Competition and Concentration in Bangladeshi Banking Sector: An Application of Panzar-Rosse Model

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Abstract

The purpose of this paper is to investigate the market structure and degree of concentration of Bangladeshi banking industry. The study measured market concentration by using widely recognized measures like k-bank concentration ratio and Herfindahl-Hirschman Index (HHI). It evaluates market structure by applying Panzar-Rosse Model over 8 years period from 2006 to 2013. The result of concentration measures indicates a decreasing trend and low level of market concentration in Bangladeshi banking industry over the sample period. The panzer-Rosse “H-Statistic” suggests that banks in Bangladesh are operating under monopolistic competition. Present paper contributes to a burgeoning literature on banking competition that has evolved significantly over the past periods on a developing country perspective like Bangladesh.

Key Words: *Banking, Competition, Concentration, Hirschman-Herfindahl Index, Panzar-Rosse Statistic.*

JEL classification: G21; L1; D40; L80

Introduction

The financial system is the ultimate engine for achieving economic prosperity of a country and it is involved in the mobilization of financial resources from the surplus units to the deficit units (Uddin and Gupta, 2012). The health of the financial services industry affects the economy at many levels including individuals, firms, and overall national development (Mercan, 2012). In a financial system, banks play a significant role in different sectors like financing, payment system, transmission of monetary policy and the provision of credit (Kashi and Beynabadi, 2013). Thus, banking sector is widely regarded as a vital cog in investment and savings cycle in the economy of a particular country (Arrawatia and Misra, 2014).

The banking industry of Bangladesh is providing attractive returns to shareholders by making double digit profits, contributing to sustainable growth, and surviving cut-throat competition while maximizing shareholders' wealth. The Private Commercial Banks (PCBs) exhibited a momentous ascending movement of the curve on their investment in share market during 2010, just before the stock market's crash. At present, private commercial banks are dominating the banking sector of Bangladesh. More than 59% of total deposits and 58% of assets are covered by the PCBs while these percentages are 28% and 29% for State owned Commercial Banks (SCBs). Constant new service innovation and automation of banks have driven PCBs to dominate over other banks (Islam *et al.*, 2014).

Banking competition is an extremely important issue as banks play a vital role in the economy (Bikker *et al.*, 2009a). Competition negatively influences the performance of banks in terms of profitability and efficiency (Uddin and Suzuki, 2014). As in any other industry, competition can affect the efficiency and the degree of innovation in the banking sector (Arrawatia and Misra, 2014). It is recognized in many studies that there is link between competition and stability. This link has also helped to formulate many prudential policies towards banks (Vives, 2001). Obviously, competition in the banking sector has a major impact on the wealth of consumers and companies and it affects the performance and financial health of banks. The drivers for assessing the level of competition are banking sector liberalization, financial markets deregulation, financial innovations, merger and consolidation etc. (Arrawatia and Misra, 2014).

Till now a very few studies have been undertaken to measure the competition of commercial banking industry of Bangladesh. A study of Parera *et al.*, (2006) identified that monopolistic competition prevails in banking industry of Bangladesh during the study period from 1995 to 2003. The study found the *H*-statistic value is 0.5244 and major contribution to the *H*-statistic comes from funding costs. Ahamed (2012) found that banking sector of Bangladesh is moderately concentrated and it is heading towards good competition. In a study of competition in NBFIs sector of Bangladesh, Uddin and Gupta (2012) notified that there has been an increase in competition in the non-banking sector during the period of 1997-2010.

The present paper contributes to the burgeoning literature on banking competition in two ways. Firstly, it addresses to analyze the factors related to competition, and by doing this it shows the factors related to competition and how it affects banking industry of Bangladesh. Secondly, the findings of this study may generate some guidelines for the policymakers to formulate policies and strategies with regard to the structure of the banking sector of Bangladesh.

The rest of the paper is structured as follows: Section 2 describes the available literature concerning the dynamics of concentration and competition. Section 3 elaborates the overview of the banking sector of Bangladesh. Section 4 introduces the data and methodology adopted for the study. Section 5 presents the empirical results of the study and the last section concludes the paper with some policy guidelines.

Literature Review

Concentration and competition are considered as two distinct features of an industry (Uddin and Gupta, 2012). To assess the contestability of a given market, previous studies (Molyneux *et al.*, 1996; Yildirim & Philippatos, 2007) used different tests of competition and the '*H*' statistic proposed by Panzar and Rosse (1987). PR model has been widely used to analyze the nature of market competition in emerging markets (Abdelkader and Mansouri, 2013). A number of studies have been conducted by researchers to find out the market concentration and competition of Bangladesh, India, Sri Lanka and Nepal (Parera *et al.*, 2006;

Gajurel and Pradhan, 2012). Traditional measures of concentration were used by many researchers to find out market structure of African banking sector (Duncan, 2003; Daley and Matthews, 2011; Claessens and Laeven, 2004).

A limited number of studies have been conducted to analyze the nature of concentration and competition of Arab countries with the exception of the works of Al-Muharrami et al. (2009), Turk-Ariss (2009) and Poshakwale and Qian (2011). PR model and H statistic have been used in many studies related to markets of North America, Canada and Europe (Shaffer, 1982; Nathan and Neave, 1989; Molyneux et al., 1996). Table 1 provides a summary of P-R studies on the banking sector across different countries.

Table 1: Summary of P-R studies on the banking sector

Author (s)	Period	Countries	Findings
Shaffer (1982)	1979	New York	MC
Nathan and Neave (1989)	1982-1984	Canada	MC
Claessens and Laeven (2004)	1994-2001	50 industrialized and developing countries	MC (largest countries tend to have lower competition)
Mkrtchyan (2005)	1998-2002	Armenia	MC
Yuan (2006)	1996-2000	China	MC
Gunalp and Celik (2006)	1990-2000	Turkey	MC
Al-Muharrami et al. (2006)	1993-2002	Gulf Cooperation Council's countries	MC (Bahrain, Qatar) PC (Kuwait, Saudi Arabia, UAE) Neither MC nor PC (Oman)
Gutierrez de Rozas (2007)	1985-2005	Spain	MC
Yildirim and Philippatos (2007)	1993-2000	11 Latin American countries	MC
Matthews et al. (2007)	1980-2004	UK	MC
Al-Muharrami (2009)	1993-2006	Saudi Arabia	MC
Turk-Ariss (2009)	2000-2006	12 MENA region countries	PC: Bahrain and Turkey MO: North African countries MC: The other countries
Park (2009)	1992-2004	Korea	MC: Pre-Crisis period PC: Post-Crisis
Biekpe (2011)	2000-2007	Ghana	MC
Mlambo and Ncube (2011)	1999-2008	South Africa	MC
Mercan (2012)	1999-2010	Georgia	MC
Sufian and Habibullah (2013)	1996-2008	Malaysia	MC
Olszak et al. (2013)	2008-2012	Poland	MC
Kashi and Beynabadi (2013)	2005-2010	Iran	MC
Arrawatia and Misra (2014)	1994-2011	India	MC

Note: PC – perfect competition; MC – monopolistic competition, MO – monopolistic market.

Banking Sector Development in Bangladesh

The financial sector of Bangladesh comprises of Bangladesh Bank, scheduled banks, Non-Bank Financial Institutions (NBFIs), Microfinance Institutions (MFIs), insurance companies, co-operatives, credit rating agencies and stock exchanges (Rayhan *et al.*, 2011). The economy of Bangladesh has been growing gradually and it needs the support of a sound financial structure (Shahid *et al.*, 2004). The banking sector has evolved to become the dominant financial intermediary in Bangladeshi financial system due to the underdeveloped money and capital markets, limited availability of financial instruments, and lack of investors' confidence in the financial system as a whole.

In spite of various limitations, banking sector is playing a dominant role in the financial sector. According to Samina and Alam (2011), banking industry of Bangladesh is leading the financial system. Based on the

time of inception all the commercial banks have been divided into three generations. Banks of all three generations are introducing new products continuously to meet the diversified demands of highly heterogeneous customers (Siddiquee *et al.*, 2013). Bangladesh Bank, as the central bank, supervises and regulates all the financial intermediaries, instruments and markets (Parera *et al.*, 2006).

Table 2 provides some selected statistics for Bangladeshi banking industry. All of the variables included in the table show a promising situation in terms of more financial inclusion of Bangladeshi banking industry. Number of bank branches per 1000 sq.km and number of Automatic Teller Machine (ATMs) per sq.km display increasing trend. Deposit to GDP ratio and Credit to GDP ratio also experienced upward surge.

Table 2: Selected Statistics of Bangladeshi Banking Sector

Indicators	2006	2007	2008	2009	2010	2011	2012	2013
No of licensed commercial banks	48	48	48	48	47	47	47	55
No. of bank branches per 1000 Sq.km	45	46	47	48	53	54	56	59
No. of ATMs per 1000 Sq.km	2	4	6	8	14	20	29	35
Deposit accounts per 1000 persons	248	254	264	270	333	368	385	398
Loan accounts per 1000 persons	62	60	60	61	63	64	63	63
Deposit to GDP ratio	0.44	0.45	0.46	0.49	0.53	0.56	0.58	0.55
Credit to GDP ratio	0.34	0.34	0.36	0.38	0.43	0.44	0.45	0.41

Source: Islam & Mamun (2011); Sophastienphong & Kulathunga (2010)

Chowdhury and Ahmed (2009) describe that in a developing country like Bangladesh, the banking system as a whole plays a vital role to contribute positively to economic development. Bangladesh Bank gave go-ahead for new nine banks in 2012. At present, there are 55 banks and 8,427 bank branches in Bangladesh (Bangladesh Bank, 2013). The structure of banking sector is shown in Table 3:

Table 3: Banking Structure of Bangladesh (*in Billion BDT¹)

Bank Types	2011				2012			
	No of Banks	No of Branches	Total Assets*	Total Deposits*	No of Banks	No of Branches	Total Assets*	Total Deposits*
SCBs	4	3437	1629.2	1235.6	4	3478	1831.9	1377.9
DFIs	4	1406	328.8	214.4	4	1440	385.5	260.4
PCBs	30	3055	3524.2	2787.5	30	3339	4371.5	3430.7
FCBs	9	63	385.2	272.2	9	65	441.8	327.0
Total	47	7961	5867.6	4509.7	47	8322	7030.7	5396.0

Source: Bangladesh Bank Annual Report, 2013.

At present four categories of scheduled banks are operating in Bangladesh namely state owned commercial banks (SCBs), state owned development financial institutions (DFIs), private commercial banks (PCBs) and foreign commercial banks (FCBs). Table 3 shows that at the end of 2011, PCBs have 60% of total industry's assets and approximately 62% of total industry deposits. The four SCBs have 27.8% of industry's assets and 27.4% of industry's deposits. The remaining 13 banks namely, FCBs and DFIs possess the remaining 12.2% of the industry's assets and the residual 10.8% of industry's deposits. However, in terms of number of branches, the SCBs have the highest number of 3437 branches across the country while the figure stands as 3055 for the PCBs. The market capitalization of banking sector stood at USD 5.36 billion as on June 30, 2013. Islami Bank Bangladesh Limited is the largest commercial bank with a Net Asset Value (NAV) of BDT 27.80 billion and loan investment portfolio of BDT 305.84 billion (DSE, 2013).

¹ 1USD = BDT 77.50 as on October 30, 2015

Research and Methodology

Data

For the empirical analysis, the present study considered 29 listed commercial banks out of the 30 commercial banks listed in the Dhaka Stock Exchange (DSE). The remaining one bank was excluded from the analysis due to having negative equity along with negative operating performance for a couple of years. Variables have been constructed using the income statements and balance sheets of the listed banks over the study period of 2006-2013.

Model Specification

K Bank Concentration Ratio

The *k* bank concentration ratio is one of the most frequently used measures of concentration due to its simplicity and limited data requirements (Bikker and Haaf, 2000). This ratio is measured by the sum of market share of *k* largest banks in the sector. Higher ratio indicates more concentration in a specific sector. It indicates the extent of market power of largest banks in the banking sector. This ratio can be calculated by taking any number of banks operating in a country's banking structure. Higher number of banks leads to higher value of concentration ratio. Low concentration ratio indicates more rivalry among the competing banks. Hence, it is expected that the value of concentration ratio remains lower in proportion to number of banks. The *k* bank concentration ratio takes summation of *k* largest banks' market shares and its formula is:

$$CR_K = \sum_{i=1}^K S_i$$

This formula gives equal emphasis to the *k* leading banks but neglects many small banks in the market. There can be variability in *k* largest banks from year to year based on their performance. Concentration ratio of three banks is calculated by taking market shares of three largest banks operating in the market. Similarly, five bank and eight bank concentration ratio are calculated by taking market shares of five and eight largest banks operating in the market. There is no rule of thumb to determine the number of banks to be included in the concentration ratio and it is just an arbitrary decision (Ahamed, 2012). The concentration ratio is a one dimensional measures ranging from zero to unity. For an infinite number of equally sized banks the index value approaches to zero and if the banks included in the calculation of the concentration ratio make up the entire industry the index value approaches to unity (Bikker, 2004).

The Herfindahl-Hirschman Index

The *HHI* is the most widely regarded summary measure of concentration and it serves as a benchmark for the evaluation of other concentration indices (Al-Muharrami, 2006). The *HHI* is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. The *HHI* takes into account the relative size distribution of the firms in a market. It approaches to zero when a market is occupied by a large number of firms of relatively equal size and reaches its maximum of 10,000 points when a market is controlled by a single firm. Generally, increasing *HHI* indicates a decrease in market competition and increase in the market power of larger firms. A decreasing *HHI* suggests increase in market competition (Gajurel and Pradhan, 2012). A significant advantage of *HHI* index is that it considers the total number of firms operating in the market which is not considered in *k* bank concentration ratio. The *HHI* is computed as:

$$HHI = \sum_{i=1}^n MS^2$$

where, *MS* is the market share of a particular bank. As mentioned in *US Merger Guidelines* (2010), a *HHI* index value less than 1,000 indicates a competitive market (perfect or monopolistic), a somewhat concentrated market if the *HHI* lies between 1,000 and 1,800, and a very concentrated market if *HHI* is

more than 1,800 (Al-Muharrami, 2009). In this study three *HHI* indices are developed based on three variables – total deposits, total loans, and total assets.

The Panzar-Rosse Method

The model investigates the extent to which changes in factor input prices (cost of capital, labor and fund) are reflected in the equilibrium industry or bank specific revenues (Thakor and Boot, 2008; Goddard and Wilson, 2008; Gischer and stiele, 2004; Alosyna, 2013). By using the logic of the model, equilibrium condition can be characterized as a steady-state reflecting adjustments to shocks (Buchs and Mathisen, 2005). This approach is widely used to test the level of competition based on *H*-statistics either scaled or unscaled revenue. Here, scaled revenue implies the use of a scale variable in the revenue equation and unscaled revenue lacks the use of a scale variable. The model is based on the macroeconomic theory of the firm equilibrium condition. It employs different pricing strategies in response to changes in output prices (Bikker and Haaf, 2002).

Following the empirical literature on competition in banking industries (Bikker and Haff, 2002; Casu and Girardone, 2006; Parera *et al.*, 2006), this study employs the reduced-form revenue equation as specified by Panzar and Rosse (1987) and Parera *et al.* (2006). Assuming long-run market equilibrium, this approach assesses the impact of changes in factor prices on the revenue under the different market structure. Market equilibrium occurs at the price at which quantity demanded equals the quantity supplied (Wessels, 2000, p. 37). The individual bank prices differ in response to the change in its factor inputs cost. The magnitude of changes helps to determine the degree of market competition in the market.

The reduced-form of revenue model is:

$$\ln REVN_{it} = a + b_1 \ln INTC_{it} + b_2 \ln LC_{it} + b_3 \ln OTHC_{it} + b_4 \ln LEC_{it} + b_5 \ln LOAN_{it} + b_6 \ln DEP_{it} + b_7 \ln BRAST_{it} + e_{it} \dots \dots \dots (1)$$

where $REVN_{it}$ is the ratio of total interest revenue to total assets for bank *i* at time *t*, $INTC_{it}$ is the total interest expenses to total deposit, LC_{it} is the ratio of persnel expenses to total assets, $OTHC_{it}$ is the ratio of total other operating expenses to total assets, LEC_{it} is defined as the ratio of number of employees to total salaries, $LOAN_{it}$ is the ratio of total loans to total assets, DEP_{it} is the ratio of total deposits to total assets, $BRAST_{it}$ includes the ratio of bank branches to total assets, and e_{it} is the stochastic error term that captures time-varying and bank-specific random components. On the other hand, *ln* form indicates natural logarithm form of all variables used in the study. The first three independent variables are the factor input prices for funds, labor, and capital respectively and latter four are bank-specific control variables. Since the P-R model follows the log-linear form, the sum of factor price elasticities is termed as “*H*-statistic” (Kashi and Beynabadi, 2013).

Hence,
$$H = b_1 \ln INTC_{it} + b_2 \ln LC_{it} + b_3 \ln OTHC_{it}$$

The value of *H*-statistic depends on the competitive environment and corresponding behaviors of banks. Goddard *et al.*, (2001) linked value of *H*-statistic with competitive environment. Under perfect competition, the value of *H*-statistic is 1 that means that a one percentage change in cost will lead to a corresponding one percentage change in revenues holding all other factors constant. On the other hand, under the monopoly market structure, the value of *H*-statistic is 0 because in monopoly market, increase in factors' input cost increases the marginal cost, reduces the outputs and ultimately decrease the revenue. If the value of *H* ranges between 0 and 1, there is presence of monopolistic competition in the market; higher value indicates higher degree of competition. Table 4 provides a brief description of Panzar-Rosse *H*-statistic.

Table 4: Interpreting the Panzar-Rosse H-statistic

Parameter Region	Competitive Environment Test
$H \leq 0$	Monopoly or conjectural variations short run oligopoly.
$0 < H < 1$	Monopolistic competition.
$H = 1$	Perfect competition or natural monopoly in a perfectly contestable market or sales maximizing firm subject to a break even constraint.
Parameter Region	Market Equilibrium Test
$E = 0$	Equilibrium.
$E < 0$	Disequilibrium.

Source: Panzar and Rosse (1987), Molyneux *et al.*, (1996), Nathan and Neave (1989).

Equilibrium Test

The basic premise on which P-R model rests is the long-run equilibrium where factor prices are not related with industry return (Panzar and Rosse, 1987). To test this proposition empirically, following empirical model is used following Casu and Girardone, (2006) ; Perera *et al.*, (2006) that validates the PR model results if sum of elasticity's of factor costs is equals to zero ($b_1+b_2+b_3= 0$).

$$\ln ROA_{it} = a + b_1 \ln INTC_{it} + b_2 \ln LC_{it} + b_3 \ln OTHC_{it} + b_4 \ln LEC_{it} + b_5 LOAN_{it} + b_6 \ln DEP_{it} + b_7 \ln BRAST_{it} + e_{it} \dots \dots \dots (2)$$

Where, ROA is the net income to total assets and other explanatory variables are same as in equation 1. The parameters in above model are estimated by using random effects estimates.

Results and Discussion

Table 5 provides the summary statistics of the variables used in the study over the period of 2006-2013. A total of nine variables have been analyzed to get a deeper understanding about the current banking sector scenario of Bangladesh. From the table 5, it is evident that deviation in total assets of banks is higher than other studied variables and deviation of other operating income variable is higher than its mean value due to excessive spending in miscellaneous expenses.

Table 5: Descriptive Statistics (in BDT Million)

Variables	Mean	St.dev	Max	Min
Deposit	643,359.0	236,357.0	1554,280.0	398,301.0
Loans	527,113.0	208,506.0	1343,288.0	318,738.0
Assets	793,336.0	272,396.0	1796,135.0	474,212.0
Int. Income	79,878.0	69,751.0	425,146.0	40,354.0
Int. Expense	61,208.0	67,250.0	403,966.0	30,675.0
Total Equity	65,110.0	23,702.0	123,915.0	26,029.0
Salaries	9,494.0	4,540.0	21,804.0	3,713.0
Other Operating Expenses	5,600.0	10,907.0	61,524.0	1,156.0
Net income	10,249.0	5,032.0	20,882.0	-3,604.0

Source: Authors' Calculation

Table 6 represents the correlation matrix of variables used in the study. The values have lower correlation, as shown in matrix below, hence there is little chance of multicollinearity problem in estimating the parameters (Gajurel and Pradhan, 2012).

Table 6: Correlation Matrix

	Inrevn	Inintc	Inlc	Inothc	Inloan	Inlec	Indep	Inbrast
Inrevn	1.0000							
Inintc	0.7413**	1.0000						
Inlc	-0.3414**	-0.4934**	1.0000					
Inothc	0.1103	-0.0264	0.1609**	1.0000				
Inloan	0.0578	-0.0511	-0.1234	0.0638	1.0000			
Inlec	0.2527**	0.3888**	0.0154	0.2704**	-0.1341**	1.0000		
Indep	0.0240	-0.0779	-0.2266**	-0.2018**	0.0598	-0.3221**	1.0000	
Inbrast	-0.6537**	-0.6517**	0.4648**	-0.1044	-0.0171	-0.5729**	0.1395**	1.0000

Note: **indicates significant at 5% level of significance.

Bank Concentration Ratio

Eight large banks' market share is comparatively less significant in the whole banking sector's market share due to large number of banks operating in Bangladesh. In Table 7, CR(3), CR(5) and CR(8) depict the market share of three, five and eight largest banks respectively. Total number of banks in the market remained same over the study period. A decreasing trend is present in all concentration ratios for all variables used in the study. The asset share of the top five and eight has declined by 13% and 8% respectively from 2006 to 2013. The three bank concentration ratio on total assets has declined from 24% in 2006 to 20% in 2013, a decline of 4% over the study period. Similarly, the level and trend for concentration ratios on deposit is similar to the assets base concentration ratios. In 2006, share of large five banks deposit was 35% which declined to 29% in 2013. The five bank concentration ratio for loan was 34% in 2006 which declined to 32% in 2013. Furthermore, the market shares of the largest three, five and eight banks, in terms of total assets, total deposit, and total loan have declined significantly over the last few years, in particular since 2009. However, eight banks concentration ratio for loan did not decrease significantly over the study period. The significant decrease in the concentration ratios shown in figure 1 reflects the changing market structure of the banking sector. These evidences suggest increasing market competition in Bangladeshi banking industry.

Table 7: Bank Concentration Ratios

	Assets			Deposits			Loan		
Year	CR(3)	CR(5)	CR(8)	CR(3)	CR(5)	CR(8)	CR(3)	CR(5)	CR (8)
2013	0.20	0.29	0.42	0.21	0.29	0.43	0.23	0.32	0.44
2012	0.21	0.29	0.41	0.21	0.30	0.42	0.24	0.32	0.44
2011	0.20	0.29	0.42	0.22	0.31	0.43	0.22	0.31	0.43
2010	0.20	0.30	0.43	0.22	0.31	0.43	0.22	0.31	0.44
2009	0.22	0.32	0.44	0.23	0.32	0.44	0.24	0.33	0.46
2008	0.24	0.33	0.45	0.24	0.33	0.46	0.25	0.34	0.45
2007	0.24	0.34	0.46	0.26	0.35	0.47	0.25	0.35	0.47
2006	0.24	0.34	0.46	0.25	0.35	0.47	0.25	0.34	0.46
Average	0.22	0.31	0.44	0.23	0.32	0.44	0.24	0.33	0.45

Source: Author

Figure 1: Trends of Market Concentration

Herfindahl-Hirschman Index

Market structure information is evident in three banks, five banks, and eight banks concentration ratios and these measures do not take into account the number of banks operating in the banking sector. The *HHI* takes into account both the relative size and number of banks in the industry. Table 8 provides a view about *HHI* index over the study period. The index value for assets decreased after 2007 but in 2012 and 2013 it was increasing at a percentage of 1.29% and 1.10%. For deposits, average decrease in index value was 1.25% and this decreasing trend indicates increase in competition in the banking sector. For loans, index value has also been decreasing over the study period. But increase (decrease) percentage in loans is comparatively lower than deposits and assets.

Table 8: Herfindahl-Hirschman Index

HHI Index						
Year	Assets	Increase (Decrease) (in %)	Deposits	Increase (Decrease) (in %)	Loan	Increase (Decrease) (in %)
2013	425.1836	1.10	434.2083	(0.15)	467.3653	(0.02)
2012	420.4960	1.29	434.8806	0.54	474.9824	0.07
2011	415.0698	(2.66)	432.5340	(2.81)	439.9605	(0.02)
2010	426.1063	(3.59)	444.7036	(2.65)	449.0142	(0.05)
2009	441.3878	(3.71)	456.5018	(3.13)	470.5746	(0.02)
2008	457.7630	(2.24)	470.8079	(2.44)	478.8766	(0.02)
2007	468.0193	0.71	482.2773	1.90	490.8071	0.03
2006	464.7114	n/a	473.1158	n/a	474.5580	n/a
Average	439.8421	(1.30)	453.6287	(1.25)	468.2673	(0.00)

Source: Authors' Calculation

Test of Market Structure: Panzar and Rosse Model

Panzar and Rosse (1987) model is one of the widely used techniques to assess competitive conduct of banking industry (Bikker *et al.*, 2009b). This model assesses the impact of changes in factor prices on the revenue under the different market structure.

Hausman test was conducted to choose between fixed and random effect model. In Hausman test, rejection of null hypothesis (*p-value*: 0.1656) validates the assumption that random effects model should be the preferred model. The results of the random effect estimates are reported in Table 9. The value of *R*-square demonstrates that the model is statistically significant and it has sufficient explanatory power. All the coefficients are statistically significant. The sum of the elasticity of factor prices is 0.9412 for the model which suggests that monopolistic competition prevails in the banking industry of Bangladesh. Parera *et al.*, (2006) also reported similar result in a study of South Asian banking sector. The Wald tests for perfect competition ($H=1$) and for monopoly ($H = 0$) are rejected suggesting the presence of monopolistic competition. The coefficients of price elasticity of funds, labor and capital are positive and statistically significant. The value of *H*-statistic indicates a higher level of competition among operating banks in the banking sector of Bangladesh.

Table 9: Random Effects Estimates of PR Model

	Co efficient	S. Error	P-value
lnINTC	0.4133**	0.0289	0.0000
lnLC	0.1293**	0.0331	0.0000
lnOTHC	0.0183**	0.0067	0.0070
lnDEP	0.5684**	0.1133	0.0000
lnLEC	-0.0927**	0.0272	0.0010
lnLOAN	0.0266	0.0231	0.2500
lnBRAST	-0.1220**	0.0277	0.0000
<i>H Statistic</i>	0.9412		
<i>Wald test for H = 1</i>			
<i>F</i> -Statistic		64.4330	
<i>P</i> -value of <i>F</i> -Statistic		0.0000	
<i>Wald test for H= 0</i>			
<i>F</i> -Statistic		370.6353	
<i>P</i> -value of <i>F</i> -Statistic		0.0000	

Note: **indicates statistically significant at 5% level of significance.

Equilibrium Test

The Wald test for null hypothesis of linear combination, $b_1+b_2+b_3= 0$, is not rejected. The Wald test for $H = 0$ shows *F*-statistic value is 0.09 with *p*-value of 0.7644. The result suggests that input prices are not related with industry return. It can be argued that Bangladeshi banking sector is in long-run equilibrium for the sample period. Thus, if input prices or average costs increase by 1% total revenue will also increase by same percentage, *ceteris paribus*..

Table 10: PR Model Equilibrium Test

Variables	Co efficient	S. Error	P-value
lnINTC	-0.5197	0.3858	0.1780
lnLC	0.1334	0.2752	0.6280
lnOTHC	0.3978**	0.0717	0.0000
lnLEC	-0.3719	0.2624	0.1560
lnLOAN	0.3048	0.3072	0.3210
lnDEP	-1.7354	1.2654	0.1700
lnBRAST	-0.5197	0.3858	0.1780
Adjusted R-squared	0.2091		
F-statistic	6.7310		
Prob(F-statistic)	0.0000		
<i>Wald test for H=0</i>			
F-statistic	0.0900		
P-value of F-statistic	0.7644		

Note: **indicates significant at 5% level of significance.

Conclusion

This paper examines the evolution of market structure and revenue behavior of Bangladeshi banking industry over 8 years period from 2006 to 2013. Concentration ratios, including Herfindahl-Hirschman Indices, show decreasing market concentration in Bangladeshi banking industry and decreasing market share of largest banks over the sample period. The evidences suggest that the banking industry is getting less concentrated that is banks operating in Bangladesh confronted fierce competition in recent years. Furthermore, revenue behavior of banking industry is studied by using PR model. The result from PR model estimate with an H -statistic value of 0.9412 indicates the presence monopolistic competition in Bangladeshi banking industry. The rejection of monopoly market competition and perfect competition confirms it. The test result of market equilibrium indicates input prices are not related with industry return.

The results are robust to different model specifications and estimation techniques. To assess the validity and objectivity of data statistical test such as Wooldridge test² has been conducted. Results of those measurements show that it is worthy to use the data and conduct the analysis. Nevertheless, as indicated by the value of H -statistic, there is room for improvement in competitive behavior of Bangladeshi commercial banks. Hence, the regulators should give continuity to the ongoing financial sector liberalization and reformation that may help to increase competitive market behavior.

This study can be extended in two ways. Firstly, instead of focusing only on traditional financial indicators, as it is done in most of the existing studies, the performance of banks can be addressed by adopting both conventional financial indicators and frontier measures of performance to grab a clear picture; and secondly, a subsequent investigation can be done to identify the impact of competition on the performance of banks in further study.

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² p -value of 0.0761 indicates null hypothesis no first-order autocorrelation is accepted.

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