

Factors Affecting the Solvency of Commercial Banks of Bangladesh: An Empirical Evidence

Shehidul Hoque¹
Dr. K.M. Zahidul Islam²
Ratul Kumar Saha³

***Abstract:** This paper aims at identifying the contributing factors to the solvency condition of selected commercial banks of Bangladesh and to propose a model that can be utilized to identify insolvency of the banks. The assumption behind the study entails that a bank may fail due to insolvency and there are factors with both systematic and idiosyncratic contents to influence the condition. The study further focuses on discovering significance of those contributing factors to the solvency of commercial banks of Bangladesh so that the model can be better utilized. The study used data of selected Bangladeshi commercial banks listed in Dhaka Stock Exchange and some macroeconomic data during the period of 2004-11. The data were analyzed using panel data regression method under both fixed effect and random effect frameworks. The study further conducts Hausman test, Wooldridge test, and Heterokedasticity test to validate the regressions models. The paper utilizes an insolvency ratio as a proxy of the solvency condition of the banks. The results show that the market valuation component, the ratio of income from securities to effective capital and the interaction term between Texas ratio and unemployment rate have significant impact on the insolvency ratio. Although serious liquidity problems theoretically can cause an otherwise solvent bank to fail under certain conditions, however, the findings of the study indicate that liquidity does not significantly affect the solvency condition of Bangladeshi commercial banks.*

***Key Words:** Solvency Condition, Insolvency, Panel Data, OLS, Regression, Accounting ratios, Texas Ratio.*

1.0 Introduction

Banks stand as the most important financial intermediaries in an economy by pursuing liquidity transformation and other services. The banking sector of Bangladesh observed a significant growth for years as reflected in higher profit margin, healthy competition and acceptable return to the shareholders. The banking sector of Bangladesh faced serious challenges as a number of scams came out regarding the preferential lending and non-performing loans in recent past. Most of the banks' profit went down because of higher default loan that resulted in higher loan loss provision (Bangladesh Bank, 2012). The malfunctioning of the sector can be tremendously exorbitant to the economy as evident in the global credit-liquidity turmoil that took place recently. It is even more costly in

¹ Assistant Vice President, SEAF Ventures Management LLC.

² Associate Professor, Institute of Business Administration (IBA-JU), Jahangirnagar University, Savar-Dhaka-1342.

³ Graduate Student, Institute of Business Administration (IBA-JU), Jahangirnagar University, Savar-Dhaka.

economies like Bangladesh where businesses largely depend on the banking sector for their financing needs. “The institutional context of the banking system can hardly be over-emphasized. In today's modern economy confidence in the banking sector is critical for economic and social stability. Lack of confidence and poor performance can cause economic havoc. The global financial crisis is an important reminder of the damage that can emerge from a poorly managed and supervised financial system. A weak banking system can also be a major source of rent seeking and corruption” (Ahmed, 2010). The recent scams of Sonali Bank Limited and BASIC Bank Limited are examples of such poor performance, ineffective management, and rather sluggish supervision. Moreover, the commencement of operations by a number of new banks is expected to lead to fierce competition in the industry which may make the industry unstable (Carletti and Hartmann, 2002).

The banking sector of Bangladesh is comparatively large in comparison to the equivalent economies in terms of GDP growth rate and per capita income. The size of the sector is about 60% of the total GDP of Bangladesh. The sector has started to experience increased non-performing loans (NPL) in both gross and net measures. The gross NPL to total loans of the sector rose from 11.91% in September, 2012 and stood as high as 12.8% in September 2013 (Bangladesh Bank, 2013). This was fueled by the increment in total classified loan that increased to 8.4% whereas total outstanding loan increased by only 1%. More importantly, all the four categories of banks i.e., the state-owned commercial banks (SCBs), the specialized banks (SBs), the private commercial banks (PCBs), and the foreign commercial banks (FCBs) experienced significant deteriorations in non-performing loan measures. The provision shortfall of the banking sector stood at BDT 32.8 billion in September 2013 which was 34% higher over the provision shortfall in June, 2012. Moreover, the net NPL ratios for SCBs, SBs, PCBs and FCBs stood 9.0%, 22.3%, 2.8% and 1.7% respectively in September 2013 (Bangladesh Bank, 2013). Such alarming rise in the non-performing loans provokes questions regarding sustainability issues and failures potential of banks. However, the solvency issue and the failure probability of Bangladeshi banks experienced little attention in academic researches.

In Bangladesh a few research works have been conducted on banks and most of the researches dealt with the profitability of the commercial banks (Hossain and Bhuiyan, 1990; Avkiran, 1997; Siddique and Islam, 2001; Chowdhury, 2002; Jahangir et al., 2007, Chowdhury and Islam, 2007). Hossain and Bhuiyan (1990) argue that the level of performance of any organization (bank) can be measured by the degree of its effectiveness as an organization. Chowdhury (2002) states that the presence of state-owned, foreign and private commercial banks make the banking industry of Bangladesh a mixed industry and the fierce competition in the industry makes the performance assessment of commercial banks a dire necessity. Siddique and Islam (2001) show that commercial banks act as one of the major contributors to the economy of Bangladesh and pointed out that the banks are giving satisfactory performance in terms of average profitability. Jahangir et al., (2007) argue that the profitability of banks is well reflected through the loan to deposit ratio.

Khan et al., (2009) and Khan (2010) evaluated the social disclosure practices followed by the commercial banks of Bangladesh in order to research the corporate social reporting

standard followed by the Bangladeshi banks. The study of Watanagase (1990) try to shed light on the reasons behind the banking distress in Bangladesh and pointed out that the weak management that enables preferential lending acted as the main reason behind the ache. Ahmed (2010) also outlines that the preferential lending is distress pouring and recommends adequate regulations and supervision to safeguard the banking industry especially the state-owned commercial banks.

Defining the solvency condition of bank requires complex analysis. Wu and Hong (2012) propose a ratio that could be used as a proxy for the solvency condition of a bank at a specific point in time. They find some variables having strong impact in solvency and liquidity conditions of bank that eventually affect the probability of bankruptcy. Those variables that are publicly available in Bangladeshi context are used in this study to see their impacts on the solvency condition of Bangladeshi commercial banks. This paper unveils the major factors contributing to the insolvency conditions of Bangladeshi commercial banks.

The rest of the paper is structured as follows: Section two shows the brief introduction of the banking sector of Bangladesh followed by the third section outlining literature review. Section four outlines the data and variables construction followed by section five that presents the objectives of the study. Section six deals with the methodology of the study. Section seven presents the empirical findings and the last section concludes the paper with some suggestions for further study.

2.0 Banking Sector in Bangladesh

The financial system of Bangladesh is mainly dominated by the banking sector. The banking sector includes 4 state-owned commercial banks (SCBs), 4 government-owned specialized development banks (SDBs), 39 domestic private commercial banks (PCBs), 9 foreign commercial banks (FCBs) and 4 non-scheduled banks. Thirty banks are enlisted in the capital market of Bangladesh. The major indicators of performance of banking industry are different accounting ratios. Table 1 shows that banks' return on asset (ROA) was only 0.6% in 2012, the lowest in four-years, while it was 1.3%, 1.7% and 1.4% in 2011, 2010 and 2009 respectively. At the same time, banks' return on equity (ROE) also declined to 7.8% in the year 2012 whereas it was 14.3 % in 2011. In 2012, the net profit of the banking sector was only Tk.44.66 billion, a 42 percent decrease from that of the year 2011(Bangladesh Bank, 2013). The capital adequacy ratio maintained by the banking sector also dropped to 10.46 % in 2012 while it was 11.3 % in 2011. More than 80 % of the Bangladeshi scheduled banks maintained their minimum capital adequacy ratios (CAR) at the end of 2012. This indicates a quite substantial part of the banking assets belonged to the banks which fulfilled the minimum requirement of CAR (Bangladesh Bank, 2013).

From Table 1, it is obvious that the portion of classified loans increased significantly in 2012 compared to the previous years. The ratio of classified loans to total loans was 10% in 2012 while it was 6.2% in 2011. Classified loan to capital ratio also experienced a sharp increase from 43.6% in 2011 to 74.2% in 2012. Provisions to classified loans ratio shifted down to 44% by the end of the 2012 compared to 63.8% at the end of the 2011,

that indicates provisions maintained for classified loan did not increase in line with the rise in the classified loan.

Table 1: Selected Ratios of Banking Sector of Bangladesh (Figures in Percentage)

| Ratio | 2009 | 2010 | 2011 | 2012 |
|---------------------------------|------|------|------|-------|
| ROA | 1.4 | 1.7 | 1.3 | 0.6 |
| ROE | 19.9 | 19.9 | 14.3 | 7.8 |
| Capital Adequacy Ratio | 11.7 | 9.3 | 11.3 | 10.46 |
| Classified loans to Total Loans | 9.2 | 7.1 | 6.2 | 10.0 |
| Classified loans to Capital | 79.7 | 54.8 | 43.6 | 74.2 |
| Provision to Classified loans | 61.3 | 65.1 | 63.8 | 44.4 |

Source: Financial Stability Report, 2012

Bangladesh bank divides classified loan into three categories: sub-standard loan, doubtful loan and bad & loss loan. Table 2 shows the breakdown of classified loans in 2012. The total amount of classified loan was Tk. 427.3 billion in 2012. The bad & loss portion stood highest among three categories of classified loan. It constitutes about 66.7% of total amount of classified loans whereas sub-standard and doubtful loans constitute about 19.1% and 14.2 % respectively.

Table 2: Classified Loan Composition of Year 2012 (Amount in Billion BDT)

| Particulars | Amount | % of Total |
|--------------|--------|------------|
| Sub-standard | 81.4 | 19.1% |
| Doubtful | 60.8 | 14.2% |
| Bad & Loss | 285.0 | 66.7% |
| Total | 427.3 | 100% |

Source: Financial Stability Report, 2012

The financial performance of the banks is greatly influenced by the extent of the classified loan out of the total loans disbursed. At the end of 2012, the banking industry of Bangladesh maintained a cumulative provision of BDT 189.8 billion due to the presence of large amount of classified loans which was only BDT 148.9 billion at the end of 2011 (Bangladesh Bank, 2013). In 2011, the banking sector maintained provision more than required (surplus of BDT 9.6 billion) but at the end of 2012 the sector could not maintain the required provision that resulted in BDT 52.6 billion shortfall in provision. This was due to the significant provision shortfall in eight commercial banks which adversely affected the picture of the whole banking sector of the country though all other banks maintained surplus provision in that period (Bangladesh Bank, 2013).

Table 3: Banking Sector Loan-Loss Provision (Amount in Billion BDT)

| Year | Required Provision | Provision Maintained | Surplus (shortfall) |
|------|--------------------|----------------------|---------------------|
| 2005 | 88.3 | 42.5 | -45.8 |
| 2006 | 106.1 | 52.9 | -53.1 |
| 2007 | 127.1 | 97 | -30.1 |
| 2008 | 136.1 | 126.2 | -9.9 |

| | | | |
|------|--------|--------|--------|
| 2009 | 134.7 | 137.8 | 3.1 |
| 2010 | 150.8 | 146.8 | -3.9 |
| 2011 | 139.3 | 148.9 | 9.6 |
| 2012 | 242.39 | 189.77 | -52.62 |

Source: Financial Stability Report, 2012

A number of high-profile loan scams in recent years threatened the proper functioning and the sustainability of this industry. The scam related to Sonali Bank Limited and Hall-Mark Group was the biggest scandal in the industry. The regulators unveiled similar discrepancies in some other Govt. and private commercial banks. As a result, at least two leading banks have requested the government for recapitalization (Emran, 2013).

3.0 Literature Review

According to the historians modern banking initiated in Italy in thirteenth century and the first crises in banking system causing extinction of few financial houses recorded in 33 A.D in Rome. Calomiris (1989) mentions some reasons of the crisis of Rome which included, *inter alia*, a slave rebellion, scam, liquidity-draining supervision policies, defaults on overseas debt etc. Caprio Jr. and Klingebiel (1996) argue that “there are three general types of bank insolvency: those limited to a single bank or a small number of banks, which clearly are not systemic; overt banking system runs; and a more silent form of financial distress”. Overt runs are recognized when a banking panic occurs. Calomiris and Gorton (1991) define banking panic as an incident when “bank debt holders at all, or many, banks in the banking system suddenly demand that banks convert their debt claims into cash (at par) to such an extent that the banks suspend convertibility of their debt into cash”. Generally this type of panic happens all of a sudden and this does not persist for a long time. Developing economies often experiences the financial distress of the banking system because of the higher stake of the government in the industry (Caprio Jr. and Klingebiel,1996).

King et al., (2006) show in their survey that a process involving search through many accounting ratios has been used in the most of the bank insolvency prediction and recognition models. These accounting-ratio-based models initiated by Altman (1968) and Beaver (1966) are widely followed in bank solvency studies. Wu and Hong (2012) argue that most models explaining bank insolvency fall into this group (Arena, 2008; Cole and Gunther, 1995; Brunnermeier et al., 2012; Cassil, 2009; Diamond and Dybvig, 1983; Demirgüç-Kunt and Huizinga 2012; Estrella et al., 2012; He and Xiong, 2012; Jesswein, 2009; Meyer and Pifer, 1970). These models are normally constructed by searching through a large number of accounting-ratio variables covering various bank specific and macro- economic factors. Among the recent studies, Konstandina (2006) finds that bank-specific factors play important role in explaining solvency and survival times while macroeconomic variables do not appear to be essential.

Meyer and Pifer (1970) examine the causes of bank insolvency and concluded that shift from solvency towards insolvency resulted from such factors as fraud and other financial irregularities, as contrasted to normal, financial concepts are generally used to measure the relative strength of banks. Wu and Hong (2012) use regression model and find from

the empirical evidence that banks with higher market valuation component are less likely to be insolvent. Estrella et al., (2012) explain that bank failures are strongly correlated with gross revenue ratio. It implies that banks with high revenue are less likely to be insolvent. In this research, interest income, income from securities and non- interest income were treated as the main sources of revenue for the bank. Demirgüç-Kunt and Huizinga (2012) argue that generation of some non-interest income can reduce the possibility of bank insolvency. However, the study by Brunnermeier et al., (2012) concludes that the banks with higher non-interest income have a higher contribution to risk of being insolvent than traditional banking.

Jesswein (2009) tries to find how the ratio of net non- performing asset to effective capital and the Texas ratio explain the solvency of banks and found that these ratios can moderately explain the insolvency of banks. Cassil (2009) states that higher unemployment rate will add stress to the financial institutions. According to Diamond and Dybvig (1983), serious liquidity problems can cause an otherwise solvent bank to become insolvent under certain conditions. Wu and Hong (2012) also argue that liquidity risk is one of the major predictors of bank insolvency. He and Xiong (2012) suggest that debt market liquidity can be used as an economic factor for predicting the solvency condition of a firm.

4. Data and Variables Construction

The data used in this research both bank specific and macroeconomic. The bank specific data were collected from the annual reports of the banks. The macroeconomic data were collected from the central bank. The researchers mainly focused on the commercial banks listed in the Dhaka Stock Exchange (DSE). There are total 30 banks listed in DSE. In this study 24 banks out of 30 banks have been used due to data unavailability of the other banks. The time period under the research interest is 2004 to 2011.

Variables Construction

Dependent Variable: The insolvency condition of bank

The dependent variable of the proposed model is the solvency condition of bank i at time t (Y_{it}). Inspired by Wu and Hong (2012), the researchers have used an insolvency ratio as a proxy for the solvency status of a bank. The ratios for the insolvency condition of Bank i at time t (Y_{it}) is defined as the distance between the normalized value of the bank's equity and zero:

$$Y_{i,t} = \frac{E_{i,t}}{TCE_{i,t-1} + TP_{i,t-1}} - 0$$

Where $E_{i,t}$ = The value of bank i 's equity at time t .
 $TCE_{i,t-1}$ = Tangible Common Equity of Bank i at time $t-1$.
 $TP_{i,t-1}$ = Total Provision of Bank i at time $t-1$.

Tangible common equity equals to total equity in this study. Total provision refers to the provisions maintained by banks for loan loss and diminution in value of investment. Provisions maintained for tax purpose is not included in total provision in this study. The summation of tangible common equity (TCE) and total provision (TP) can be viewed as

effective capital. Hereafter the word “effective capital” will be alternatively used to mean the sum of tangible common equity (*TCE*) and total provision (*TP*). Normalizing the banks’ equity using its effective capital, the insolvency condition of the bank is derived. The greater the value of this value the more solvent a bank is. If the value equals to zero or less than zero, the bank is insolvent.

Independent Variables:

Measure of leverage multiplied by the ratio of return of assets to market discount rate:

This first independent variable ($X_{1,it}$) consists of two terms measure like leverage and ratio of return on asset to market discount rate. Measure of leverage is the ratio of total asset to effective capital.

$$X_{1,it} = \frac{A_{i,t}}{TCE_{i,t} + TP_{i,t}} + \frac{ROA_{i,t}}{r_t}$$

Where $A_{i,t}$ = Total book value of asset of Bank i at time t

$ROA_{i,t}$ = Return on asset of bank i at time t

r_t = Market discount rate.

Market discount rate (r_t) is calculated as sum of country risk premium, 10 year T-bond rate at year t and TED spread at year t . Country risk premium for Bangladesh is collected from the research work of Damodaran (2012). The *TED* spread is the difference between the interest rates on interbank loans and on short-term government debt (T-bills). In this study *TED* spread is calculated as the difference between call money rate and 3 months T-bill (issued by Bangladesh Bank) rate. According to Wu and Hong (2012), this variable is called the market valuation component.⁴ Researchers expect the coefficient on the $X_{1,it}$ (β_1) to be positive, as an increase in the return on assets increases the solvency while an increase in the market discount rate reduces the solvency. The leverage term (ratio of total assets to effective capital) serves as an amplifier for the effects of changes in the return on assets and in the market discount rate. In other words, this amplifier can make a good thing better and a bad thing worse.

Ratio of interest income to effective capital and ratio of income from securities to effective capital:

Ratio of interest income to effective capital is the second independent variable ($X_{2,it}$) in this study. This ratio is calculated as follows:

$$X_{2,it} = \frac{\text{Interest Income}_{i,t}}{TCE_{i,t} + TCE_{i,t}}$$

⁴ The modeling of the market valuation component (Wu & Hong, 2012) is inspired by the works on the interaction between liquidity risk and mark-to-market valuation (Allen and Carletti (2008); and Plantin, Sapra, and Shin (2008)), and on asset pricing with liquidity risk by Acharya and Pedersen (2005), and Chordia, Huh, and Subrahmanyam (2009).

Again, the third independent variable ($X_{3,it}$) is the ratio of income from securities to effective capital. Income from securities includes both the income from investments in government securities and other securities available in capital market. The ratio is calculated as follows:

$$X_{3,it} = \frac{\text{Securities Income}_{i,t}}{TCE_{i,t} + TP_{i,t}}$$

Interest incomes and incomes from securities of selected banks are collected from the income statements of the selected banks. Researchers expect to coefficients on $X_{2,it}$ and $X_{3,it}$ (β_2 and β_3) to have positive signs as banks with more income are more likely to be solvent.

Ratio of interest expense to effective capital:

Ratio of interest expense to effective capital is the fourth independent variable ($X_{4,it}$) in this study. This ratio is calculated as follows:

$$X_{4,it} = \frac{\text{Interest Expense}_{i,t}}{TCE_{i,t} + TP_{i,t}}$$

Interest expenses of selected banks are collected from the Income statements of the selected banks. As more interest expense can negatively affect the solvency condition of banks, researchers expect to the coefficient on $X_{4,it}$ (β_4) to be negative.

Ratio of net non- interest income to effective capital:

Ratio of interest income to effective capital is the fifth independent variable ($X_{5,it}$) in this study. This ratio is calculated as follows:

$$X_{5,it} = \frac{\text{Net Non - Interest Income}_{i,t}}{TCE_{i,t} + TP_{i,t}}$$

Banks' net non- interest income refers to the banks' net income minus the net interest income from loans and securities. Researchers do not have any priori expectation about the sign on the coefficient on the net non-interest income (β_5). Demirgüç-Kunt and Huizinga (2012) argue that generation of some non-interest income can reduce the possibility of a bank's being insolvent. On the other hand, the study by Brunnermeier et al., (2012) conclude that the banks with higher non-interest income have a higher contribution to risk of being insolvent than traditional banking.

Texas ratio multiplied by unemployment rate:

The sixth independent variable of the proposed model consists of two components. First one is the ratio of net non-performing asset to effective capital. This ratio is commonly known as Texas ratio. This measure is developed by Gerard Cassidy at RBC Capital while analyzing bank stocks during the wave of failures that hit in the 1980s. This ratio is calculated as follows:

$$\text{Texas Ratio}_{i,t} = \frac{\text{Net Non - Performing Asset}_{i,t}}{\text{TCE}_{i,t} + \text{TP}_{i,t}}$$

Here net non-performing asset is calculated as the sum of total non- performing loans and fixed assets including premise and building. In this study non- performing loan refers to the classified loan. If this ratio is at or above 100%, the bank is at severe risk of failure because it might not have sufficient capital to cover its losses (Jesswein, 2009). The second one is the unemployment rate. The interaction term between Texas ratio and unemployment rate is the 6th independent variable

$$X_{6,it} = \frac{\text{Net Non - Performing Asset}_{i,t}}{\text{TCE}_{i,t} + \text{TP}_{i,t}} \times \text{Unemployment Rate}_t$$

According to Wu and Hong (2012), higher unemployment rate will add to the pressure of financial institutions and could lead them to insolvency. As higher unemployment rate will increase the possibility of bank being insolvent, the researchers expect the sign on the coefficient on $X_{6,it}$ (β_6) to be negative.

Government securities ratio and total deposit Ratio

Government securities ratio at the year t and total deposit ratio at the year t are the seventh and eighth independent variables of the proposed model respectively. These variables are calculated as follows:

$$X_{7,it} = \frac{\text{Total government securities}_{i,t}}{\text{Total Asset}_{i,t}}$$

$$X_{8,it} = \frac{\text{Total Deposit}_{i,t}}{\text{Total Asset}_{i,t}}$$

Here $X_{7,it}$ is used as proxy for asset’s liquidity measure and $X_{8,it}$ is used as a proxy for measure of fund stability. Serious liquidity problems can cause an otherwise solvent bank to become insolvent under certain conditions (Diamond and Dybvig, 1983). Wu and Hong (2012) argue that liquidity risk is one of the major predictor of the bank being insolvent. So the researchers expect the coefficient on the government securities ratio (β_7) to be positive, as banks with more liquid assets are less likely to encounter liquidity difficulties. Lastly, the researchers do not have any prior expectation on the coefficient on the total deposit ratio (β_8), as it is not possible to know with confidence that whether this deposit is stable or unstable and bank with excessive reliance on unstable funding are more likely to run into funding problems. Researchers’ expectations on different variables are summarized in the following table.

Table 4: Expectation on Different Variables.

| Variable Type | Variables | Expected sign |
|---------------|---|---------------|
| Dependent | Proxy for Bank Solvency (Y_{it}) | |
| | Market Valuation Component ($X_{1,it}$) | + |
| | Ratio of Income from Securities to Effective Capital ($X_{2,it}$) | + |

| | | |
|-------------|---|-----|
| Independent | Ratio of Interest Income to Effective Capital ($X_{3,it}$) | + |
| | Ratio of Interest Expense to Effective Capital ($X_{4,it}$) | - |
| | Ratio of Net Non- Interest Income to Effective Capital ($X_{5,it}$) | +/- |
| | Texas Ratio Multiplied by Unemployment Rate ($X_{6,it}$) | - |
| | Government Securities Ratio ($X_{7,it}$) | + |
| | Total Deposit Ratio ($X_{8,it}$) | +/- |

5.0 Objectives

This paper aims at identifying the contributing factors to the solvency of commercial banks of Bangladesh and to propose a model that can be utilized to judge insolvency of the banks. The study assumes that a bank may fail due to insolvency and there are factors with both systematic and idiosyncratic contents to influence the insolvency. The study further focuses on discovering significance of those contributing factors to the solvency of commercial banks of Bangladesh so that the model can be better utilized.

6.0 Methodology

Model Specification

Panel data regression method has been applied to conduct this study. If individual effect μ_i (cross-sectional or time specific effect) does not exist ($\mu_i = 0$), ordinary least squares (OLS) is most efficient and consistent parameter estimator (Park, 2011). The estimation under such assumption is specified as follows:

$$Y_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \beta_4 X_{4,it} + \beta_5 X_{5,it} + \beta_6 X_{6,it} + \beta_7 X_{7,it} + \beta_8 X_{8,it} + \varepsilon_{it} \quad (1)$$

$i = 1, 2, 3, 4, \dots, 24$

Here ε_{it} is the error term and other variables are explained as above. OLS consists of few basic assumptions. Those assumptions include no autocorrelation and homoscedasticity. If individual effect μ_i is not zero in longitudinal data, heterogeneity may influence these assumptions. If autocorrelation and heteroskedasticity are found in collected data, the OLS estimator is no longer best unbiased linear estimator. Then panel data models provide a way to deal with these problems. Panel data models examine group (individual-specific) effects, time effects, or both in order to deal with heterogeneity or individual effect that may or may not be observed ((Park, 2011). These effects are either fixed or random effect. A fixed effect model examines if intercepts vary across time period or group. On the other hand a random effect model discovers differences in error variance components across time period or individual. The fixed effect model and random effect model are discussed below.

Fixed Effect Model and Random Effect Model

Fixed-effects (FE) model is used to analyze the influence of variables that differ over time. FE discover the connection between predictor and outcome variables within an entity (In this study, bank). Each bank has its own individual characteristics that may or not impact the predictor variables. The functional form of fixed effect model is:

$$Y_{it} = (\alpha + \mu_i) + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \beta_4 X_{4,it} + \beta_5 X_{5,it} + \beta_6 X_{6,it} + \beta_7 X_{7,it} + \beta_8 X_{8,it} + v_{it}$$

(2) $i = 1, 2, 3, 4, \dots, 24$

Where μ_i is a fixed or random effect specific to individual (bank) or time period that is not included in the regression, and errors are independent identically distributed, v_{it} . Since an individual specific effect is time invariant and considered a part of the intercept, μ_i is allowed to be correlated with other regressors. This fixed effect model is estimated by within effect estimation methods. On the other hand the rationale behind using random effects model is that, unlike the fixed effects model, the deviation across entities is supposed to be random and uncorrelated with the included in the model. The functional form of random effect model is:

$$Y_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \beta_4 X_{4,it} + \beta_5 X_{5,it} + \beta_6 X_{6,it} + \beta_7 X_{7,it} + \beta_8 X_{8,it} + (\mu_i + v_{it})$$

(3) $i = 1, 2, 3, 4, \dots, 24$

It is assumed in a random effect model that individual effect is not correlated with any regressor and then estimates error variance specific to groups or times (Park, 2011). Here, μ_i is considered as a component of the composite error term. For this reason a random effect model is also known as an error component model. Here random effect model is estimated by generalized least squares method. Both fixed effect and random effect model is run by the researchers by using statistical software Stata11.

Hausman Test

Hausman test is run to identify whether fixed effect or random effect is significant in the panel data. The Hausman specification test compares fixed and random effect models under the null hypothesis that individual effects are uncorrelated with any regressor in the model (Hausman, 1978).

Wooldridge Test for Autocorrelation

To identify whether autocorrelation exists in the panel data, Wooldridge test is run by the researchers in this study. Wooldridge (2002) derives a simple test for autocorrelation in panel-data models. Drukker (2003) provides simulation results showing that the test has good size and power properties in reasonably large sized samples. Null hypothesis for Wooldridge test shows there is no first order autocorrelation in the data. The rejection of null hypothesis means there is autocorrelation in data. Then fixed effect and random effect model would be run again by adjusting autocorrelation. Stata11 provides a way to run those models by adjusting autocorrelation. Hausman test is also run to identify the most effective model for controlled autocorrelation.

Testing for Heteroskedasticity in Panel Data

The panel data is also further tested to identify whether heteroskedasticity exists in the data. A test for heteroskedasticity is available for the fixed-effects model in Stata11. This test is called modified wald test. In this test the null hypothesis is homoskedasticity (or constant variance). The rejection of null hypothesis concludes heteroskedasticity. Robust option of Stata11 is then used to control heteroskedasticity in both fixed effect and random effect model.

7.0 Analysis and Findings

7.1 Econometric Issues

The data were analyzed using panel data regressions. Therefore, autocorrelation and heteroskedasticity problems on the residuals could provide incorrect standard errors. As cross-sectional data deals with different firms at a given point of time, such firms may be of different sizes such as small, medium, and large, heteroskedasticity is likely to be common. In order to check for the heteroskedasticity and autocorrelation problems, Modified Wald test and Wooldridge test were used and the results suggest that there was no evidence of positive autocorrelation⁵ but there was evidence of heteroskedasticity⁶. As a result, in the presence of heteroskedasticity, the OLS estimation of equation (1) would provide biased and incorrect standard errors. Therefore, fixed effect and Random effect Regression models were estimated at first. After that Hausman test was run to find whether the fixed effect or random effect model is better estimator. Based on the estimated models, random effect model is preferred over the fixed effect model. It may be noted that since the panel data suffers from heteroskedasticity, heteroskedasticity robust random effect model seems to be the best model for the present study.

7.2 Analysis of Empirical Results and Major Findings

The descriptive statistics of the variables are listed in the following table.

Table 5: Descriptive Statistics of the Variables (figure in ratio value)

| Variable | Mean | Std. Dev. | Min | Max |
|------------|----------|-----------|----------|----------|
| Y_{it} | 1.028874 | 1.87602 | -24.0463 | 2.095657 |
| $X_{1,it}$ | 0.993202 | 2.105288 | -22.3435 | 7.804812 |
| $X_{2,it}$ | 1.073339 | 1.325407 | -10.3579 | 12.07758 |
| $X_{3,it}$ | 0.148706 | 0.324425 | -2.71114 | 3.040617 |
| $X_{4,it}$ | 0.741563 | 1.082223 | -8.91225 | 9.384539 |
| $X_{5,it}$ | -0.06018 | 0.343842 | -2.82122 | 2.455655 |
| $X_{6,it}$ | 0.102446 | 1.163271 | -10.9168 | 11.53027 |
| $X_{7,it}$ | 0.106484 | 0.054739 | 0 | 0.320571 |
| $X_{8,it}$ | 0.827568 | 0.063211 | 0.642308 | 1.261124 |

Source: Calculations are done by researchers.

Table 5 shows that the average value of the solvency ratio of Bangladeshi banks (Y_{it}) is 1.028874. By definition if this value is equals to zero or less than zero, it indicates insolvency. Here average value of this variable not indicating insolvency. Table 6 presents the results of the heteroskedasticity robust random effect model. The diagnostic statistics are provided at the bottom of the table and the results indicate a strong goodness of fit of the estimated model. The R^2 of the regression models is 0.8760; similarly Wald

⁵ Wooldridge test was run for detecting autocorrelation on panel data: the null hypothesis of no first-order autocorrelation of $F(1, 23) = 1.849$ and $\text{prob} > F = 0.1871$, implying that there is no strong evidence of positive autocorrelation.

⁶ Modified Wald test for group wise heteroskedasticity in fixed effect regression mode: the null hypothesis of homoscedasticity of $\chi^2(24) = 4165.55$ and $\text{prob} > \chi^2 = 0.000$, suggests that there is evidence of heteroskedasticity.

test of the regression is statistically significant at 99% level⁷. This suggests that the model has a satisfactory overall explanatory power. Overall, most parameters in the study are consistent with our expectation and three of them are highly statistically significant.

Table 6: Result of the Random effect Model

| Variable | Coefficient of variable |
|------------|-------------------------|
| $X_{1,it}$ | 1.127***(17.21) |
| $X_{2,it}$ | -0.271(-0.44) |
| $X_{3,it}$ | -0.443***(-3.36) |
| $X_{4,it}$ | -0.167(-0.35) |
| $X_{5,it}$ | -0.105(-1.42) |
| $X_{6,it}$ | -0.324***(-3.82) |
| $X_{7,it}$ | 0.0229(1.11) |
| $X_{8,it}$ | 0.0273(1.19) |
| Constant | 0.555***(5.8) |
| R-sq | 0.8760 |
| Wald Test | 8177.44 |
| Prob>chi | 0 |

Asymptotic *t*- statistics are in parentheses. *** $p < 0.001$

The estimated results show that the coefficient on market valuation component (β_1) is positive and statistically significant at 0.001 significance level that implies when all other variables remain constant, for one unit increase in this variable, the solvency ratio is expected to increase by 1.127 units. This result is in line with prior expectation. Wu and Hong (2012) found similar results and explained that higher market valuation makes the banks less vulnerable. Another significant variable of the model is the ratio of income from securities to effective capital ($X_{3,it}$). The coefficient on $X_{3,it}$ is negative and also statistically significant at 0.001 significance level. However, this result is not consistent with the prior expectation of the researchers. The result also deviates from the findings of the research of Wu and Hong (2012). The volatility in stock market of Bangladesh might be a reason for this deviation. The unpredictable nature of capital market of Bangladesh makes the income from securities of banks inconsistent (Bangladesh Bank, 2013). The coefficient on the interaction term between the Texas ratio and the unemployment rates (β_6) is negative and statistically significant at 0.001 significance level. It implies that higher Texas ratio and unemployment rate will lead to insolvency of banks. This result is consistent with the findings of Jesswein (2009) and Wu and Hong (2012).

The authors expect the coefficient on the ratio of interest expense (β_4) to be negative and the empirical result matches with the prior expectation. It means that banks with lower interest expense are less likely to be insolvent. Empirical result found the coefficient on

⁷ The probability value of Wald test of $P [0.00] < 0.01$ rejects the null hypothesis and it implies that the regression model has got significant explanatory power.

the ratio of net non- interest income to effective capital (β_5) is negative which implies that banks with higher net non-interest income are likely to be insolvent. This finding matches with the study of Brunnermeier et al., (2012).

The coefficient on government securities ratio (β_7) is positive that matches with the expectation of the researchers. The coefficient on total deposit ratio (β_8) is also positive. These empirical results suggest that banks with higher liquidity are less likely to be insolvent but these results are not statistically significant. It also suggests that liquidity has no significant impact on the solvency of the commercial banks of Bangladesh. Empirical result also shows the coefficient on the ratio of interest income to effective capital (β_2) is negative. It deviates from the researchers' expectation but the result is not significant statistically. Among the eight variables used in the study except the ratio of interest income to effective capital ($X_{2,ii}$) and the ratio of income from securities to effective capital ($X_{3,ii}$), the rest of the variables provide the consistent result with the researchers' expectation and are consistent with the findings of the previous studies (Wu and Hong, 2012; Altman, 1968; Beaver, 1966; Jesswein, K.R., 2009).

8.0 Conclusion

In this paper, the researchers tried to find out how the selected variables can affect the solvency condition of banks using the panel data of Bangladeshi commercial banks from 2004 to 2011. The variables were selected based on previous empirical findings. The study found that bank specific factors such as market valuation component, ratio of income from securities to effective capital, and interaction term between Texas ratio and unemployment rate have significant effects on the solvency of the banks. The ratio used as proxy for liquidity risk has no significant impact on the solvency of the banks according to the result of the study. It implies liquidity plays insignificant role in the solvency of the banks. The major variables used in this paper matched the empirical findings of earlier studies. The findings suggest that the stakeholders should closely look at market valuation, income from securities and net non-performing asset of respective banks in their review of solvency of Bangladeshi banks. Banks should be more careful about their security holdings in the capital market and the amount of non- performing assets they hold. Macro- economic variables such as unemployment rate should also be taken into consideration. As higher employment rate will adversely affect the banking sector.

However, this type of analysis is usually complemented by testing the models to identify whether they correctly identify insolvency condition of banks based on the prior mishaps that took place. Nonetheless, bank failures are not common in Bangladesh as regulators don't allow banks to go bankrupt or fail through employing Commissioners and/or by means of recapitalization. Thereby, performing test on actual events is not possible in the current context. However, the results of the study conform to the findings and conclusions of empirical studies reviewed and followed. Thus, this study bears empirical and theoretical application. Further research in this area can be conducted to validate the

model on banks specifically on those banks that are on the edge of insolvency. Some new variables like growth of GDP, inflation, and consumer price index on the solvency of the banks can also be examined in further study.

References

1. Acharya, V. V. and Pedersen, L. H. (2005). Asset pricing with liquidity risk, *Journal of Financial Economics*, Vol. 77, pp. 375-410.
2. Ahmed, S. (2010, January 21). Institutions matter for development: Role of banking sector. Retrieved from http://www.pri-bd.org/index.php?option=com_content&view=article&id=75:institutions-matter-for-development-role-of-banking-sector&catid=47:bangladesh-economy&Itemid=59.
3. Allen, F. and Carletti, E. (2008). Mark-to-market accounting and liquidity pricing, *Journal of Accounting and Economics*, Vol. 45, pp. 358-378
4. Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, Vol.23, pp. 589-609.
5. Arena, M. (2008). Bank failures and bank fundamentals: A comparative analysis of latin america and east asia during the nineties using bank-level data, *Journal of Banking & Finance*, Vol.32, pp.227-299.
6. Avkiran, N. K. (1997). Models of retail performance for bank branches: predicting the level of key business drivers. *International Journal of Bank Marketing*, Vol.16, No.6.
7. Beaver, W. H. (1966), Financial ratios as predictors of failure, *Journal of Accounting Research*, Vol. 4, pp. 71-111.
8. Bangladesh Bank. (2012). *Financial Stability Report 2012*. Dhaka, Bangladesh Bank: Author. Retrieved from http://www.bangladesh-bank.org/pub/annual/fsr/final_stability_report2012.pdf
9. Bangladesh Bank. (2013). *Bangladesh Bank Quarterly July-September 2013* (XI.1). Dhaka, Bangladesh Bank: Author. Retrieved from <http://www.bangladeshbank.org.bd/pub/quarterly/bbquarterly/jul-sep2013/bbquarterly.php>
10. Brunnermeier, M.K., Dong, G. and Palia, D. (2012). Banks' Non-Interest Income and Systemic Risk. Retrieved from scholar.princeton.edu/markus/files/paper_2012_01_31.pdf on October, 2, 2013
11. Calomiris, C.W. (1989). Deposit Insurance: Lessons from the Record. *Federal Reserve Bank of Chicago Economic Perspectives*, (May/June), pp. 10-30.
12. Caprio Jr, G., and Klingebiel, D. (1996). Bank Insolvency : Bad Luck, Bad Policy or Bad Banking ? *Annual World Bank Conference on Development Economics 1996*. pp. 29-62
13. Carletti E. and Hartmann P. (2002). *Competition and Stability: What's Special Banking?* European Central Bank Working Paper No. 146.
14. Chordia, T., Huh, S. and Subrahmanyam, A. (2009). Theory-based illiquidity and asset pricing. *Review of Financial Studies*, Vol.22, pp. 3629-3668.
15. Chowdhury, A. (2002). Politics, Society and Financial Sector Reform in Bangladesh. *International Journal of Social Economics*, Vol.29, No.12, pp. 963 – 988.
16. Chowdhury, H. A., and Islam, M. S. (2007). Interest Rate Sensitivity of Loans and Advances: A Comparative Study between Nationalized Commercial Banks (NCBs) and specialized Banks (SBs). *ASA University Review*, Vol.1, No.1.
17. Cole, R. A. and Gunther, J. W. (1995). Separating the likelihood and timing of bank failure, *Journal of Banking & Finance*, Vol.19, pp. 1073-1089.
18. Damodaran, A. (2012). *Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2012 Edition*. Retrieved from <http://ssrn.com/abstract=2027211>
19. Demirgüç-Kunt, A. and Huizinga, H. (2012). Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads, *Journal of Banking and Finance*. Vol.37, pp.875-894
20. Diamond, D. W. and Dybvig, P. H. (1983), Bank runs, deposit insurance, and liquidity, *Journal of Political Economy*, Vol. 91, pp. 401-419

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21. Drukker, D.M. (2003). Testing for serial correlation in linear panel-data models. *The Stata Journal*, 2003, Vol.3 , No.2, pp. 168-177
22. Emran, Z. M. (2013, August 8). Banking sectors requires discipline. *The Financial Express*, p. 10.
23. Estrella, A., Park, S., and Perustuani, S. (2000). Capital ratios as predictors of Bank Failure. *Economic Policy Review*, Vol.6, No.2, pp. 33-52
24. Gorton, G. (1988). Banking Panics and Business Cycles. *Oxford Economic Papers*, Vol. 40 (December,1988), pp. 55-221.
25. Hausman, J. A. (1978). "Specification Tests in Econometrics." *Econometrica*, Vol.46, No.6, pp.1251-1271.
26. He, Z. and Xiong, W. (2012). Rollover risk and credit risk, *Journal of Finance*, Vol.67, pp. 391-429.
27. Hossain, M. K., and Bhuiyan, R. H. (1990). Performance Dynamics of Nationalized Commercial Banks in Bangladesh – The Case of Sonali Bank. *Journal of Business Studies, University of Dhaka*, Vol.11, No.1
28. Jahangir, N., Shill, S., and Haque, M. A. (2007). Examination of Profitability in the Context of Bangladesh Banking Industry. *ABAC Journal*, Vol.27, No.2
29. Jesswein, K.R. (2009). Bank Failure Models: A Preliminary Examination of the “Texas” Ratio. *Proceedings of the Academy of Banking Studies*, Vol.9, No. 1. New Orleans.
30. Khan, M. (2010). The Effect of Corporate Governance elements on Corporate Social Responsibility (CSR) Reporting: Empirical Evidence from Private Commercial Banks of Bangladesh. *International Journal of Law and Management*, Vol.52, PP. 82-109.
31. Khan, M., Halabi, A. and Samy, M. (2009). CSR Reporting Practice: A study of Selected Banking Companies in Bangladesh. *Social Responsibility Journal*, Vol.5, No.3, pp. 344-357.
32. King, T. B., Nuxoll, D. A. and Yeager, T. J. (2006). Are the causes of bank distress changing? Can researchers keep up?, *Federal Reserve Bank of St. Louis Review*, Vol.88, pp. 57-80.
33. Konstandina, N. V. (2006). *Probability of Bank Failure :The Russian Case*, Moscow: Economics Education and Research Consortium
34. Meyer, P. A. and Pifer, H. W. (1970). Prediction of Bank Failures. *Journal of Finance*, Vol. 25, pp. 853-868.
35. Park, H. M. (2011). *Practical Guides To Panel Data Modeling: A Step-by-step Analysis Using Stata. Tutorial Working Paper*. Graduate School of International Relations, International University of Japan
36. Plantin, G., Sapra, H. and Shin, H. S. (2008). Marking-to-market: Panacea or pandora's box?, *Journal of Accounting Research*, Vol.46 ,pp. 435-460.
37. Siddique, S. H., & Islam, A. F. (2001). Banking Sector in Bangladesh: Its Contribution and Performance. *Journal of Business Research, Jahangirnagar University*, Vol. 3.
38. Thomas, R. G. (1935). Bank Failures-Causes and Remedies. *The Journal of Business of the University of Chicago*, Vol. 8, No. 3 (Jul., 1935), pp. 297-318.
39. Watanagase, T. (1990). *Banks in Distress: The Case of Bangladesh (September 1990)*. IMF Working Paper, pp.1-33. Retrieved from <http://papers.ssrn.com/sol3/Delivery.cfm/WPIEA0811990.pdf?abstractid=885006&mirid=1>
40. Wooldridge, J. M. (2002), *Econometric Analysis of Cross Section and Panel Data*. Retrieved from Duke University, Economics Web site: http://public.econ.duke.edu/~vjh3/e262p_07S/readings/Wooldridge_Panel_Data_Chapters.pdf
41. Wu, D. and Hong, H. (2012). *Liquidity Risk, Market Valuation, and Bank Failures*. Retrieved from http://www.stanford.edu/doubleh/papers/Paper_Liquidity_Risk_and_Bank_Failures.pdf on September, 2013