran, et al. [60]
Amran, et al. [60]	Hassan and Harahap [62]	Maali, et al. [61]
Maali, et al. [61]		Hassan and Harahap [62]
Hassan and Harahap [62]		Rahman, et al. [63]
Rahman, et al. [63]		Aribi and Arun [65]
Farook, et al. [64]		Haniffa and Hudaib [66]
Aribi and Arun [65]		Platonova, et al. [67]
Haniffa and Hudaib [66]		
Platonova, et al. [67]		

Literature is enriched with the association of sustainability practices and firm performance. Sustainability is reported under three heads i.e., economic sustainability, environmental sustainability, and social sustainability. This group of variables is consistent with the stakeholders' theory as the theory suggests that the value of the firm increases when multiple stakeholders of the company are addressed and satisfied. The stakeholders of the company may include those individuals or groups which are affected by the actions of the company. Generally, it includes its employees, customers, creditors, suppliers, government, regulators, political groups, and public, etc. [68]. According to stakeholder theory, sustainability practices have a positive association with firm performance. Generally, it is assumed that firms with better firm performance are less bankrupt, and firms with inefficient financial performance have higher chances to go bankrupt. Against this background, and in the context of the stakeholders' theory, it is assumed that better sustainability practices will reduce the chances of bankruptcy. Hence, hypothetically sustainability practices are assumed to have a positive significant impact on bankruptcy prediction. Hence, the following proposition is developed.

**Hypothesis 3 (H3).** *There is a significant association between Islamic banks sustainability practices and bankruptcy forecasting.*

After the detailed theoretical review, the conceptual framework of this study is presented in Figure 1 below.



**Figure 1.** Conceptual framework of the study (Graphical Abstract).

#### 2.4.4. Conceptual Framework

Figure 1 shows the detailed conceptual framework of this study. Broadly it shows the association of three strands of independent variables with the dependent variable (bankruptcy forecasting). For the purpose, top financial ratios that were used by past studies for bankruptcy forecasting are selected under the strand of financial ratios. Similarly, the most appropriate ratios comprised of Islamic and conventional corporate governance mechanisms are selected under the strand of corporate governance. Finally, under the third strand of corporate sustainability, appropriate sustainability items were selected (refer to Tables 5–7). This study claims novelty by adding two new dimensions of (corporate governance and corporate sustainability) to be the part of a bankruptcy prediction model (see Sections 2.4.2 and 2.4.3) for bankruptcy forecasting this study is proposing insolvency ratio as a proxy for bankruptcy prediction. The fuzzy technique will split the value of the dependent variable (insolvency) into three zones i.e., bankrupt, grey, and the safe zone. It will illuminate the Islamic banks from different countries whether they are in the safe zone, grey zone, or the bankrupt zone. Hence, the proposed framework is equipped with the latest parameters and measures for predicting bankruptcy instead of the past bankruptcy forecasting models which only used financial ratios for predicting bankruptcy.

Consistent with the past studies of Jan, et al. [69] this study is using a weighted content analysis technique to measure corporate governance and corporate sustainability variables. The dependent variable of this study is bankruptcy. While the nature of the subjected dependent variable (bankruptcy) is of categorical nature i.e., either a bank can be bankrupt or non-bankrupt. In the first stage of the analysis, the solvency ratio will be used to investigate the overall financial health of Islamic banks. As the solvency ratio measures the ability to meet a firm's long-term liabilities, accordingly a higher ratio indicates a greater degree of financial risk, following by bankruptcy.

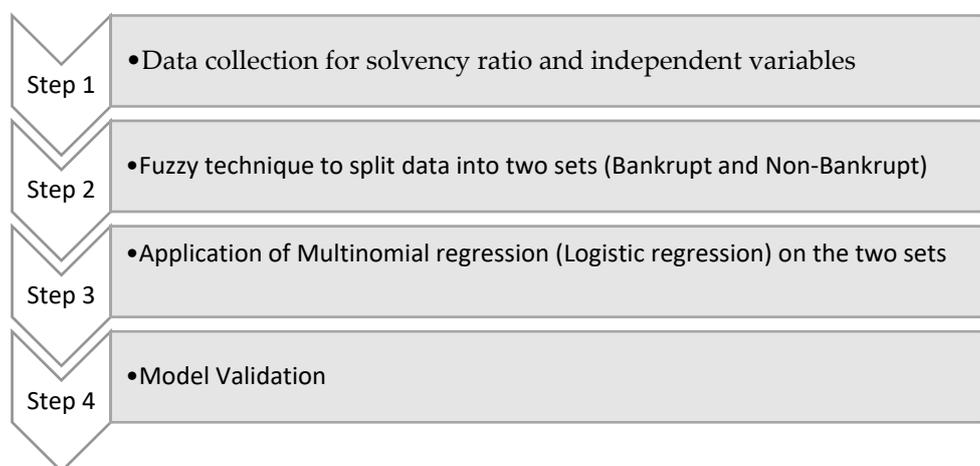
### 3. Methodology

#### 3.1. Population, Sampling, and Data Collection

The population of this study is the Islamic banking industry of the world. The sample of this study is the top five Islamic banking countries ranked by global banking assets. The top five Islamic banking countries ranked by global banking assets were identified from the Islamic Financial Services Industry Stability Report (2018). Five Islamic banks were selected from each country for the decade of (2009–2018) based on their total assets. Data using DataStream/Bloomberg database were cross-referenced with the annual reports of the Islamic banks operating in the top five Islamic banking countries ranked by global Islamic banking assets.

#### 3.2. Model Development

This study followed the following steps for model development. In the first stage, this study will collect a time series data for the insolvency ratio for the selected sample. In the second step, the fuzzy technique will be applied to the insolvency ratios to create two zones that are bankrupt and non-bankrupt. Against those two zones, multinomial Logit regression will be applied using financial ratios, corporate governance, and corporate sustainability as the independent variables. The dependent variable for Logit regression will be categorical variables of 0, 1, and 2. Whereas “0” denote bankrupt zone, “1” represents a grey zone, while “2” represents a non-bankrupt zone. In this case, the independent variables of financial ratios, corporate governance, and corporate sustainability will illuminate its role in assigning the zones of 0, 1, and 2 as discussed above. The flow chart of the proposed model is shown in Figure 2.



**Figure 2.** Flowchart of the proposed model.

The statistical representation of the model is shown below.

$$\text{Insolvency} = \alpha + \beta_1 \text{Prof } it + \beta_2 \text{Liq } it + \beta_3 \text{Lev } it + \beta_4 \text{AQ } it + \beta_5 \text{BS } it + \beta_6 \text{SSB } it + \beta_7 \text{IND } it + \beta_8 \text{Duality } it + \beta_9 \text{Eco-sus } it + \beta_{10} \text{Env-sus } it + \beta_{11} \text{Soc-sus } it + \epsilon t \quad (1)$$

where as,

Insolvency: Categorical variable for measuring bankruptcy

Prof = Profitability

Liq = Liquidity

Lev = Leverage

AQ = Assets Quality

BS = Board Size

SSB = Shariah Supervisory Board

IND = Independent Directors

Duality = CEO Duality

Eco-sus = Economic Sustainability

Env-sus = Environmental Sustainability

Soc-sus = Social Sustainability

The newly proposed dynamic bankruptcy forecasting model (see Equation (1)) is equipped with the latest parameters and measures for predicting bankruptcy instead of the past bankruptcy forecasting frameworks which only used financial ratios for predicting bankruptcy. Therefore, it is anticipated that the proposed model will depict the true default risks of Islamic banks. It is because the previous models were mostly developed in the production era, and during that time the focus of organizations mostly revolved around maximizing productivity and profitability. The current era follows the social system theory and because of that, the previous models are obsoleted. This social system theory assures sustainability attributes and efficient teamwork through compliant governance practices in the business model along with profitability.

#### 4. Conclusions

This study by proposing bankruptcy forecasting models for the Islamic banking industry will first help the five leading Islamic banking countries ranked by global banking assets to witness their true bankruptcy profile. Outcomes of this study will provide policy insights to the practitioners and policymakers of Islamic banks to achieve higher business sustainability by reducing the chances of bankruptcy through efficient bankruptcy estimations. It will eventually help the Islamic banks to expand internationally, which will holistically contribute towards the stability of the global financial system. Hence, the completion of this study has some serious implications on domestic as well as to the international financial system. Evidence shows that the banking industry holds a central position in the economic system. For the smooth continuation of the economic system, the proper working of its banking industries and strong surveillance models are required. In the case of Islamic banking, evidence shows that a Shariah-based bankruptcy forecasting model for apprehending the true bankruptcy position is over sighted. It can lead to a financial crisis in the countries where Islamic banking is in domination. Hence, an efficient Shariah-based bankruptcy prediction model may reduce this risk.

##### 4.1. Significance of the Study

- Theoretical Contribution

With the execution of this research, the contemporary subject of Islamic banks bankruptcy forecasting will enrich the present body of knowledge. This study added to the theory of financial ratios by using it as a base for incorporating Islamic financial ratios in a proposed bankruptcy prediction model. This study claims novelty by adding two new dimensions of (corporate governance and corporate sustainability) to be the part of bankruptcy prediction model in the case of Islamic banks, whereas the past models only used financial ratios for apprehending bankruptcy. In a way, this study illuminated and established the link for using the stakeholders' theory in the Islamic bankruptcy forecasting studies. Subsequently, by using agency theory this study established the link of Islamic corporate governance variables in evaluating bankruptcy.

- Methodological Contribution

This study by developing and proposing a new bankruptcy prediction model aided with the latest bankruptcy techniques i.e., incorporating new dimensions of corporate governance and corporate

sustainability will serve as a methodological base for future bankruptcy prediction models. Future studies by following the proposed steps can add new (governance and sustainability) variables into their bankruptcy prediction model, which will improve the precision level of their models.

- Practical Contribution Results of this study will support different matters in the following streaks
  1. It will help Islamic banks of the selected countries not only to forecast but to prevent their bankruptcy threats, and to maintain a strong sustainable Islamic banking sector industry.
  2. The bankruptcy forecasting model for Islamic banks will aid the smooth growing financial system in the selected region.
  3. This research will provide guidelines to managers and practitioners for surveillance of their subject areas and will support to keep strong economic sustainability.
  4. It will provide a ground to customers, depositors, investors, and other stakeholders about choosing more sustainable Islamic bank

#### 4.2. Future Work

This study encourages future studies to empirically test the proposed bankruptcy prediction model in different countries to generalize the concept.

**Author Contributions:** Conceptualization, M.M. (Mehreen Mehreen) and M.M. (Maran Marimuthu); methodology, M.M. (Mehreen Mehreen) and M.M. (Maran Marimuthu); software, A.J.; validation, M.M. (Maran Marimuthu) and S.A.A.K.; writing—original draft preparation, M.M. (Mehreen Mehreen); writing—review and editing, A.J.; supervision, M.M. (Maran Marimuthu) and S.A.A.K. All authors have read and agreed to the published version of the manuscript.

**Funding:** This study is fully supported by Universiti Teknologi PETRONAS (UTP), Malaysia through the Graduate Assistant Scheme (GRA) to the first author.

**Acknowledgments:** Thank you to Universiti Teknologi PETRONAS for financial support.

**Conflicts of Interest:** The authors declare no conflict of interest.

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