Bankruptcy Forecasting Models and the Problem of Endogeneity. A Case of Malaysian Banking Industry

Abstract:

This study by investigating the relevant previous literature on bankruptcy forecasting models identified that accounting for endogeneity in bankruptcy forecasting models have been widely over-sighted, and using these models as it is may lead towards inconsistent results and biased precision in some contexts. Considering the sensitivity of bankruptcy forecasting issue, it is vital that the precision drawn about it should be unbiased and accurate. In line with that, this study established that retained earnings under variable X_2 of the Altman' (2000) model is endogenous to firm's age in the perspective of Malaysian banking industry. Subsequently, this study sets an efficient instrumental variable for the identified endogenous variable in order to get accurate and unbiased bankruptcy forecasting results for Malaysian banking industry using Altman model. The analysis here is viable to draw the attention of researchers towards the relatively neglected, but very essential aspect in bankruptcy forecasting. This study may open avenues for researchers to consider endogeneity in the bankruptcy forecasting models and investigating the subsequent instrumental variables for it.

Key words: bankruptcy forecasting, endogeneity, instrumental variables, Malaysian banking industry

JEL classification: G17, G21, G33

1. Introduction

The underlying presumption of the any business todays is to achieve sustainable economic growth and long term competitive advantage (Hamilton & Nickerson, 2003). Therefore, business managers are highly interested in frequent evaluation of those key performance indicators which may affect the sustainability ratings of their business in either direction. Accordingly, it is important to forecast financial distress if any, and take remedial measures in advance, for minimizing its negative effects on the financial health of businesses (Helmut Elsinger, 2006). This process is known as systematic risk identification or the early warning system (Elsinger, Lehar, & Summer, 2005). Incorporating with early warning system the (EWS),

and maintaining strong sustainability, different bankruptcy forecasting models were proposed over the period of time.

Since early 1960's, the subject of bankruptcy forecasting remained the area of pursuit for many researchers (Kumar & Ravi, 2007). The most prominent and pioneered work in the field of bankruptcy was carried out by (Beaver, 1966) which served as base in the field of bankruptcy diagnosing models. This work sparked the development of uniquely featured bankruptcy models using different techniques i.e. Univariate, multiple discriminant analysis, correlation matrix, logistic regression, principle component analysis, step wise regression, probit analysis, hazard models and neural network models (Altman, 1968, 1984, 2000; Altman, Haldeman, & Narayanan, 1977; Altman, Hartzell, & Peck, 1998; Aziz, Emanuel, & Lawson, 1988; Bilanas, 1987; Deakin, 1972; Ohlson, 1980; Springate, 1978; Zmijewski, 1984).

However, the financial crisis of (2007-2008) brought the issue of bankruptcy into spotlight again. It specially boosted the debate on Islamic banks financial stability, as it was the first major financial crisis since Islamic banks appeared on main stage (Cheng, Lin, & Wei; S. Hashem, Giudici, & Abedifar, 2016). Researchers like (Alqahtani, Mayes, & Brown, 2016; Beck, Demirgüç-Kunt, & Merrouche, 2013; Čihák & Hesse, 2010; S. Q. Hashem & Giudici, 2016; Olson & Zoubi, 2016; Sorwar, Pappas, Pereira, & Nurullah, 2016; Trad, Trabelsi, & Goux, 2016) measured and compared the financial stability of Islamic vs. conventional banking industry after the financial crisis of (2007-2008). Kusuma and Ayumardani (2016) studied the efficiency of corporate governance of the Islamic banks in Indonesia. Karim, Lee, Karim, and Jais (2012) measured the financial stability of Malaysian Islamic banks after financial crisis. Researchers like (Jan & Marimuthu, 2015a, 2015c, 2016) evaluated the sustainability and bankruptcy profile of the world's top five Islamic banking countries included Malaysia. Their study found that, the performance of Malaysian Islamic banks deteriorated at large after the subprime crisis.

In addition, with the development of efficient statistical packages and their built in facilities, the literature suggests revisiting the past findings as most of these studies overlooked the possibility of endogeneity. Therefore, it is widely advised to investigate endogeneity for accurate estimation of the models particularly in social sciences (Wintoki, Linck, & Netter, 2012). There are many reasons which may cause endogeneity in the model. Omitting important variable/s, errors in measurement, reverse causality, and simultaneity are some of these reasons (Wintoki, Linck, and Netter 2012).

In line to previous research studies, this study is with the view that the problem of endogeneity in bankruptcy forecasting models has been widely over sighted. Any bankruptcy evaluation model that does not take into account endogeneity might suffers from biased coefficient estimates, and thus the statistical inference and conclusions may become inconsistent, irrational, and biased. Biased or inaccurate findings may not only misguide the public and society but it will also misguide the practitioners and regulators as well. These in turn, negatively affect the strategy choice and other corrective measures for maintaining

and strengthening sustainability (Hamilton & Nickerson, 2003). Therefore, considering endogeneity for estimating unbiased coefficients is obligatory for depicting the true financial picture of the business.

Identification of an endogenous variable and addressing it with suitable instrumental variable is not very easy. The case of endogeneity must be analyzed from theoretical as well as statistical perspectives. Accounting for endogeneity in the bankruptcy forecasting models designed especially for the banking industry is even more important, as the banking industry holds a central role in the country's economy (Brown, 2003; Hanif, Tariq, Tahir, & Momeneen, 2012; Jeucken & Bouma, 1999; Olson & Zoubi, 2011; Safiullah, 2010). Along with the responsibility of economic growth, the central role also makes it responsible for any deterioration cause to the economy in case of banking failure (Cecchetti, 2015; Iman van Lelyveld, 2006). The importance of accurate bankruptcy forecasting becomes even more important in the areas where the banking industry share has reached up to a significant level in the financial system (Jan & Marimuthu, 2015b; Swamy, 2014). By keeping in mind, the universal and unanimous importance of banking industry around the world, it is vital that the precision drawn about it should be very accurate. The accurate precision ensures unbiased results which is not possible without investigating and addressing for endogeneity if present in the model.

2. Objectives of the Study

1. To investigate the use of endogeneity in the famous bankruptcy forecasting models which overlooked the issue in past.
2. To insight and determine theoretically and statically justified instruments for the endogenous variable in bankruptcy forecasting model.
3. To witness the outcome of identified endogenous and set instrumental variables in the context of services industry of developing countries like Malaysian banking industry.

3. Literature Review

Considering the sensitivity of the bankruptcy forecasting process for the banking industry, it is almost mandatory to draw an accurate precision about it, and efficient precision requires appropriate tools and techniques of estimation. However, this study found that the bankruptcy forecasting models have over sighted the problem of endogeneity in past. Therefore, using these models as it is may leads towards irrational and biased results in different scenarios. For the sake of concreteness, this study tabulated the relevant literature about the famous bankruptcy evaluation models in Table 1 below.

Table 1. Prominent Bankruptcy Forecasting Models Used in the Past.

Models	Data Period	OBS	Variables Taken	Financial Performance Technique	Accounts For Endogeneity	Instrumental Variables
Beaver (1966)	Data (1954-1964) for 79 failed and 79 non-filed firms were taken from 38 different U.S industries.	158	Cash flow ratios, net income ratio, debt to total asset ratio, liquidity asset to total asset ratio, Current ratio, turnover ratio.	Ratio analysis, univariate analysis	No	No
Altman (1968) Z-Score Model	Data (1946-1965) for 33 non-bankrupt and 33 bankrupt U.S firms.	66	Liquidity, profitability, productivity, Insolvency. asset turnover ratio	Ratio analysis, stepwise multiple discriminant analysis (MDA).	No	No
Deakin (1972)	Data 1962-1966 for 11 failed and 23 non-failed firms were drawn from Moody's industrial manual.	34	The initial 14 ratios taken by beaver (1966) were used in a discriminant analysis manure.	Ratio analysis, multiple discriminant analysis (MDA).	No	No
Altman et-al (1977) Zeta Model	Data (1969-1975) for 53 bankrupt and 58 non-bankrupt manufacturing and retailing firms were sampled.	111	Productivity ratio, stability of earnings ratio, debt service ratio, cumulative profitability ratio, liquidity ratio, capitalization ratio, and size.	Ratio analysis, multiple discriminant analysis (MDA).	No	No
Springate (1978)	20 failed and 20 non-failed manufacturing companies of Canada.	40	Liquidity ratio, profitability ratio, productivity ratio, assets turnover ratio.	Multiple discriminant analysis (MDA).	No	No
Ohlson (1980)	Data (1970-1976) for 105 bankrupt and 2058 non-bankrupt firms were drawn from wall Street Journal Index.	2163	Total assets to GNP price-level index, debt ratio, liquidity ratio, current ratio, ROA, cash flow to debt ratio, and dummy variables.	Ratios analysis, Logistic regression	No	No
Altman (1984)	Data (1982-83) for U.S and Japan sample. (1976-80) for Germany and Switzerland. (1975-77) for Brazil. (1963-77) for Australia. (1971-80) for U.S and U.K. (1970-80) for Ireland. (1970-79) for Canada. (1950-74) for Netherland. And data (1974-79) were taken for France sample.		Liquidity, profitability, productivity, Insolvency. asset turnover ratio	Ratio analysis, multiple discriminant analysis (MDA)	No	No
Zmijewski (1984)	Data (1972-1978) collected from New York stock exchange for those firms which had SIC code less than 6000	129	ROA, total debt/ total assets, CA/ CL	Logit model	No	No
Bilanas (1987) CA Score	Data were collected for companies with total assets between 1-20 million dollars	173	Share holder investment to total assets, EBT + financial expenses to total assets, turnover ratio,	Stepwise multiple discriminant analysis (MDA).	No	No
Aziz et al. (1988) CFBM Model (1988)	Data (1972-1986) For 114 failed and non-failed firms. Data (1986-1987) for 68 failed and non-failed, for sample 2 derived from COMPUSTAT.	364	Operating cash flow to total assets, capital investment to total assets, taxes to total assets, liquidity change to total assets, interest payment – debts to total assets.	Cash flow model	No	No
Altman (2000) Service Firms Model	Data (1946-1965) For 33 Non-Bankrupt and 33 bankrupt U.S Firms.	66	Liquidity, profitability, productivity, Insolvency.	Ratio analysis, multiple discriminant analysis (MDA.	No	No
Shumway (2001)	Data (1962-1992) for 300 firms were collected from Wall Street Journal Index, Capital changes report and Compustat research file	300	The same variables of Altman (1968) i.e. WC/ TA, RE/ TA, EBIT/ TA, Sales/ TA. Same variables as that of Zmijewski (1984) i.e. NI /TA, TL/ TA, CA/ CL, Log Size, Log Age	Financial ratios, hazard model.	No	No

Table 1 highlights that all the prominent bankruptcy forecasting models have over sighted the problem of endogeneity and subsequently setting the instrumental variables in past.

4. Methodology

The methodological process adopted by this study for addressing the issue of endogeneity is divided into three steps. First, this study has in-sighted an endogenous variable in the bankruptcy forecasting model. Secondly, it determined a suitable and efficient instrument for the identified endogenous variable. And thirdly, it applied the set instrumental variables to witness its outcome in the context of developing country like Malaysia. In-line to it, this study shortlisted Altman's (2000) model to be applied on Malaysian banking industry. The reason for choosing Altman's model is because of the facts that, that the unit of analysis in this study is the banking industry, and Altman's (2000) model is already been applied to the banking industry by researchers like (Bankapure, Soni, & Mandhane, 2015; Chiaramonte, Poli, & Zhou, 2016; Chieng, 2013; Jan & Marimuthu, 2015b, 2015c; Mamo, 2011; Sharma, 2013).

Table 2. Sample of the Study

S.N	Conventional Banks of Malaysia	Starting Year	S.N	Islamic Banks of Malaysia	Starting Year
01	Affin Bank	2001	15	Alliance Islamic bank	2008
02	CIMB BANK BHD	2003	16	Public Islamic Bank	2008
03	United Overseas Bank	1993	17	Hong Leong Islamic Bank	2008
04	Alliance Bank Malaysia Bhd	1958	18	OCBC Al-Amin	2007
05	AM Bank	1975	19	Asian Finance Bank	2007
06	Bangkok Bank Berhad	1994	20	KFH Malaysia Berhad	2005
07	Citi Bank Bhd	1994	21	CIMB Islamic Bank	2003
08	Hong Leong Bank	1969	22	Affin Islamic Bank Berhad	2006
09	May Bank	1960	23	Al Rajhi Banking & Investment Co	2006
10	OCBC Bank Malaysia	1994	24	Bank Muamalat	1999
11	Public Bank Berhad	1966	25	RHB Islamic Bank	2005
12	RHB Bank Malaysia	1994	26	HSBC Ammnah	1994
13	Royal Bank of Scotland Bhd	1905	27	Bank Islam	1983
14	Standard Chartered Bank	1984	28	Standard Chartered Saadiq Berhad	2008

Table 2 shows selected Islamic banks from Malaysia. This study choose 14 Islamic and 14 conventional banks of Malaysia based on convenient sampling technique. The list of Islamic and conventional banks of Malaysia were traced from the official website of the central bank of Malaysia i.e. Bank Negara Malaysia. http://www.bnm.gov.my/?ch=fs_mfs&pg=fs_mfs_list.

5. Addressing the Problem of Endogeneity

Endogenous variable means an independent variable outside the model that affects the model without being affected by it. In a statistical linear model which is $\mathbf{Y_i = \alpha + \beta x_i + \mu_i}$ the endogenous variable among the regressor is the one which is correlated with the error term i.e. $\mathbf{E\,[x|\mu] = Cov\,(x'\mu) \neq 0}$ (Adkins,

2011). This implies that change in $\mathbf{y_i}$ is not solely occurring due to $\mathbf{x_i'}$ but it is also occurring due the error term $\boldsymbol{\mu}$ as well, because of the fact that **[x|μ]** are correlated to each other. The problem of $\mathbf{Cov\ (x'\mu) \neq 0}$ might be occurring due to three different circumstances i.e. omitted variables, reverse causality, and measurement error in the independent variables (Wintoki et al., 2012). The problem which arise due to any one of the above condition happening is that the expectations of $\boldsymbol{\beta}$ in OLS no longer remains equals to zero i.e. $\boldsymbol{\beta \neq 0}$. In other words, the OLS estimation becomes inconsistent and biased. Because generally in OLS the beta value represents that $\boldsymbol{\beta = \frac{\Delta y}{\Delta x}}$. But due to the correlation of $\mathbf{x_i'}$ with the error term $\boldsymbol{\mu}$, the change in $\mathbf{y_i}$ is also caused due to the $\boldsymbol{\mu}$ as well. As a result of it, the problem arises in the OLS is that the beta does not represents the true change arise in $\mathbf{y_i}$ as a result of the change in $\mathbf{x_i}$ i.e. $\boldsymbol{\beta \neq \frac{\Delta y}{\Delta x}}$. But In fact the changes in $\mathbf{y_i}$ also occurs because $\boldsymbol{\mu}$ as well i.e. $\boldsymbol{\beta = \frac{\Delta y}{\Delta x} = \frac{\Delta yx + \Delta y\mu}{\Delta x} = \frac{\Delta y\mu}{\Delta x}}$. Therefore, to overcome this problem and depict the true financial picture, accounting for endogeneity in the model is very vital.

5.1. Accounting For Endogeneity in Altman's (2000) Model

$$\boldsymbol{Z = 6.56x_1 + 3.26x_2 + 6.72x_3 + 1.05x_4}$$ ***(Whereas)***

$\boldsymbol{Z}$ *= Bankruptcy index used to denote bankruptcy.*

$\boldsymbol{X1}$*=Working Capital / Total Assets.*

$\boldsymbol{X_2}$*=Retained Earnings / Total Assets.*

$\boldsymbol{X_3}$*=Earnings before Interest and Taxes / Total Assets.*

$\boldsymbol{X_4}$ *=Book value of Equity / Book Value of Total Liabilities.*

In the above model the variable $X_{2,}$ is derived by dividing retained earnings over total assets. This study suspected that retained earnings is an endogenous variable, because it is expectedly dependent upon an external market driven factor called the firm's age. As in the starting years of business, the firms normally reinvest their profits known as the ploughing back of profit. Due to this ploughing back of profit, the retained earnings remains low or negative in the starting years of business and vice versa. As a consequence to this phenomenon of retained earnings being depended upon firm's age, the calculation of cumulative profitability i.e. (retained earnings / total assets) under Altman bankruptcy model is expected to be affected and biased.

To prove the claim that the value of retained earnings is dependent upon firm's age, and it is an endogenous variable, this study divided the sample banks from Malaysia into two age groups. Group one represents those banks that were incorporated 10 years before the time of data collection period, as the data taken in this study is from (2009-2013). In line to it, the group one possess those banks that were incorporated before 1999, and have more than 10 years of age. Similarly, group two represents those

banks that were incorporated after 1999 and have their ages less than 10 years from the time of data collection period. This benchmark of 10 years firm age in noticing the expected variations in the value of retained earnings is purely set and proposed by this study, in line with the argument that higher is the age, higher will be the retained earnings and vice versa.

Table 3. Influence of Firm's Age on the Value of Retained Earnings

Started Before 1999 (Age > 10)	Starting Year	Average Profitability	Started After 1999 (Age < 10)	Starting Year	Average Profitability
HSBC Ammnah	1994	0.06	Alliance Islamic bank	2008	0.04
Bank Islam	1983	-0.07	Public Islamic Bank	2008	0.03
United Overseas Bank	1993	0.18	Hong Leong Islamic Bank	2008	0.04
Alliance Bank Malaysia	1958	0.12	OCBC Al-Amin	2007	0.03
AM Bank	1975	0.86	Asian Finance Bank	2007	-0.07
Bangkok Bank Berhad	1994	0.02	KFH Malaysia Berhad	2005	-0.12
Citi Bank Bhd	1994	0.30	CIMB Bank	2003	0.28
Hong Leong Bank	1969	0.13	Affin Islamic Bank Berhad	2006	0.04
May Bank	1960	0.11	Al-Rajhi Banking & Co	2006	-0.13
OCBC Bank Malaysia	1994	0.16	Bank Muamalat	1999	0.03
Public Bank Berhad	1966	0.11	RHB Islamic Bank	2005	0.05
RHB Bank Malaysia	1994	0.69	Standard Chartered Saadiq	2008	0.02
Royal Bank of Scotland	1905	0.09	Affin Bank	2001	0.05
Standard Chartered Bank	1984	0.16	CIMB BANK BHD	2003	0.08
Sample One Average		**0.21**	**Sample Two Average**		**0.03**

Table 3 shows the linkage of firm's age with the value of retained earnings of the firm. To control the expected variations this study divided retained earnings by total assets, and labeled it as average profitability. In Table 3 the five year (2009-2013) average profitability of those firms with the age of greater than 10 years was found with 0.21 percent. While on the other hand, the five year (2009-2013) average profitability of those firms with less than 10 years of age before the data collection period was found with only 0.03 percent. These results vindicates the argument that the firm age do affect the value of retained earnings. Therefore, in the light of above arguments and finding of this study we can declare retained earnings as an endogenous variable. The next step is to set an efficient instrumental variable for this endogenous variable.

6. Instrumental variables

To deal with the problem of endogeneity instrumental variables denoted by **"Z"** are used. However, there are some basic requirements for setting up an instrumental variable. Firstly, $\mathbf{z'}$ should be correlated with the regressor $\mathbf{x'\ E\ [z'x] \neq 0}$. Secondly, $\mathbf{z'}$ should be uncorrelated with the error term, $\mathbf{E\ [z'\mu] = 0}$. And thirdly, that the $\mathbf{z'}$ should not be in the $\mathbf{y'}$ equation, and not the direct cause of $\mathbf{y_i}$ i.e. $\mathbf{Cov\ [y, z\ |x] = 0}$

6.1. Determining Instrumental Variable for This Study

In line of the endogenous variable retained earnings, this study setup the dummy codes as an instrumental variable for capturing the yes and no affects. If the age of a bank was found greater than 10 years, this

study gave code 1 to those banks. However, if the age of subjected was less than 10 year, code 0 was given to those banks.

7. Two Stage Least Square Method (2SLS)

Once the identification of endogenous variable and setting instruments for it is finalized, the next step is to apply 2SLS which illuminates about the weight of an individual variable in the overall model. In the context of this study, the results of 2SLS will indicate the significance of different performance indicators used in Altman's (2000) model in the context of Malaysian banking industry. Practically the 2SLS method replaces the value of endogenous variable with the predicted value of the subjected endogenous variable when regressed on the instruments. The overall process is carried out in two stages. In the first stage, the endogenous variable is regressed on the exogenous and the instrumental variables i.e. $\mathbf{y_2 = x_1 y_1 + x_2 y_2 + \mu}$. In the second stage, the predicted value for the endogenous variable $\mathbf{y_2}$ are put in the structural equation model i.e. $\mathbf{y_1 = \hat{y}_2 \beta_1 + x'_1 \beta_2 + \mu}$. Before applying 2SLS this study performed the basic data diagnostic tests which are stated below.

8. Data Analysis

Table 4. Descriptive Statistics of 28 Malaysian Banks

Variable	Observations	Mean	Std. Deviation	VIF
Liquidity	140	0.77	0.62	1.57
Profitability	140	0.18	0.26	1.42
Productivity	140	0.10	0.15	1.11
Insolvency	140	0.25	0.56	1.05
Z-score	140	1.26	0.87	

Table 4 shows the descriptive statistics of the variables used in Altman's (2000) model. Data taken in this study belongs to the post subprime crisis period i.e. five years 2009-2013. The five year time period and the total number of 28 banks made the observation 140 in number. Moreover, the results of VIF shows no sign of multicollinearity in the model, as the values of VIF for all variables are found less than 10.

Table 5. Heteroscedasticity and Serial Correlation

Heteroscedasticity		Serial Correlation	
Breusch-Pagan / Cook-Weisberg		*Wooldridge test for serial correlation*	
F-value	P-value	F-value	P-value
9.77	0.000	12.452	0.000

Table 5 shows the results of two diagnostic tests namely *Breusch-Pagan/Cook-Weisberg* test for heteroscedasticity, and *Wooldridge* test for serial correlation. The p-values of both the tests are found significant at 1 percent, which confirms both heteroscedasticity and serial correlation in our model at the

same time. In order to deal with both heteroscedasticity and serial correlation in the model a clustered robust model can be used (Drukker, 2003).

Table 6. Tests for Endogeneity

Durbin Score		**Wu-Hausman**	
F-Value	P-value	Chi2 (1)	P-value
4.32	0.03	4.28	0.04

H_o: *Variables are exogenous*

In Table 6, the P-values of robust score and robust regression for ***Durbin Score*** and ***Wu-Hausman*** are significant at 5 percent i.e. 0.03 and 0.04 respectively. It rejects the null hypothesis which states that the variables are exogenous. Hence, it implies that the retained earnings under variable X_2, of Altman's (2000) model is endogenous to firm age in the context of Malaysian banking industry. Therefore, to overcome the problem of endogeneity this study used instrumental variable.

Table 7. First-Stage Regression Summary Statistics

Variable	**R-Squared**	**Adjusted R-Squared**	**Partial R-Squared**	**F-Value**	**P-value**
Profitability	0.18	0.15	0.09	14.36	0.000

H_0: *Instruments are weak*

Table 7 shows the first stage regression results for the endogenous variable X_2 of the Altman's (2000) model which is (retained earnings/total assets). This study selected the instrumental variable after it passed the theoretical justification and statistical alignment. The theoretical and statistical strengths of the instrumental variable are evident from the previous Tables 3 and 6. Moreover, the findings of the above Table 7 rejects the null hypothesis which states that the instrument is weak. Hence, this study proposed and proved that the instrument used in this study to cope endogeneity problem in the application of Altman's (2000) model is very efficient in Malaysian banking perspective.

Table 8. Two -Stage Least Square Results vs. Multiple Regression Comparison

Two -Stage Least Square				**Multiple Regression**			
Z-Score	Coefficient	Z	P>z	Z-Score	Coefficient	t	P>t
Profitability	1.02***	94.85	0.00	Profitability	1.017***	6.65	0.000
Liquidity	0.99***	802.14	0.00	Liquidity	0.966***	17.01	0.000
Productivity	0.98***	91.62	0.00	Productivity	1.171***	4.30	0.000
Insolvency	1.00***	512.86	0.00	Insolvency	0.596***	9.48	0.000
constant	-0.00	-0.97	0.33	Constant	0.071	1.09	0.277
R-Squared = 0.98				R-Squared = 0.79			

*significant at 10%, **significant at 5%, and *** significant at 1%.

Table 8 shows the comparison between the results of 2SLS and multiple regression. The results of 2SLS in Table 8 are reported after the injection of instrumental variable for retained earnings under variable X_2 of Altman model which predicts profitability. In order to overcome the problem of heteroscedasticity and serial correlation in the model a clustered robust model was used. Furthermore, as previously Table 3 and 6 highlighted that the retained earnings under variable X_2 of the Altman's (2000) model is endogenous to firm age. Therefore, in order to capture the true weights of different performance indicators used in Altman's (2000) we must account for endogeneity in it and subsequently use 2SLS for the banking industry of Malaysia. Moreover, the results in the above Table 8 shows a clear difference between the values of coefficients, R-squared and in the Z and T values for 2SLS and multiple regression respectively. Hence, using an inappropriate model, which in this case is a multiple regression model may leads toward inconsistent and biased results in the context of finding bankruptcy for the Malaysian banking industry.

9. Conclusion

Considering the undeniable importance and sensitivity of banking industry failure on the financial economy of the country, this study urged that the precision drawn about bankruptcy forecasting should be highly accurate and unbiased. The unbiased and accurate results require the use of accurate tools, techniques and formulas of estimation. Accordingly, this study highlighted the rather neglected but an essential aspect in the bankruptcy forecasting models i.e. endogeneity.

In line with the first objective this study investigated the famous bankruptcy forecasting models along with accounting for endogeneity and setting instrumental variables in it. The study found that all the sampled bankruptcy forecasting models have over sighted the problem of endogeneity and subsequently setting the instrumental variables for it. Addressing to the problem, this study sampled Altman's (2000) and theoretically and statistically established the retained earnings under variable X_2 of Altman model is endogenous to firm's age in the context of Malaysian banking industry. And applying Altman (2000) on Malaysian banking industry without accounting for endogeneity in it may leads towards biased and inconsistent results.

In consonant with the second objective this study suspected that retained earnings of Altman's model is endogenous to firm age in Malaysian banking perspective. To validate the claim theoretically that higher firm age leads towards higher retained earnings and vice versa, this study first divided the sample of Malaysian banks into two groups on the basis of their ages. Sample one comprised of banks with their ages greater than 10 years, while sample two comprised of banks with their ages less than 10 years. The higher average sum of sample one and subsequently the lower average sum of sample two vindicated the claim of this study that retained earnings is dependent upon firm's age, and higher firm age contributes to higher retained earnings and vice versa. Secondly, to validate the claim statistically, this study by

capturing the yes and no affects assigned the dummy code 1 to firms with their ages greater than 10 years. And the dummy code 0 to those banks which had their ages less than 10 years at the time of data collection. The statistical tests Wu-Hausman and Durbin score indicated that the instruments is significant and 1 percent. Which ultimately validates the claim of this study that the retained earnings is an endogenous variable and the subsequent instrument is suitable for it in the context of Malaysian banking industry.

In line with the third objective, the results shows that to capture the unbiased coefficient for variable X_2 which predicts profitability it is necessary to account for endogeneity in Altman's (2000) model for it. Subsequently, to capture the true impact between the performance indicators used in Altman's model along with bankruptcy profile of the Malaysian banking industry it is vital to account for endogeneity in it and to use 2SLS instead of multiple regression.

9.1. Significance of the Study

The analysis of this study is viable to draw the attention of managers, practitioners, and researchers towards relatively neglected but very important aspect of bankruptcy forecasting in the banking industry. This study may serve as a launching pad in the process of addressing endogeneity issue in bankruptcy forecasting models and subsequently setting instrumental variable for it.

9.2. Suggestions for Further Studies

Looking at the sheer importance of bankruptcy forecasting issue as discussed in this paper, there is a need to identify and addressed the endogenous variables in other bankruptcy forecasting models beside Altman's model before applying them in different countries. This study also persuades the researchers to incorporate and address the problem of endogeneity in future economic and econometric modeling, which are designed for evaluating sensitive economic issues like sustainability and bankruptcy forecasting.

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