The Determinants of Risk in Banking Sector of Bangladesh: A Panel Analysis

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Abstract- Commercial banks deal with other people's money. Therefore they have to perform their stewardship responsibility properly over their collected money. So comparing with others, banks have to face more risk. This paper considers the fundamental risks like capital risk measured by capital adequacy, credit risk and liquidity risk faced by banks and factors that exert impact over them. This paper shows that asset turnover and cash hold positive impact over capital adequacy where operating efficiency also influences positively to some extent but management efficiency, age and non-performing loan ratio are possessing negative impact. Asset turnover, age and cost-to-income ratio hold negative impact and non-performing loan ratio and liquidity risk are holding positive impact over credit risk. Asset turnover, credit risk, cost-to-income ratio and ROA are positively affecting liquidity risk ratio which implies liquidity risk reduction of banks. Age also possesses positive impact over liquidity risk to some extent. Some suggestions for the risk mitigation have also been provided.

Keywords- Capital Adequacy, Commercial Bank, Credit Risk, Difference GMM, Liquidity Risk, System GMM.

1. Introduction:

For any growing economy service sector plays crucial role and banking sector is the most inevitable contributor on behalf of overall service sector of such economy. Banking sector is quite different from other service related sectors as it conducts its commercial activities with other people's money and trust is the most concerning issue here. So risk faced by this sector is significantly higher in comparison to that of other service sectors. If banks are listed then public interest is more involved with the operational decisions made by the executives of them. So capital related risk is one of the core concerns for their related stakeholders. Trust is

an inseparable component for both the deposit collection and loan distribution activities of banks. Even though banks loan approbation mechanism is properly fortified through related guidelines banking scams are occurring more frequently in recent times. So credit risks faced by the banks are uprising day by day. Loans and investments are considered the major source of revenue for commercial banks. But they are not allowed to employ all of their money for revenue generation. As banks are doing business with other people's money they are bound to give them back on the demand of the legal owner of that money. So liquidity maintenance is one of the primal contributors of the reputation of the commercial banks. Therefore liquidity risk is crucial for banks to meet both profitability and reputational requirement of banks stakeholders. This paper is dealing with the major risks i.e. capital risk, credit risk and liquidity risk faced by the commercial banks of Bangladesh. It has also tried to find out the determinants or the influential factors of such risks with a view to improving risk management endeavors of commercial banks for their better performance in a highly competitive market environment.

This paper consists of six sections. The second section is dealing with Literature Review and hypotheses development which have been highlighted there for each individual variable. Third section is Model Specification and Variable Definition where three models for fundamental risk aspects have been formulated. Definition of all the variables used in this is also defined here. Fourth section is Data Collection and Descriptive Statistics where the methods used for data collection are discussed along with summary statistics, correlation analysis and multicollinearity test. Fifth section is econometric methodology, results, and discussion where all the methods used for analysis are briefed along with the interpretation of the outcomes obtained and causality of variables considered. Sixth section is Conclusion and Policy Implication where along with concluding the paper, a number of suggestions for risk mitigation of commercial banks of Bangladesh have been given through policy implications.

2. Literature Review and Hypotheses Development

In the area of risk management of the banking sector different researchers work on different sort of risks that exist in banking industry like operational risk, strategic risk, credit risk, liquidity risk, exchange rate risk, equity risk, default risk and so on. IT related risk is also a great concern of the modern banking era. This paper considers Credit Risk (CR), Liquidity

Risk (LR) and Capital Adequacy Ratio (CAR) for equity related risk to reveal the fundamental risk scenario faced by the commercial banks.

Capital Adequacy and Bank Age

A few literatures have revealed the impact of bank age on the capital adequacy of commercial banks. Dietrich and Wanzenried (2011) have shown that age of bank can affect bank structure. Aytül and Vuslat (2014) have found non importance of bank age over the capital adequacy of Turkish banks. Therefore following hypothesis can be developed to justify the effect of bank age or experience over the capital adequacy of banks:

H1a: *Bank age has positive/negative impact over the capital adequacy of banks.*

Capital Adequacy and Asset Turnover

It is hard to find credible sourced evidence that has used asset turnover of banks to justify its impact over the capital adequacy of banks. Binh and Thomas (2014) have examined the impact of asset turnover on capital adequacy and have found that insignificant positive relationship prevails between capital adequacy and asset turnover. So following hypothesis can be developed to justify the impact of asset turnover on the capital adequacy of banks:

H1b: *Asset turnover has positive/negative impact over the capital adequacy of banks.*

Capital Adequacy and Management Efficiency

Most of the available literatures have used both CAR and Management Efficiency for the CAMELS analysis of commercial banks. But we have not found any credible source which has used management efficiency to find out its impact on the capital adequacy of banks. Therefore we are not citing any previous work here. But in this paper management efficiency is to justify its impact over the capital adequacy of banks. As no previous working is available, outcome may not be predicted as usual. Therefore following hypothesis can be developed to justify the impact of management efficiency on capital adequacy of banks:

H1c: *Management Efficiency has positive/negative impact on the capital adequacy of banks.*

Capital Adequacy and Operating Efficiency

Only a few previous literatures have used operational efficiency of banks to uncover its effect over the capital adequacy of banks. Altunbas *et al.* (2000) has used operating efficiency of banks to determine the growth in bank capital. Awojobi *et al.* (2011) have found significant

negative effect of operating efficiency over the capital adequacy of banks. Onaolapo *et al.* (2012) have found that efficiency ratio does not reflect or affect much the capital adequacy of Nigerian Banks. Asma and Khadidja (2015) have found no significant effect of operating efficiency over the capital adequacy of banks. A number of papers have also used CAR to find its impact over operating efficiency. Odunga *et al.* (2013) have found no effect of CAR over the operational efficiency of commercial banks. Olarewaju *et al.*(2016) have found that debt to total equity, core capital ratio and bank risk hold major role over the effect of capital adequacy on the operating efficiency of banks. Odunga (2016) has shown that equity to total asset and equity to total asset have influence over the effect of CAR on operating efficiency. Increased equity and capital level also play vital role in developing operational efficiency of banks. So the following hypothesis can be developed to justify the impact of operating efficiency on the capital adequacy of banks:

H1d: *Operating Efficiency has negative impact on the capital adequacy of banks.*

Capital Adequacy and Cash

No credible sourced evidence has been found that has used cash and balance with other banks to judge their impact on the capital adequacy ratio of commercial banks. But a number of literatures have used liquidity ratio to judge its impact on the capital adequacy ratio of commercial banks where liquid assets of banks were used as the numerator of liquidity ratio. Yu (2000) has found significant positive relation exists between the equity to asset ratio and liquidity ratio of small banks but the result is reverse for medium sized banks. Ahmet and Hasan (2011) have found no significant impact of liquidity ratio over the capital adequacy of banks. Mohammed (2013) has found positive relation of liquidity with capital adequacy of banks. Aspal *et al.* (2014) has found that liquidity has statistically significant positive impact on capital adequacy of banks. Mekonnen (2015) has found insignificant negative effect of liquidity over capital adequacy of banks. Therefore following hypothesis can be developed to justify the impact of cash over the capital adequacy of banks:

H1e: *Cash has positive impact on the capital adequacy of banks.*

Capital Adequacy and Non-performing Loan Ratio

Available literatures are showing mixed result on the determination of impact of non-performing loan ratio over the capital adequacy of banks. Ahmad *et al.* (2008) have found

non performing loan ratio has positive relation with capital adequacy ratio of the banks of developing economy which is statistically significant. Abusharaba *et al.* (2013) have found significant negative correlation between non performing loan and CAR of Islamic banks. Rahari (2014) has found that CAR is affected by non performing loans. Polat and Al-Kalaf (2014) have shown insignificance between CAR and non performing loans. Vatansever et al (2015) has shown CAR has positive effect on non performing loans ratio. Alajmi and Alqasem (2015) have shown that non performing loan ratio has insignificant positive effect on CAR of Egyptian Banks. Therefore following hypothesis can be developed to justify the impact of non-performing loan ratio over the capital adequacy of banks:

H1f: *Non-performing loan ratio has positive/negative impact on capital adequacy of banks.*

Credit Risk and Bank Age

A few literatures have considered the impact of bank age over the credit risk related issues of banks. Volk (2014) has found negative relation between credit default and age of banks. Feng (2016) has found significant negative relation between bank age and credit risk. Chi and Li (2017) have shown positive relation between credit risk and bank age of Chinese banks. So the following hypothesis can be developed to justify the impact of bank age over the credit risk ratio of banks:

H2a: *Bank age has positive/negative impact over the credit risk ratio of banks.*

Credit Risk and Asset Turnover

Fang and Huang (2011) have showed that asset turnover of financial institutions has significant negative relation with credit default probability. Volk (2014) has shown that firms with higher asset turnover have the lower probability of credit default. Feyzi *et al.* (2016) have found significant negative relationship between asset turnover and credit risk of the listed banks of Tehran stock exchange. Therefore the following hypothesis can be developed to justify the impact of asset turnover on the credit risk ratio of banks:

H2b: *Asset turnover has negative impact over the credit risk ratio of banks.*

Credit Risk and Cost to Income Ratio

A number of literatures have used cost to income ratio to reveal or judge its effect over the credit risk of banks. Berger and DeYoung (1997) have found that high CIR may reduce available resources for risk management. Such may push the credit risk ratio up for the

commercial banks. Pestova *et al.* (2013) have shown that increase in cost to income ratio may increase the overdue loan ratio of commercial banks. Such incident may increase the credit risk of commercial banks. Amos Layola *et al.* (2016) have found that cost to income ratio has insignificant negative influence over the credit risk of commercial banks. On the other hand Mesa *et al.* (2014) have shown that (1-CR) has significant positive impact over cost to income ratio of banks. Therefore significant negative influence may prevail by credit risk over cost to income ratio of banks. So the following hypothesis can be developed to justify the impact of cost to income ratio on the credit risk ratio of banks:

H2c: *Cost to income ratio has positive impact over the credit risk ratio of banks.*

Credit Risk and Liquidity Risk

Tehulu and Olana (2014) have found negative but insignificant relationship between bank liquidity and credit risk. High liquidity reduces liquidity risk by creating high liquidity risk value which may reduce credit risk value. Volk (2014) has found that banks with higher liquidity have the lower probability of credit default. Waemustafa and Sukri (2015) have shown that higher liquidity generates lower credit risk exposure which is congruent to the finding of Cornett *et al.* (2011). It interprets that lower liquidity risk will generate higher credit risk for banks and proves the negative relationship between them. Therefore the following hypothesis can be developed to justify the impact of liquidity risk ratio over the credit risk ratio of banks:

H2d: *Liquidity risk ratio has positive/negative impact over the credit risk ratio of banks.*

Credit Risk and Non-performing Loan Ratio

Most of the available literatures have used Non-performing loan ratio as the proxy of credit risk. But credit risk ratio here is not using NPL ratio as proxy in this paper. Some other literatures have used credit risk as one of the determinants of non-performing loan ratio of commercial banks. However Ötker-Robe and Podpiera (2010) have examined the impact of NPL ratio over the credit risk of European financial institutions and have found that positive correlation prevails between non-performing loans and credit risk ratio. So the following hypothesis can be developed to justify the impact of non-performing loan ratio on the credit risk ratio of banks:

H2e: *Non-performing loan ratio has positive/negative impact on credit risk ratio of banks.*

Liquidity Risk and Bank Age

A number of literatures have examined the impact of bank age over the liquidity risk ratio such as, Ahmed *et al.* (2011) have shown that Islamic banks of Pakistan have positive and statistically significant relationship between liquidity risk and bank age which interprets that older banks have higher value of liquidity risk ratio. Maas (2016) has shown positive relationship between bank age and liquidity risk of European banks but the significance is very weak. Therefore the following hypothesis can be developed to justify the impact of bank age over the liquidity risk ratio of banks:

H3a: *Bank age has positive impact over the liquidity risk ratio of banks.*

Liquidity Risk and Asset Turnover

Raji and Sadiq (2016) has used asset turnover of Nigerian banks as proxy of banks' liquidity but we have not found any credible sourced document which has used asset turnover to find out its impact on the liquidity risk ratio of banks. Therefore we are not citing any previous work here. But in this paper asset turnover of bank is to justify its impact over the liquidity risk ratio of banks. As no previous working is available, outcome may not be predicted as usual. So the following hypothesis can be developed to justify the impact of asset turnover on the liquidity risk ratio of banks:

H3b: *Asset turnover has positive/negative impact over the liquidity risk ratio of banks.*

Liquidity Risk and Credit Risk

Wagner (2007), Cai and Thakor (2008), Gatev *et al.* (2009), Acharya *et al.* (2010) and Acharya and Naqvi (2012) all have found negative association between liquidity risk and credit risk but Hajja and Hussain (2015) have shown strong significant positive relationship between credit risk and liquidity risk. Samad (2015) has shown that banks' liquidity risk increases when Loan to total asset ratio increases which is used as credit risk ratio for this paper. Therefore positive relation prevails between credit risk and liquidity risk but the finding of Leykun (2016) is just opposite which means statistically negative significance exists between credit and liquidity risk. Therefore the following hypothesis can be developed to justify the impact of credit risk ratio over the liquidity risk ratio of banks:

H3c: *Credit risk ratio has negative impact over the liquidity risk ratio of banks.*

Liquidity Risk and Cost to Income Ratio

It is hard to find credible sourced evidence that has used cost to income ratio of banks to justify its impact over the liquidity risk ratio of banks. Bonfim and Kim (2011) have examined the impact of cost to income ratio over the liquidity risk ratio of commercial banks and have shown that cost to income ratio has insignificant negative relationship with liquidity risk of bank. As it is hard to make prediction about the result because of scarcity of previous literature on this the following hypothesis can be developed to justify the impact of cost to income ratio on the liquidity risk of banks:

H3d: *Cost to income ratio has positive/negative impact over the liquidity risk ratio of banks.*

Liquidity Risk and Return on Asset

Aspachs *et al.* (2005) have found insignificant relation between liquidity risk and banks' profitability. Valla *et al.* (2006) and Delechat *et al.* (2012) both have found negative relation between liquidity risk and profitability of banks. Vodova (2013), Lartey *et al.* (2013) and Singh and Sharma (2016) have found significant positive impact of banks profitability over liquidity risk where measurement of profitability is banks' ROA. Iqbal *et al.* (2015) have found impact of ROA is positively significant to the liquidity risk of Pakistani Islamic banks. Rahman and Banna (2015) have found ROA has insignificant influence over liquidity risk in conventional banks but influence is significantly positive for Islamic banks. Therefore the following hypothesis can be developed to justify the impact of return on asset over the liquidity risk ratio of banks:

H3e: *Return on asset has positive/negative impact over the liquidity risk ratio of banks.*

3. Model Specification and Variable Definition

3.1. Model Specification

This paper has used capital adequacy ratio, credit risk and liquidity risk for measuring fundamental risk scenario of banking sector. So, three basic models are developed for risk related issues. Therefore for risk related aspect, the following multivariate regression equations have been used to test the hypotheses:

$$CAR_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 ATO_{it} + \beta_3 ME_{it} + \beta_4 OE_{it} + \beta_5 Cash_{it} + \beta_6 NPLR_{it} + \varepsilon_{it} \quad (1)$$

$$CR_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 ATO_{it} + \beta_3 LR_{it} + \beta_4 CIR_{it} + \beta_5 NPLR_{it} + \varepsilon_{it} \quad (2)$$

$$LR_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 ATO_{it} + \beta_3 CR_{it} + \beta_4 CIR_{it} + \beta_5 ROA_{it} + \varepsilon_{it} \quad (3)$$

In the above regressions, 'i' is noted for individual banking company,'t' stands for time period and ε_{it} is the disturbance term.

3.2 Variable Definition

For analyzing fundamental risk scenario of banking industry, Capital Adequacy Ratio (CAR), Liquidity Risk (LR) and Credit Risk (CR) have been used in this paper and all are expressed in percentage. Capital adequacy is the proportion of banks own equity in comparison to its risk exposure. It also signifies the solvency of any particular bank. It also ensures its ability to absorb reasonable amount of loss along with its compliance with statutory capital requirements. It assures the stability and efficiency of banks. The formula of it is used as per Ahmad *et al.* (2008) which is defined according to 1998 Basel Accord. Banks' exposure to counterparty risk is measured by credit risk. High value of this signifies high risk along with a high profitability of banks but risk minimization and profit maximization is possible if proper management is performed and it is calculated as per the formula used by Awojobi *et al.* (2011). Liquidity risk ratio represents how much liquid asset is available in comparison to banks total asset. High value of this ratio signifies high liquidity with low risk but it reduces loan creation and the profit generation ability of commercial banks and it is calculated as per the reference of Rahman and Banna (2015).

Table 1: Variable definition

CAR	Capital Adequacy Ratio= (Tier 1 Capital + Tier 2 Capital) / Risk Weighted Asset
LR	Liquidity Risk= Cash / Total Asset
CR	Credit Risk= Loans & Advances / Total asset
CIR	Cost to Income Ratio= Non-interest Expense / Total Income
ME	Management Efficiency= Earning Asset / Total Asset
OE	Operating Efficiency= Operating Expense / Operating Income
ROA	Return on Asset= Net Income / Average Total Asset
AGE	Number of years for which a particular bank is operating
ATO	Asset Turnover= Total Revenue / Average Total Asset
NPL	Non-Performing Loan Ratio= Non-performing loan / Total Loans & Advances
Cash	Cash= Cash in Hand +Balance with Central Bank+ Balance with other Commercial Banks & Financial Institutions

When earning assets of any particular bank increases eventually it will increase the value of management efficiency which is better for any particular banking company and this variable is used as per Ali and Ghauri (2013) and ME is expressed in percentage. Operating Efficiency denotes the amount of operating expense generated by each unit of operating income as per Olweny and Shipho (2011). So the lower the operating efficiency ratio for any particular bank the better cost efficiency of any particular bank is represented and it is expressed in percentage. If non-interest expense that means operating expense increases with the addition of each unit of total income of bank which means total interest income then value of cost to income ratio will increase. So increment in CIR will signify inefficiency of the bank and lower CIR represents better situation for any particular bank and it is calculated as per Growe *et al.* (2014) and it is also expressed in percentage.

Increment in Return on Asset (ROA) is considered better for the overall performance of the company. Increase in net income or decrease in total asset would increase the value of return on asset and vice versa. ROA is considered in this paper as per the formula used by Shah and Jan (2014) and it has been expressed in percentage. Value of AGE of a particular bank denotes the experience of that bank and it is measured as per Zeitun (2012). More experienced banks are appeared here with higher value of AGE which is considered a good sign for that bank. Asset turnover (ATO) measures the amount of revenue generated by each monetary unit of asset as per Feyzi *et al.* (2016) and used in percentage format for this paper. So usually a higher asset turnover is a better signature for banks but reversed situation may be appeared at the period of expansion or growth. NPL measures the amount of non-performing loan as per the total amount of loans and advances outstanding of any particular bank determined as per Alajmi and Alqasem (2015) and for this paper it is measured in percentage. This ratio measures the quality of the loans and advances of any bank and high value of this ratio is considered as an important indicator of bank winding up or bank collapse in many literatures. Cash signifies the liquidity held or maintained by the considered commercial banks. Liquidity is needed for reputation of commercial banks through better service providence. But excessive cash holding or liquidity may imply that the bank is unable to use available resources for revenue generation and it increases the cost also. Cash hold by banks is calculated for this paper by combining cash in hand, balance with central bank and balance with other banks & financial institutions and this formula is developed by authors' idea.

4. Data Collection and Some Descriptive Statistics

This section is discussing data collection mechanism of the report and comments or discussion on the descriptive statistics and correlation analysis among all sorts of variables which are used in this report for model building up and analysis. Descriptive statistics especially mean, standard deviation and coefficient of variance for each individual variable are determined for each individual banks considered in this report and for overall banking sector. Correlation analysis of all variables used in this report is performed for overall banking sector.

4.1 Data Collection

This report is considering almost all the Dhaka Stock Exchange (DSE) listed banks of Bangladesh. Out of thirty commercial banks which are now listed in DSE, this paper is working with a sample of twenty nine banks except ICB Islami bank limited. This paper is using secondary data source as most of the financial information on the basis of which this paper is prepared is basically from the published annual reports of the commercial banks. This paper is considering the financial data of eleven years annual reports of the considered DSE listed commercial banks for period 2005 to 2015 to formulate data panel for analysis.

4.2 Descriptive Statistics

Table 02 is showing the bank wise Mean, Standard Deviation (SD) and Coefficient of Variation (CV) of all the variables used in this paper. Table 03 is showing the mean standard deviation and coefficient of variation of the total sample size used in this paper. Here covariance values of a number of variables are very much high because of the large sample size which is used for this paper.

4.2.1 Discussion

By considering Table 02 and Table 03 together is has been seen that for capital adequacy ratio data volatility is very much lower except for Rupali bank in comparison to that of the whole sample. Credit risk ratio volatility is highest for The City bank which is greater than that of the whole sample as covariance of credit risk is very high for the overall sample. Volatility of credit risk ratio for Rupali bank, Pubali bank, Prime bank and SIBL is also a bit high. The liquidity risk ratio volatility for the whole sample is highest among all other

Table 2.1: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		CAR	CR	LR	ME	OE	CIR
	Mean	12.8455	72.9572	12.0636	75.8002	34.2003	68.0193
Al-ArafahIslami Bank	SD	1.9350	4.2591	3.8345	3.2827	4.8910	7.1457
	CV	15.06	5.84	31.79	4.33	14.30	10.51
	Mean	10.9991	66.3874	9.0169	79.6811	43.6479	71.7751
AB Bank	SD	1.4152	3.7957	1.3052	3.2610	13.3853	10.0643
	CV	12.87	5.72	14.48	4.09	30.67	14.02
	Mean	11.4936	70.0095	7.0333	84.8039	35.7892	70.6056
Bank Asia	SD	1.7644	5.7396	1.1403	1.8935	3.6403	2.3995
	CV	15.35	8.20	16.21	2.23	10.17	3.40
	Mean	10.8464	69.8645	12.7314	81.2995	38.5189	74.5161
Dhaka Bank	SD	0.7827	1.5326	3.0422	1.6473	5.6707	5.4419
	CV	7.22	2.19	23.90	2.03	14.72	7.30
	Mean	9.8900	72.8423	12.5995	78.5637	54.1717	84.5653
First Security Islami Bank	SD	0.8654	8.1939	2.6527	6.7829	9.6284	8.2499
	CV	8.75	11.25	21.05	8.63	17.77	9.76
	Mean	11.2982	69.0751	10.7893	82.6341	37.1525	67.2427
Eastern Bank	SD	3.1595	2.9632	2.3946	2.2752	4.7655	4.3476
	CV	27.96	4.29	22.19	2.75	12.83	6.47
	Mean	11.6809	61.2002	16.6147	71.2352	50.2085	73.1021
Dutch-Bangla Bank	SD	1.5085	4.1919	4.6539	4.2812	8.1648	6.2101
	CV	12.91	6.85	28.01	6.01	16.26	8.50
	Mean	11.8591	157.2896	36.3466	197.2994	47.3516	73.0233
The City Bank	SD	1.7925	207.4328	57.8502	264.9891	3.7416	8.9752
	CV	15.11	131.88	159.16	134.31	7.90	12.29
	Mean	11.9182	59.0555	8.1154	77.8635	38.4595	72.1361
Prime Bank	SD	1.3875	20.9269	0.8770	20.4194	6.1106	4.6359
	CV	11.64	35.44	10.81	26.22	15.89	6.43

Table 2.2: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		ROA	AGE	*Cash*	ATO	NPL
	Mean	1.6291	14.5000	11632.7831	12.5399	3.0300
Al-ArafahIslami Bank	SD	0.4744	3.3166	10600.3508	3.8513	1.5967
	CV	29.12	22.87	91.12	30.71	52.70
	Mean	1.6455	29.0000	12556.2645	14.9213	3.7200
AB Bank	SD	1.3184	3.3166	7084.7837	2.0040	1.6152
	CV	80.12	11.44	56.42	13.43	43.42
	Mean	1.7591	11.0000	7665.8236	13.2988	3.3564
Bank Asia	SD	0.7126	3.3166	5694.7176	2.6889	1.5678
	CV	40.51	30.15	74.29	20.22	46.71
	Mean	1.3382	15.0000	12876.3997	14.7190	3.8027
Dhaka Bank	SD	0.4543	3.3166	6845.8742	1.2474	1.8167
	CV	33.95	22.11	53.17	8.47	47.77
	Mean	0.8400	11.0000	11708.6072	13.1775	2.2101
First Security Islami Bank	SD	0.6232	3.3166	9677.8881	1.6167	1.0791
	CV	74.19	30.15	82.66	12.27	48.82
	Mean	1.8664	18.0000	11244.3294	14.5025	3.4145
Eastern Bank	SD	0.6311	3.3166	7561.1257	1.1425	1.0558
	CV	33.82	18.43	67.24	7.88	30.92
	Mean	1.4291	14.5000	21937.2531	14.7113	3.1711
Dutch-Bangla Bank	SD	0.3929	3.3166	17606.7233	2.6109	0.6909
	CV	27.49	22.87	80.26	17.75	21.79
	Mean	1.2473	27.0000	11616.9640	14.2512	6.1091
The City Bank	SD	0.6128	3.3166	7660.7904	1.4246	1.4601
	CV	49.13	12.28	65.94	10.00	23.90
	Mean	1.5745	15.0000	12492.2252	17.2418	3.0073
Prime Bank	SD	0.5868	3.3166	5739.7537	8.6553	2.6760
	CV	37.27	22.11	45.95	50.20	88.98

Table 2.3: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		CAR	CR	LR	ME	OE	CIR
	Mean	11.3536	69.8004	10.1027	84.1312	53.1811	79.4628
Premier Bank	SD	1.9870	6.4315	1.4781	3.4774	17.7258	11.5453
	CV	17.50	9.21	14.63	4.13	33.33	14.53
	Mean	10.1791	68.3421	10.3591	81.1618	41.4477	69.4667
United Commercial Bank	SD	1.5563	2.9570	1.4146	2.6360	2.8104	4.0339
	CV	15.29	4.33	13.66	3.25	6.78	5.81
	Mean	11.7027	66.1816	13.9411	80.5028	45.0518	77.5831
Trust Bank	SD	1.4561	5.2759	5.0210	5.0878	8.8259	6.3440
	CV	12.44	7.97	36.02	6.32	19.59	8.18
	Mean	12.2027	67.1002	9.9255	84.5924	49.2627	72.4656
National Bank	SD	1.1386	2.8691	1.8421	3.5780	15.1610	11.3957
	CV	9.33	4.28	18.56	4.23	30.78	15.73
	Mean	11.1391	66.9169	9.2161	84.9051	44.6573	79.5607
Mutual Trust Bank	SD	0.9679	5.2448	2.0302	1.9841	13.9356	6.9479
	CV	8.69	7.84	22.03	2.34	31.21	8.73
	Mean	0.1319	446.9570	88.4960	599.4372	60.9206	83.7956
Rupali Bank	SD	14.2748	196.3348	49.7381	260.8809	12.9825	9.5853
	CV	10821.11	43.93	56.20	43.52	21.31	11.44
	Mean	10.7794	68.2097	13.1354	81.1788	52.6469	74.4519
IFIC Bank	SD	1.3830	3.8071	2.9594	2.8093	6.1856	7.3182
	CV	12.83	5.58	22.53	3.46	11.75	9.83
	Mean	11.0235	76.8839	14.1197	82.0827	33.3433	73.8406
EXIM Bank	SD	1.2343	3.1588	3.1205	2.6929	6.1663	8.2984
	CV	11.20	4.11	22.10	3.28	18.49	11.24
	Mean	10.8927	71.3553	10.9857	83.9085	41.7764	74.2567
One Bank	SD	1.1241	2.2034	2.0069	2.1441	6.4605	3.1932
	CV	10.32	3.09	18.27	2.56	15.46	4.30

Table 2.4: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		ROA	**AGE**	***Cash***	**ATO**	**NPL**
	Mean	1.1745	11.0000	6730.6156	14.8326	5.1645
Premier Bank	SD	0.7332	3.3166	3715.5736	1.5124	1.7942
	CV	62.43	30.15	55.20	10.20	34.74
	Mean	1.4182	27.0000	14172.1038	13.8977	4.0327
United Commercial Bank	SD	0.3115	3.3166	8884.2998	1.1000	1.6149
	CV	21.96	12.28	62.69	7.91	40.05
	Mean	0.9809	10.5000	8786.6996	12.6308	2.6218
Trust Bank	SD	0.5540	3.3166	4800.5823	2.9692	0.8797
	CV	56.48	31.59	54.63	23.51	33.55
	Mean	2.1400	28.5000	13391.9265	14.2861	5.0527
National Bank	SD	1.6347	3.3166	7541.9868	1.3375	1.4152
	CV	76.39	11.64	56.32	9.36	28.01
	Mean	1.1536	10.0000	6218.4183	13.1055	3.3975
Mutual Trust Bank	SD	0.6204	3.3166	3520.0251	0.7949	2.2138
	CV	53.78	33.17	56.61	6.07	65.16
	Mean	-0.7973	24.0000	16920.3068	10.4295	18.8540
Rupali Bank	SD	4.2307	3.3166	13844.8450	1.7497	11.0532
	CV	-530.65	13.82	81.82	16.78	58.63
	Mean	1.2109	34.0000	11319.0385	13.6562	6.8707
IFIC Bank	SD	0.6818	3.3166	6625.2229	1.7623	5.2789
	CV	56.31	9.75	58.53	12.90	76.83
	Mean	1.7400	10.5000	18990.9102	14.2617	3.5951
EXIM Bank	SD	0.7181	3.3166	14015.3442	1.0831	1.9201
	CV	41.27	31.59	73.80	7.59	53.41
	Mean	2.0818	10.5000	6915.0008	13.7953	4.3518
One Bank	SD	0.7921	3.3166	3955.8544	2.5788	1.4147
	CV	38.05	31.59	57.21	18.69	32.51

Table 2.5: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		CAR	CR	LR	ME	OE	CIR
	Mean	11.4564	76.2416	7.4563	91.8088	33.2872	67.9462
NCC Bank	SD	1.5227	9.2499	1.2876	7.3810	6.0738	9.7025
	CV	13.29	12.13	17.27	8.04	18.25	14.28
	Mean	11.8436	62.2717	12.2927	82.8445	41.1208	75.8828
Jamuna Bank	SD	1.4362	5.6584	3.4770	3.5520	5.0769	5.9129
	CV	12.13	9.09	28.29	4.29	12.35	7.79
	Mean	10.9182	70.8246	8.0014	88.0999	42.8966	75.1571
Mercantile Bank	SD	1.0183	4.3365	0.9322	0.9082	3.9157	6.1823
	CV	9.33	6.12	11.65	1.03	9.13	8.23
	Mean	11.6173	61.1161	10.8654	66.9477	40.1588	73.8256
Islami Bank Bangladesh	SD	1.6370	1.5515	2.0577	4.0733	4.3863	4.3853
	CV	14.09	2.54	18.94	6.08	10.92	5.94
	Mean	12.0006	63.9764	10.5576	78.7867	45.7109	66.0117
Pubali Bank	SD	0.8968	20.7800	2.3354	25.0519	4.9644	5.1968
	CV	7.47	32.48	22.12	31.80	10.86	7.87
	Mean	12.1855	65.7411	14.2866	77.1099	49.4058	73.7872
BRAC Bank	SD	1.3522	4.5238	3.1348	4.5140	2.2308	3.3223
	CV	11.10	6.88	21.94	5.85	4.52	4.50
	Mean	12.4345	72.4298	13.4936	76.1567	33.0679	71.9435
ShahjalalIslami Bank	SD	2.1794	3.5211	5.6817	2.8904	12.6442	8.1057
	CV	17.53	4.86	42.11	3.80	38.24	11.27
	Mean	11.1500	69.3819	6.9375	87.2706	26.1820	69.1852
Southeast Bank	SD	1.5461	5.4564	1.1357	1.0601	3.4279	4.7372
	CV	13.87	7.86	16.37	1.21	13.09	6.85
	Mean	10.8909	63.4558	13.5334	67.3528	42.7719	76.2642
Social Islami Bank	SD	2.4113	19.2207	7.0463	20.2368	7.9751	6.5775
	CV	22.14	30.29	52.07	30.05	18.65	8.62

Table 2.6: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		ROA	AGE	*Cash*	ATO	NPL
	Mean	1.6091	26.5000	6469.0289	13.9227	4.7000
NCC Bank	SD	0.6472	3.3166	3770.9713	1.2296	1.7207
	CV	40.22	12.52	58.29	8.83	36.61
	Mean	1.3436	8.5000	8052.7164	14.1258	4.5418
Jamuna Bank	SD	0.5054	3.3166	4782.5338	1.7782	2.7911
	CV	37.62	39.02	59.39	12.59	61.45
	Mean	1.2218	10.5000	7964.0497	13.5788	3.6245
Mercantile Bank	SD	0.2988	3.3166	4928.7347	0.8578	1.1289
	CV	24.45	31.59	61.89	6.32	31.15
	Mean	1.0582	27.0000	46643.2647	11.2794	3.2273
Islami Bank Bangladesh	SD	0.3191	3.3166	19084.8948	1.0871	0.9164
	CV	30.15	12.28	40.92	9.64	28.40
	Mean	1.5155	51.0000	13839.0281	15.2742	3.6908
Pubali Bank	SD	0.5079	3.3166	6415.1034	9.4930	1.6369
	CV	33.51	6.50	46.36	62.15	44.35
	Mean	1.2673	8.5000	18484.3445	16.2937	5.1691
BRAC Bank	SD	0.4024	3.3166	14375.0150	1.2549	1.4360
	CV	31.76	39.02	77.77	7.70	27.78
	Mean	1.7409	8.5000	8936.0618	14.7432	2.7500
ShahjalalIslami Bank	SD	0.7544	3.3166	4462.1518	2.4762	2.8318
	CV	43.34	39.02	49.93	16.80	102.97
	Mean	1.4764	14.5000	10339.7699	13.7805	4.0027
Southeast Bank	SD	0.4262	3.3166	6617.8478	1.0233	0.3166
	CV	28.87	22.87	64.00	7.43	7.91
	Mean	1.7445	16.0000	9057.3198	14.2314	4.6118
Social Islami Bank	SD	0.8454	3.3166	5247.5452	1.5066	1.1882
	CV	48.46	20.73	57.94	10.59	25.76

Table 2.7: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		CAR	CR	LR	ME	OE	CIR
Standard Bank Limited	Mean	13.2082	72.6059	8.9671	85.1409	32.1836	72.6556
	SD	2.7931	4.9091	2.0832	3.0098	6.6695	8.3388
	CV	21.15	6.76	23.23	3.54	20.72	11.48
Uttara Bank Limited	Mean	13.2303	54.1898	10.8270	81.0263	50.3608	73.7358
	SD	2.2780	4.4362	3.0734	3.2952	4.9251	10.9348
	CV	17.22	8.19	28.39	4.07	9.78	14.83

Table 2.8: Bank Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance)

		ROA	AGE	*Cash*	ATO	NPL
Standard Bank Limited	Mean	1.7436	10.5000	5332.5697	14.0314	2.1436
	SD	0.4843	3.3166	2838.2637	0.9729	0.9973
	CV	27.78	31.59	53.23	6.93	46.52
Uttara Bank Limited	Mean	1.1564	45.0000	9325.4890	13.0361	9.2036
	SD	0.5404	3.3166	4482.3222	0.6300	3.6735
	CV	46.74	7.37	48.07	4.83	39.91

Table 3: Variable Wise Descriptive Statistics (Mean, Standard Deviation and Coefficient of Variance) of the Overall Banking Sector

	Mean	SD	CV
CAR	11.1438	3.7232	33.41
CR	83.8849	87.3873	104.18
LR	14.5797	20.3398	139.51
ME	102.5388	117.1899	114.29
OE	42.7219	11.1683	26.14
CIR	73.6643	8.2257	11.17
ROA	1.3900	1.1166	80.33
AGE	18.8793	11.3830	60.29
ATO	13.9502	3.1040	22.25
NPL	4.6009	4.0857	88.80
Cash	12469.6315	11297.0202	90.60

variables and similar to credit risk ratio The City bank is also having highest volatility which is more than that of the sample used. Similar to credit risk Rupali bank, SIBL and Shahjalal bank is having high liquidity risk ratio volatility too. Covariance of Management efficiency ratio is also very much high for the overall sample used. The City banks management efficiency ratio volatility is higher than that of the whole sample considered which is similar to previously discussed ratios. Pubali bank and SIBL are also bit high covariance value for management efficiency in comparison to other banks. Operating efficiency ratio covariance of overall sample is low which is good but AB bank, Premier bank, National bank and MTB are having higher covariance value than that of the overall sample used which is not good. Cost income ratio of overall sample is holding lowest covariance among all other variables which is good but AB bank, The City bank, Premier bank, National bank are holding more covariance than that of the overall sample used as usual along with NCC bank and Uttara bank. ROA of overall banking sector sample is also very much volatile but volatility of ROA of Rupali bank is quite noticeable. AB bank, First Security Islami bank and Premier bank are also holding high covariance value. Bank age is holding moderate coefficient value for total sample in comparison to other variables and no individual banks covariance is higher than that. Covariance of asset turnover for whole banking sector sample is much lower which is second lowest among other variables and it represents less volatility but Al-Arafah Islami

bank, Prime bank and Pubali bank are holding higher covariance in comparison to that of the overall banking sector sample. Non-performing loan ratio is holding much high covariance for total sample which signifies higher volatility of non-performing loan ratio of different banks but covariance of non-performing loan ratio of Prime bank and Shahjalal Islami bank have exceeded that. Cash is also holding much large covariance value for whole sample which implies higher volatility of cash holding of different banks but among all other sampled banks, covariance of cash holding of only Al-Arafah Islami bank has exceeded that.

4.2.2 Correlation Analysis

Table 4.1: Correlation Matrix (CAR)

	CAR	*ME*	*OE*	*ATO*	*Cash*	*AGE*	*NPLR*
CAR	1.0000						
ME	-0.5530* (0.0000)	1.0000					
OE	-0.2130* (0.0001)	0.2271* (0.0000)	1.0000				
ATO	0.1981* (0.0004)	-0.1836* (0.0010)	-0.1546* (0.0056)	1.0000			
Cash	0.1139* (0.0420)	0.0606 (0.2805)	0.1931* (0.0005)	-0.0956 (0.0882)	1.0000		
AGE	0.0218 (0.6987)	0.0969 (0.0840)	0.2636* (0.0000)	-0.0505 (0.3684)	0.2986* (0.0000)	1.0000	
NPLR	-0.5709* (0.0000)	0.6019* (0.0000)	0.4303* (0.0000)	-0.2085* (0.0002)	0.0498 (0.3749)	0.2498* (0.0000)	1.0000

The correlation matrix presented in table 4.1 is showing that ME and OE both are holding significant negative correlation with CAR where significant positive correlation prevails between ME and OE. ATO is holding significant positive correlation with CAR but significant negative correlation prevails with ME and OE. Cash is holding significant positive correlation with both CAR and OE. AGE is holding significant positive correlation with OE and Cash. NPLR is holding significant negative correlation with both CAR and ATO but positive correlation prevails with ME, OE and AGE with proper significance.

Here it is noticeable that one variable's relation with itself is appearing with coefficient value one. And this relation is following a diagonal pattern in the table when one variable is paired with itself. It is considered as one of the basic characteristics of Pearson correlation table.

Table 4.2: Correlation Matrix (CR)

	CR	*AGE*	*ATO*	*CIR*	*LR*	*NPLR*
CR	1.0000					
AGE	0.0684	1.0000				
	(0.2228)					
ATO	-0.1929*	-0.0505	1.0000			
	(0.0005)	(0.3682)				
CIR	0.1852*	-0.1006	-0.1976*	1.0000		
	(0.0009)	(0.0729)	(0.0004)			
LR	0.9078*	0.0778	-0.0986	0.2341*	1.0000	
	(0.0000)	(0.1660)	(0.0786)	(0.0000)		
NPLR	0.5893*	0.2498*	-0.2086*	0.3020*	0.4840*	1.0000
	(0.0000)	(0.0000)	(0.0002)	(0.0000)	(0.0000)	

The correlation matrix presented in table 4.2 is representing that ATO is holding significant negative correlation with CR. CIR is holding significant positive correlation with CR but negative correlation is significant with ATO. LR is possessing positive correlation which is significant with both CR and CIR. NPLR is holding significant negative correlation with ATO but positive correlation prevails which is quite significant with CR, AGE, CIR and LR.

Table 4.3: Correlation Matrix (LR)

	LR	*AGE*	*ATO*	*CR*	*CIR*	*ROA*
LR	1.0000					
AGE	0.0778	1.0000				
	(0.1660)					
ATO	-0.0986	-0.0505	1.0000			
	(0.0786)	(0.3682)				
CR	0.9078*	0.0684	-0.1929*	1.0000		
	(0.0000)	(0.2228)	(0.0005)			
CIR	0.2341*	-0.1006	-0.1976*	0.1852*	1.0000	
	(0.0000)	(0.0729)	(0.0004)	(0.0009)		
ROA	-0.3003*	-0.0672	0.2001*	-0.3690*	-0.5239*	1.0000
	(0.0000)	(0.2317)	(0.0003)	(0.0000)	(0.0000)	

The correlation matrix presented in table 4.3 is reporting that CR is holding significant positive correlation with LR where negative correlation appears along with significance for ATO. CIR is holding significant negative correlation with ATO but correlation becomes positive along with proper significance for both LR and CR. ROA is possessing significant positive correlation only with ATO where significant negative correlation prevails with LR, CR and CIR.

4.2.3 Test of Multicollinearity

Table 5: Variance Inflation Factor (VIF)

Variable	Dependent Variable CAR		Dependent Variable CR		Dependent Variable LR	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
ATO	1.06	0.939841	1.07	0.935598	1.08	0.928966
AGE	1.20	0.835042	1.11	0.902030	1.04	0.965508
NPLR	1.92	0.521339	1.52	0.658488		
CIR			1.18	0.848498	1.44	0.696841
ME	1.59	0.627811				
OE	1.30	0.767270				
Cash	1.13	0.881403				
LR			1.32	0.756239		
CR					1.18	0.847255
ROA					1.57	0.637333

Different methods have been applied by researchers in order to verify if there is any multicollinearity problem in the considered variables. This paper has used Variance Inflation Factor (VIF) test. VIF indicates whether a predicator has strong liner relationship with other predicator(s). No hard and fast rule exists about what value of the VIF should cause for concern but Andy Field (2006) has suggested that the value of 10 is a good value at which to worry which is consistent with Gujarati and Porter (2009). Reciprocal of VIF which means (1/VIF) is also related to the VIF tolerance statistics and as per Andy Field (2006) values below 0.1 indicate serious problem. Menard (1995) had suggested that values below 0.2 are worthy of concern. Based on the output presented in table 5 it can be concluded that the variables used in this study have no multicollinearity problem as the VIF value is below 10 and also the tolerance is above 0.1.

5. Methodology, Results and Interpretations

5.1 Methodology

The second step GMM has been used to remove endogeneity problem (the regressors may be correlated with the error terms) and to remove firm specific unobserved (inborn) heterogeneity as per Arellano and Bond (1991). Moreover, due to the presence of lagged dependent variable, auto-correlation problem may arise. Therefore, to get rid of the auto-correlation problem first difference lagged dependent variable is also instrumented with its past levels. One key problem of second step difference GMM estimation is that the standard

errors of the estimates may have downward bias. To fix out this problem, White period robust standard errors have been used. It is also notable that if panel has small time dimension (T) and long firm dimension (N), the estimation according to Arellano and Bond (1991) can be used even if it is not necessary as per Roodman (2009). The second step system GMM has been used for consistency check in results by Blundell and Bond (1998). It has augmented difference GMM estimation through the introduction of an additional assumption which generates additional set of moment conditions to leverage. It requires that lagged changes in dependent variable are the valid instruments for the level of lagged dependent variable in the level equation. To sum up system GMM requires more assumptions than difference GMM, and if the assumptions hold, it will achieve greater efficiency.

5.2 Empirical Result

From table 6 it has been found that negative impact is possessed by management efficiency over the capital adequacy ratio at 1 percent significant level in both difference GMM and system GMM method which represents that with the increase in earning assets of commercial banks or decrease in total asset may reduce the capital adequacy ratio of those commercial banks and vice versa but the co-efficient value is not so high. When impact of operating efficiency over capital adequacy ratio is measured result discrepancy has been found between difference GMM and system GMM method. In difference GMM method it has been found that operating efficiency has significant positive impact over capital adequacy ratio and this is just reverse of the finding of Awojobi *et al.* (2011), where system GMM has shown positive but insignificant impact of operating efficiency over capital adequacy ratio of commercial banks and this is consistent with the finding of Onaolapo *et al.* (2012) and Asma and Khadidja (2015). This analysis has also found that asset turnover ratio of commercial banks exerts moderately significant positive impact over the capital adequacy ratio of commercial banks in difference GMM method but with a comparatively higher positive co-efficient value asset turnover ratio of commercial banks has been found having favorable impact on capital adequacy ratio at 1 percent significant level in system GMM method. This result signifies that for the increase in revenue with constant or lower total asset may exert considerable supportive effect over the capital adequacy of commercial banks and vice versa and this goes against the finding of Binh and Thomas (2014). It has also been found that cash is possessing positive impact over the capital adequacy ratio of commercial banks at 1 percent significant level in both difference GMM and system GMM methods but the co-efficient value is very

Table 6: Panel Regression Result

Variables	Dependent Variable CAR		Dependent Variable CR		Dependent Variable LR	
	Difference GMM	System GMM	Difference GMM	System GMM	Difference GMM	System GMM
CAR (-1)	0.3866746*** (0.000)	0.3780209*** (0.000)				
CR (-1)			0.2959887*** (0.000)	0.2405587*** (0.000)		
LR (-1)					0.1732046*** (0.000)	0.2350201*** (0.000)
ME	-0.0096595*** (0.000)	-0.0036823*** (0.001)				
OE	0.0184568*** (0.001)	0.0021217 (0.696)				
ATO	0.0577921** (0.037)	0.1049627*** (0.001)	-2.365531*** (0.000)	-2.502233*** (0.000)	0.4695036*** (0.000)	0.4986206*** (0.000)
CR					0.1813718*** (0.000)	0.1807416*** (0.000)
Cash	0.0001375*** (0.000)	0.0001197*** (0.000)				
AGE	-0.1572843*** (0.001)	-0.0773179 (0.180)	-1.102751*** (0.000)	-1.422714*** (0.000)	0.0856485* (0.073)	0.1627195*** (0.000)
NPLR	-0.577922*** (0.000)	-0.4534377*** (0.000)	5.506219*** (0.000)	6.066857*** (0.000)		
CIR			-1.116469*** (0.000)	-1.155287*** (0.000)	0.2527389*** (0.000)	0.2470065*** (0.000)
ROA					0.5718091*** (0.000)	0.4720185*** (0.000)
LR			2.793885*** (0.000)	2.821613*** (0.000)		
CONSTANT	10.03916*** (0.000)	7.760814*** (0.000)	131.8512*** (0.000)	143.4578*** (0.000)	-31.0759*** (0.000)	-33.33289*** (0.000)
n	261	290	261	290	261	290
AR (2) Statistic	-1.0111 (0.3120)	-0.82486 (0.4095)	0.47861 (0.6322)	0.59701 (0.5505)	-1.2927 (0.1961)	-1.3092 (0.1905)
J-Statistic	26.35838 (0.9838)	27.39782 (0.9986)	26.13264 (0.9852)	25.39435 (0.9995)	26.59383 (0.9824)	25.25074 (0.9996)

*, **, *** Statistically significant at less than 0.10, 0.05 and 0.01 level

much lower in both of the methods. This result implies that with the increase in cash in hand of commercial banks it may also favorably affect or increase the capital adequacy ratio value of the commercial banks and vice versa but the effect is not so considerable and this is supported by the findings of Yu (2000), Mohammed (2013) and Aspal *et al.* (2014). Considering the effect of age of commercial banks over the capital adequacy ratio discrepancy has been found between the results in difference GMM and system GMM method. In difference GMM method bank age is possessing highly significant negative effect over the capital adequacy ratio of commercial banks with moderate co-efficient value but in system GMM method though impact of bank age over capital adequacy ratio is negative, the co-efficient value is comparatively lower with no significance which is consistent with the findings of Aytül and Vuslat (2014). Non-performing loan ratio of commercial banks is exerting highly negative effect over the capital adequacy ratio at 1 percent significant level in both difference GMM and system GMM method with very high negative co-efficient value which has been matched with the finding of Abusharaba *et al.* (2013). This result interprets that with the per unit increase in non-performing loan ratio the capital adequacy ratio may be decreased by around half unit and vice versa. So it is quite noticeable that the capital adequacy ratio of commercial banks is very much sensitive to the change in non-performing loan ratio of those commercial banks.

Among the determinants of credit risk of commercial banks it has been found that asset turnover ratio of commercial banks is having huge negative impact over the credit risk measurement of banks at 1 percent significant level along with very large negative co-efficient value in both difference GMM and system GMM method which is consistent with the finding of Feyzi *et al.* (2016). This result implies that with the per unit increase in asset turnover ratio of the commercial banks the credit risk ratio will be reduced by almost more than two unit and vice versa. Therefore it shows that increase in asset turnover may affect reversely the loan and advances of commercial banks which imply that revenue decreases when the loans and advances increase which indicates the poor quality of additional loans and advances of commercial banks. Bank age is also sowing negative impact over the credit risk ratio of commercial banks at 1 percent significant level along with large negative co-efficient value in both difference GMM and system GMM method which is consistent with the finding of Volk (2014) and Feng (2016). It represents that with the each year increase in age of commercial banks the credit risk of banks also decreases by almost one unit or more. Therefore it implies that the older commercial banks are possessing lower opportunity to

diversify their lending scope and may have failed to grab new lending opportunity. Result from table 6 is suggesting that non-performing loan ratio is having huge positive impact over the credit risk of commercial banks which is very much usual. Non-performing loan ratio is holding the largest positive co-efficient value among all other independent variables of credit risk of commercial banks along with 1 percent significant level in both difference GMM and system GMM method which is maintaining consistency with the finding of Ötker-Robe and Podpiera (2010). This output interprets that with the increase in per unit non-performing loan ratio the credit risk of commercial banks is also increased by almost five units or more and vice versa. This implies that in consideration of increasing loans and advances amount the commercial banks should be more concern regarding non-performing loan which may adversely affect the banks' total asset also. Cost to income ratio is also representing negative impact over the credit risk of commercial banks at 1 percent significant level along with large negative co-efficient value in both difference GMM and system GMM method which is supported by the finding of Pestova *et al.* (2013) and Mesa *et al.* (2014). This result interprets that each unit increase in cost to income ratio of commercial banks may reduce the credit risk of commercial banks by almost one unit or more than that and vice versa. It implies that decrease in revenue may adversely affect the loans and advances of the commercial banks or the loan maintenance expense is high which adversely affects loans and advances through increase in total cost. Liquidity risk ratio is exerting highly positive effect over the credit risk of commercial banks at 1 percent significant level along with huge negative co-efficient value in both difference GMM and system GMM method which is showing inconsistency with the findings of Cornett *et al.* (2011) and Waemustafa and Sukri (2015). This result represents that per unit increase in liquidity risk ratio of commercial banks the credit risk may increase by almost 2.50 units or more and vice versa. The probable reasons behind such incident may be increase in deposited amount in commercial banks or other related factors which increase the monetary flow or loan creation power of commercial banks.

Among the independent variables of liquidity risk of commercial banks it has been found that asset turnover ratio of commercial banks is possessing highly positive impact over the liquidity risk ratio at 1 percent significant level along with large positive co-efficient value in both difference GMM and system GMM method. This result interprets that per unit increment in asset turnover of commercial banks may lead to increase in liquidity risk ratio value by almost half a unit which represents reduced liquidity risk for those commercial banks. It implies that asset turnover increment or revenue increment may also have

significantly high positive influence over cash in hand of the commercial banks. Credit risk of commercial banks is having positive influence over the liquidity risk ratio at 1 percent significant level in both difference GMM and system GMM method which is showing consistency with the findings of Hajja and Hussain (2015) and Samad (2015). This result interprets that with the increment in credit risk ratio the liquidity risk ratio value of commercial banks may also be increased. The probable reason of such incident may be the increment of monetary flow among commercial banks or other related factors that may influence the loan creation power of commercial banks favorably. Result discrepancy exists in case of determining the bank age's impact over the liquidity risk ratio of commercial banks. Difference GMM method shows that bank age is having positive influence over the liquidity risk ratio with a very little significance and the co-efficient value is also not so large which is showing consistency with the outcome of Maas (2016). But with the increment in co-efficient value of bank age in system GMM method, it shows positive impact over the liquidity risk ratio of commercial banks at 1 percent significant level which is maintaining congruence with the finding of Ahmed *et al.* (2011). This result implies that the older banks are holding more cash to maintain high liquidity which is favorable for service reputation with the increase in their experience. Cost to income ratio exerts positive influence over the liquidity risk ratio of commercial banks at 1 percent significant level in both difference GMM and system GMM method which is showing incongruence with the finding of Bonfim and Kim (2011). This result interprets that the increase in cost to income ratio may produce increment in liquidity risk ratio of commercial banks which implies that lower revenue or high cost may consequently produces higher cash in hand for commercial banks as they may have failed to use their monetary resource in revenue generating activities and holding more liquid assets than they needed. Return on asset is possessing positive impact over the liquidity risk ratio of the commercial banks at 1 percent significant level along with moderate positive co-efficient value in both difference GMM and system GMM method which is maintaining consistency with the findings of Vodova (2013), Lartey *et al.* (2013), Iqbal *et al.* (2015) and Singh and Sharma (2016). This result interprets that the per unit increase in return on asset ratio of commercial banks the liquidity risk ratio may also be increased by almost half of one unit which implies the reduction of liquidity risk for the banks. It represents that with the increase in return on asset the commercial banks may have a tendency holding more cash to increase the liquidity which develops service quality of commercial banks.

5.3 Causality

Table 7.1: Short Run Causality of Equation ()

Variable	CAR	ME	OE	ATO	CASH	AGE	NPLR
CAR		4.89* (0.09)	4.53 (0.10)	6.29** (0.04)	1.02 (0.60)	2.53 (0.28)	79.41*** (0.00)
ME	17.27*** (0.00)		3.72 (0.16)	1.10 (0.58)	1.74 (0.42)	1.71 (0.42)	38.13*** (0.00)
OE	0.47 (0.79)	4.15 (0.13)		0.53 (0.77)	1.03 (0.60)	1.35 (0.51)	4.08 (0.13)
ATO	0.67 (0.72)	1.08 (0.58)	0.62 (0.73)		8.60** (0.01)	1.88 (0.38)	4.67* (0.09)
CASH	4.00 (0.13)	0.68 (0.71)	1.34 (0.51)	3.99 (0.14)		1.31 (0.52)	2.71 (0.26)
AGE	0.61 (0.74)	1.44 (0.49)	0.32 (0.85)	2.36 (0.30)	2.38 (0.30)		0.86 (0.65)
NPLR	7.43** (0.02)	20.23*** (0.00)	16.87*** (0.00)	7.66** (0.02)	2.29 (0.32)	0.56 (0.76)	

Note: *** P value <0.01 denotes significant at 1%,** P value <0.05 denotes significant at 5%, *P value <0.10 denotes significant at 10%.

The short flow of causality is [$CAR \Leftrightarrow ME$, $NPLR \Leftrightarrow CAR$, $NPLR \Leftrightarrow ME$, $CASH \Rightarrow ATO$, $NPLR \Leftrightarrow ATO$, $ATO \Rightarrow CAR$, $OE \Rightarrow NPLR$]. Here, the symbol $\Leftrightarrow$ denotes the bidirectional causality and the symbol $\Rightarrow$ denotes the unidirectional causality.

Table 7.2: Short Run Causality of Equation ()

Variable	CR	ATO	AGE	NPLR	CIR	LR
CR		0.45 (0.79)	4.07 (0.13)	70.70*** (0.00)	2.55 (0.28)	75.57*** (0.00)
ATO	0.40 (0.81)		4.12 (0.13)	1.01 (0.60)	10.74*** (0.00)	0.05 (0.97)
AGE	0.21 (0.89)	1.90 (0.38)		0.03 (0.98)	0.66 (0.71)	0.21 (0.90)
NPLR	2.91 (0.23)	3.44 (0.18)	6.99** (0.03)		11.82*** (0.00)	1.01 (0.60)
CIR	2.99 (0.22)	1.26 (0.53)	2.28 (0.32)	12.22*** (0.00)		9.17** (0.01)
LR	37.16*** (0.00)	1.08 (0.58)	1.48 (0.47)	27.89*** (0.00)	2.67 (0.26)	

Note: *** P value <0.01 denotes significant at 1%, ** P value <0.05 denotes significant at 5%, * P value <0.10 denotes significant at 10%.

The flow of short run causality [$NPLR \Rightarrow CR$, $LR \Leftrightarrow CR$, $CIR \Rightarrow ATO$, $AGE \Rightarrow NPLR$, $CIR \Leftrightarrow NPLR$, $LR \Rightarrow CIR$, $NPLR \Rightarrow LR$]. Here, the symbol $\Leftrightarrow$ denotes the bidirectional causality and the symbol $\Rightarrow$ denotes the unidirectional causality.

Table 7.3: Short Run Causality of Equation ()

Variable	LR	ATO	CR	AGE	CIR	ROA
LR		0.96 (0.62)	48.56*** (0.00)	0.09 (0.95)	1.07 (0.59)	11.62*** (0.00)
ATO	0.06 (0.97)		0.54 (0.76)	5.48* (0.06)	7.60** (0.02)	0.29 (0.86)
CR	62.72*** (0.00)	0.26 (0.88)		0.02 (0.99)	3.31 (0.19)	12.95*** (0.00)
AGE	0.24 (0.89)	1.91 (0.38)	0.25 (0.88)		0.57 (0.75)	0.09 (0.95)
CIR	11.28*** (0.00)	1.17 (0.56)	5.07* (0.08)	4.02 (0.13)		10.95*** (0.00)
ROA	1.73 (0.42)	6.13** (0.07)	1.89 (0.39)	2.62 (0.27)	16.38*** (0.00)	

Note: *** P value <0.01 denotes significant at 1%, ** P value <0.05 denotes significant at 5%, * P value <0.10 denotes significant at 10%.

The flow of short run causality [$CR \Leftrightarrow LR$, $ROA \Rightarrow LR$, $AGE \Rightarrow ATO$, $CIR \Rightarrow ATO$, $ROA \Rightarrow CR$, $LR \Rightarrow CIR$, $CR \Rightarrow CIR$, $ROA \Leftrightarrow CIR$, $ATO \Rightarrow ROA$]Here, the symbol $\Leftrightarrow$ denotes the bidirectional causality and the symbol $\Rightarrow$ denotes the unidirectional causality.

6. Conclusion and Policy Recommendation

A core objective this paper is to investigate empirically what factors are affecting and the way of affecting the fundamental risk aspects of the banking sector of Bangladesh. Panel regression methodology with two methods, difference GMM and system GMM have been employed to investigate the risk associated variables. Considering our finding from panel regression analysis it has been represented that capital adequacy which is used as a proxy of capital risk is influenced positively with asset turnover, operating efficiency and by cash to some extent but negative impact is imposed by management efficiency, bank age and non-performing loan ratio. Credit risk is influenced positively by liquidity risk and non-performing loan ratio where reverse impact is imposed by asset turnover, bank age and cost-to-income ratio. Asset turnover, return on asset, cost to income ratio and credit risk ratio all possesses positive impact over liquidity risk ratio which implies their positive contribution towards liquidity risk reduction of commercial banks. Bank age is also holding positive effect over liquidity risk ratio to some extent.

Based on the evidence presented in this paper it is suggesting some effective initiatives for risk mitigation of the commercial banks. For capital risk reduction, since increase in loan and

advances leads requiring sufficient capital for banks (significant negative impact of management efficiency) banks should maintain adequate capital for excess loan and advances. It has been found that additional units of operating expense increases the capital requirement of the commercial banks (significant positive impact of operating efficiency). So adequate amount of capital should be maintained to face sudden hike in operating expense. Banks should give emphasis on increase of asset turnover since asset turnover has positive impact on capital adequacy ratio. Since it has been seen that increase in cash improves the capital adequacy ratio of banks, more cash should be held by banks for to satisfy additional capital requirements. We have also found that older banks are maintaining lower capital adequacy ratio. So the regulatory authority (Bangladesh Bank) need to formulate necessary policies specially for experienced banks for the betterment of their capital adequacy level. NPLR reduces the CAR of commercial banks (significant negative impact of NPLR). So effective policies needed to be enforced by the regulatory authority (Bangladesh Bank) over banks for reducing their NPLR level. For credit risk reduction, more emphasis should be given to asset turnover with the increase in loans and advances of banks to reduce the credit risk of banks (significant negative impact of asset turnover). NPLR behaves amicably with credit risk of banks. So reduction in NPLR is inevitable to refrain the credit risk from crossing the alarming level. It has been found that with the increase in cash assets of commercial banks the loan giving capacity of banks increases (significant positive impact of liquidity risk ratio). So adequate cash should be maintained to satisfy the demand of the clients of banks. For liquidity risk management, commercial banks should maintain proper balance among loans & advances and liquidity. This is very much necessary because loans and advances is banks' main source of maintaining profitability where Liquidity is necessary for daily operation and maintaining bank reputation. Balance between them may change the scenario of both the credit risk and liquidity risk to a favorable way for commercial banks. Asset turnover of commercial banks are needed to be maximized to reduce the liquidity risk to a tolerable level since increasing asset turnover is an ideal way to inflate cash assets of commercial banks. With the increase in loan and advances banks should hold enough cash to meet the depositors claim as and when requires. Experienced banks hold more liquid assets to perform banking operations more smoothly which provides them with competitive advantage in the market. Sudden hike in total operating cost of banks is one of the major challenges of commercial banks and additional holding of cash is one of the most viable ways for resolving such contingencies.

Overall one more thing is very much important for the commercial banks of developing countries and that is ethics. The decision makers of the banks should be more ethically strong in banking business operation and abide existing banking guidelines properly. Ethical development is the panacea for most of the recent predicaments of banking industry of Bangladesh. Bankers should always bear in mind that they are dealing with public money and public interest. So any sort of irresponsible decision of them may hamper the public directly.

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