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# The Competitiveness of Banking Industry in Bangladesh : An application of Conjectural Variation (CV) Approach.

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***Abstract***

Stability in the financial market is largely influenced by its market structure. The efficiency of the production of financial services, the quality of the financial products as well as the degree of innovation of financial products is also influenced by the degree of competition in the financial sector. Moreover, the degree of competition in financial sector or banking sector in specific, determines the accessibility of firms and households to the extent of financial services and external financing.

Using a panel data framework of 36 banks for 10 years (2001-2013) and applying a non-structural Conjectural Variation (CV) approach, the empirical investigation finds that the overall banking industry in Bangladesh is in a state of monopolistic competition. Segregating the whole sample into two samples based on the ownership structure of banks, the paper finds that the private commercial banks (PCBs) are more competitive than the government owned commercial banks (SCBs) and also reveals that more market power is exercised by the PCBs (28.5) than the SCBs (3.79%).

The results reveal that banks in Bangladesh could have taken relationship lending/banking strategies and might have ensure stability in the financial market protecting themselves encountered from the lemon market. The findings also may help the regulators whether to increase competition in the banking industry by allowing more banks, but with the fortune of "winner's curse".

**Keywords:** Competition, Banking, Conjectural Variation

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## 1. Introduction

From the early 1990s, the financial sector of Bangladesh has undergone a lot of reform measures: deregulation of administered interest rate regime, moving out subsidies from the banking system to the budget etc. Allowing more commercial banks under private ownerships and deepening of the financial system through the participation of broad based non-bank financial institutions are also remarkable events in the financial systems of Bangladesh in the last two decades. Considering the past and recent banking sector performance and the both inside & outside competitive environment, the present paper identifies the degree of competition with market power among the banks.

Stability in the financial market is largely influenced by its market structure. The efficiency of the production of financial services, the quality of the financial products as well as the degree of innovation of financial products is also influenced by the degree of competition in the financial sector (Claessens & Laeven, 2004). Moreover, the degree of competition in financial sector or banking sector in specific determines the accessibility of firms and households to the extent of financial services and external financing.

The empirical investigation through a non-structural conjectural variation approach finds that the overall banking market in Bangladesh is in a state of monopolistic competition and the PCBs are more competitive than the SCBs. The empirical result of conjectural variation approach also indicates that the PCBs enjoy a greater market power (28.5%) than the SCBs (3.79%).

The competition in the banking system is also crucial for Bangladesh. It is important for the policy makers and regulators while licensing more banks as well as bank branches, whether the existing industry is sufficiently producing financial assets with efficiency or not. For example, if the industry is already in a state of sufficient competition, it might be vulnerable for the industry if regulators allow more banks. This is because; more competitors will force more risk taking behavior by banks and thus, may cause a bank run. As such, the study of the competitive conduct in the banking industry of Bangladesh in a more logical and empirical way is desirable.

The rest of the paper is organized as follows. Section-2 gives a brief on the important characteristics of the banking industry of Bangladesh. Section -3 provides the theoretical approaches for measurement of competition along with the review of relevant literatures. Section-4 provides the empirical approach and data sources; while Section-5 measures the level of competition in the banking industry using the empirical approach and discussions. Finally, this paper ends with conclusion and recommendations in Section-6.

## 2. Financial System of Bangladesh: An Overview

The financial system of Bangladesh at present, like many other developing and developed nations, is comprised of scheduled commercial banks, non-bank financial institution (NBFIs), microfinance institutions (MFIs), various co-operative banks, insurance companies, capital markets, securities companies and stock exchanges.

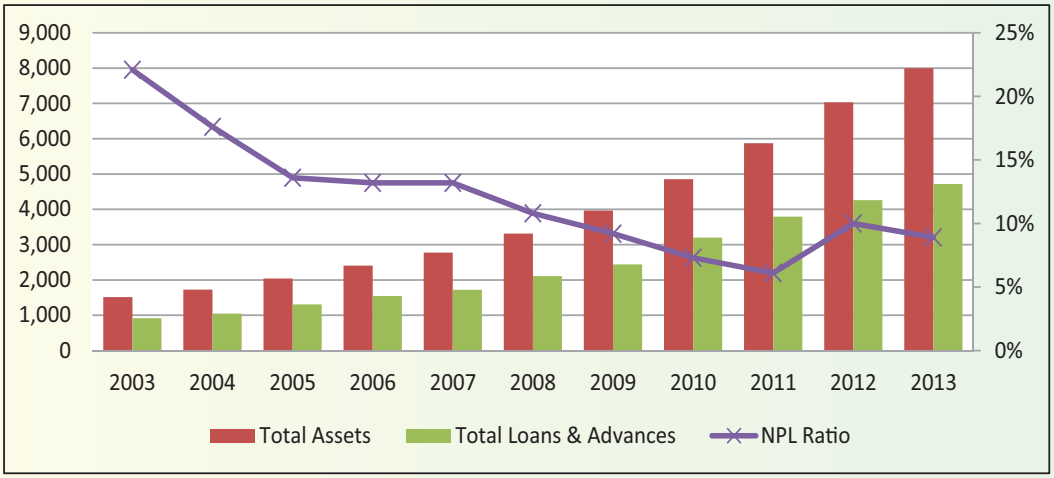
The financial system of Bangladesh is largely dominated by the banking sector. According to Goldsmith (1969), McKinnon (1973) and Shaw (1973) the financial deepening and the economic development of a country is closely related. Though Bangladesh's financial system has a wide array of other financial institutions of 62 insurance companies (44 general & 18 life), 31 NBFIs, 54 merchant banks, Bangladesh House Building Finance Corporation, Investment Corporation of Bangladesh and 599 registered MFIs beside the formal banking sector[1], their share is still insignificant. One way to justify this argument is to look at the contribution of financial intermediaries to national GDP. The sectoral share of financial intermediaries to GDP at constant prices in FY 2012 was 2.1%; out of which the banking sector alone contributes by 1.54% (Bangladesh Economic Review, 2014). The NBFIs role is assumed to be marginal and have only 1% of total financial system assets (Bahar, 2009). Thus, Bangladesh still has an underdeveloped financial system characterized by poor financial intermediation wherein the banking sector is dominating with a limited role of NBFIs (Bahar, 2009).

In terms of ownership structure the banking sector of Bangladesh is sub-grouped into state owned, privately owned and foreign owned banks. As of December 2013, the banking sector of Bangladesh is comprised of: (a) Bangladesh Bank as the central bank, (b) 56 commercial banks, including 4 state owned commercial banks (SCBs), 39 domestic private commercial banks (PCBs), 9 foreign commercial banks (FCBs) , and 4 state owned specialized banks (DFIs). Of that, 6 domestic private banks and 1 foreign bank are operating under Islamic Shariah.

By the end of December 2013, the total banking sector assets of Bangladesh was Taka 8000.2 billion; of that, the share of loans and advances to total assets was 58.98% amounted to Taka 4718.2 billion. However, a significant portion (8.9% in 2013) of this interest earning assets is characterized as non-performing. A favorable aspect is that the financial sector of Bangladesh has experienced a positive trend in reducing the portion of non-performing assets during the last decades. The ratio of non-performing loans (NPLs) to total loans has declined substantially from 31.5% in 2001 to 6.1% in 2011, however, further increased to 8.9% in 2013. Chart-1 shows the status of total assets, total loans and advances and the ratio of NPLs to total loans for the period 2001 to 2013. This high concentration of assets in loans and advances and high NPLs ratios reflect the risk taking behavior of the country's banking sector. The result of high NPLs is that banks are forced to keep the interest rate of loans high. Not only that, high NPLs endanger banks to suffer from capital inadequacy and performance efficiency problem (Wheelock & Wilson, 1994).

1 Financial Stability Report, 2013, Bangladesh Bank, Issue 4, June 2014.

**Chart-1: Total Assets, Loans and Advances & NPL ratio of all Banks: 2001-2013**




Source: Statistics Department, Bangladesh Bank

The structure of the banking system has changed dramatically over the last two decades. The share of state owned banks assets to total industry assets declined to 26.36% in 2013 from 46.5% in 2001. On the contrary, the privately owned banks (PCBs) share rose from 34.87% in 2001 to 61.85% in 2013 (see Table-1).The market share of PCBs to total industry deposit and advances stood at 62.8% and 69.15% respectively in 2013; while in 1985 the respective share was 18.3% and 13.5% (see Table-2).

**Table-1: Share of Total Assets by type of Banks: 2001-2013**

(in %)

| Year | SCBs | PCBs | FCBs | DFIs |
|---|---|---|---|---|
| 2001 | 46.50 | 34.87 | 6.86 | 11.77 |
| 2002 | 45.56 | 36.16 | 6.81 | 11.47 |
| 2003 | 41.72 | 40.81 | 7.27 | 10.20 |
| 2004 | 39.62 | 43.43 | 7.22 | 9.73 |
| 2005 | 37.36 | 45.74 | 7.25 | 9.65 |
| 2006 | 32.69 | 47.69 | 11.84 | 7.78 |
| 2007 | 33.09 | 51.43 | 8.21 | 7.27 |
| 2008 | 31.11 | 54.16 | 8.02 | 6.71 |
| 2009 | 28.63 | 57.38 | 7.38 | 6.60 |
| 2010 | 28.50 | 58.80 | 6.60 | 6.10 |
| 2011 | 27.78 | 60.00 | 6.56 | 5.66 |
| 2012 | 26.06 | 62.18 | 6.28 | 5.48 |
| 2013 | 26.36 | 61.85 | 6.11 | 5.68 |

Source: Annual Reports, Bangladesh Bank Bulletin, Bangladesh Bank, different issues

**Table-2: Market share of Deposit and Advances by type of Banks: 1985-2011**

(in %)

| Year | Deposits | | | | Advances | | | |
|---|---|---|---|---|---|---|---|---|
| | SCBs | PCBs | FCBs | DFIs | SCBs | PCBs | FCBs | DFIs |
| 1985 | 70.9 | 18.3 | 6.4 | 4.4 | 58.3 | 13.5 | 5.3 | 22.9 |
| 1990 | 62.4 | 26.1 | 7.1 | 4.4 | 52.8 | 21.0 | 5.8 | 20.4 |
| 1995 | 62.0 | 27.9 | 5.2 | 4.9 | 52.4 | 25.1 | 5.3 | 17.2 |
| 2000 | 55.3 | 31.6 | 7.1 | 6.0 | 47.2 | 31.1 | 5.5 | 16.2 |
| 2005 | 40.5 | 46.5 | 7.0 | 6.0 | 35.3 | 49.0 | 6.5 | 9.2 |
| 2009 | 29.5 | 57.8 | 7.2 | 5.5 | 22.8 | 62.9 | 7.0 | 7.3 |
| 2010 | 28.1 | 60.9 | 6.1 | 4.9 | 21.8 | 65.4 | 5.8 | 7.0 |
| 2011 | 27.3 | 61.7 | 6.2 | 4.8 | 21.3 | 66.6 | 5.6 | 6.5 |
| 2012 | 25.5 | 63.6 | 6.1 | 4.8 | 21.08 | 66.97 | 5.29 | 6.67 |
| 2013 | 26.0 | 62.8 | 5.7 | 5.5 | 18.77 | 69.15 | 5.00 | 7.08 |

Source: Statistics Department, Bangladesh Bank

The branch network of private sector banks are growing dramatically with 3602 branches in 2013. However, still the banking industry as a whole is being dominated by the state-owned banks (including DFIs) with a branch network of 5014 branches in 2013. As of December 2013, there are 8685 bank branches in Bangladesh, of which SCBs and DFIs together have 58% (see Table-3).

**Table-3: Distribution of bank branches by type of Banks: 1985-2009**

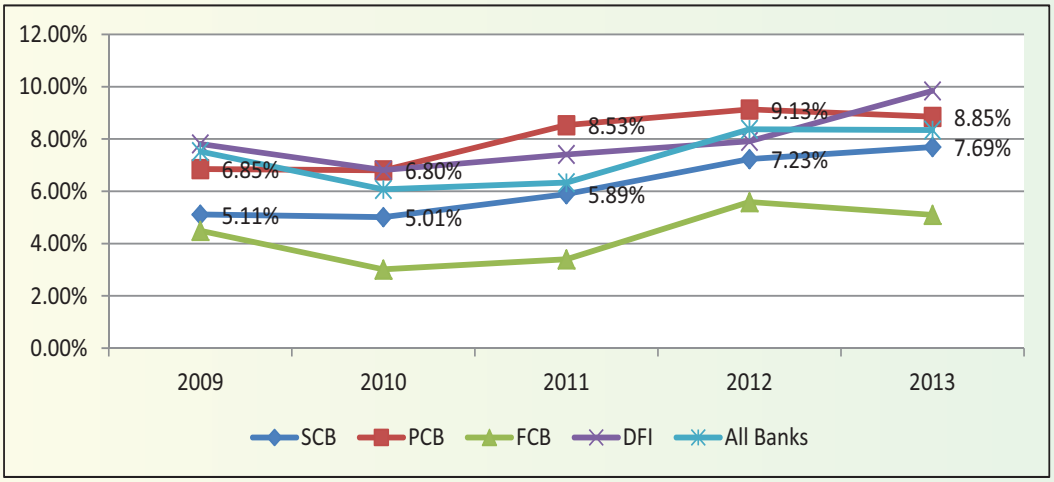
(in %)

| Year | Urban | | | | | Rural | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SCBs | PCBs | FCBs | DFIs | Total | SCBs | PCBs | FCBs | DFIs | Total |
| 1985 | 22.4 | 7.8 | 0.4 | 2.0 | 32.7 | 44.6 | 5.1 | 0.0 | 17.7 | 67.3 |
| 1990 | 21.4 | 10.2 | 0.4 | 2.0 | 34.0 | 42.3 | 5.0 | 0.0 | 18.5 | 66.0 |
| 1995 | 22.7 | 12.7 | 0.4 | 2.5 | 38.3 | 39.1 | 5.5 | 0.0 | 17.1 | 61.7 |
| 2000 | 21.8 | 15.4 | 0.6 | 2.5 | 40.2 | 37.1 | 5.3 | 0.0 | 17.4 | 59.8 |
| 2005 | 19.4 | 18.9 | 0.6 | 2.4 | 41.2 | 33.5 | 6.7 | 0.0 | 18.6 | 58.8 |
| 2009 | 17.9 | 21.3 | 0.8 | 2.3 | 42.3 | 31.0 | 9.3 | 0.0 | 17.4 | 57.7 |
| 2010 | 16.2 | 23.5 | 0.8 | 2.1 | 42.6 | 28.2 | 13.2 | 0.0 | 16.0 | 57.4 |
| 2011 | 15.6 | 24.3 | 0.8 | 2.1 | 42.8 | 27.5 | 14.1 | 0.0 | 15.6 | 57.2 |
| 2012 | 15.06 | 24.86 | 0.78 | 2.1 | 42.8 | 26.74 | 15.26 | 0.0 | 15.2 | 57.2 |
| 2013 | 14.60 | 25.42 | 0.79 | 2.05 | 42.86 | 25.93 | 16.05 | 0.0 | 15.15 | 57.14 |

Source: Statistics Department, Bangladesh Bank

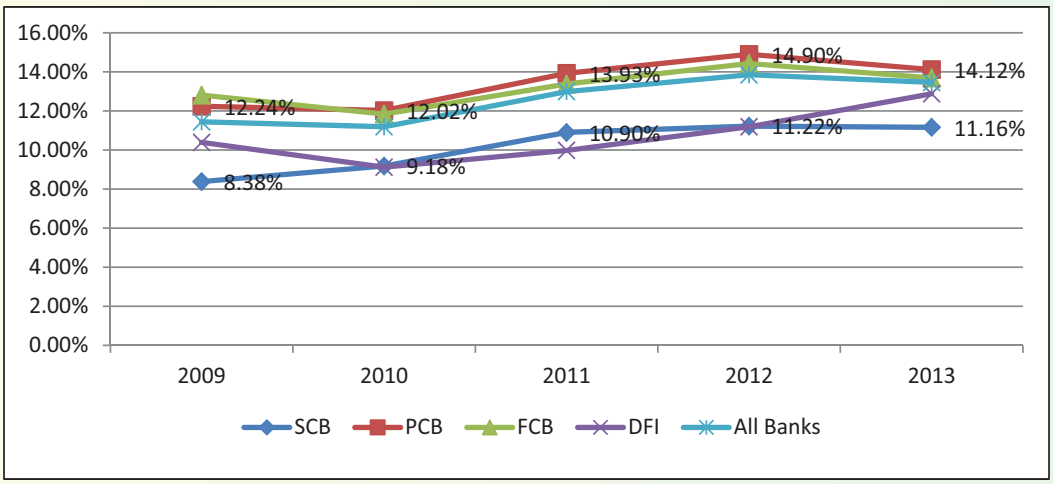
Another important feature of the banking sector in Bangladesh is that the interest rate differentials of deposit and advances among different types of banks. While the SCBs have advantageous position for credit clients; the PCBs, however, have advantages over deposit mobilization due to interest rate. Chart-2&3 make clear the comparative advantageous position of different type banks on deposit and advances.

**Chart-2**. Weighted Average Interest Rate on Deposits: 2009-2013




Source: Scheduled Bank Statistics, Bangladesh Bank, different issues

**Chart-3**. Weighted average interest rate on loans and advances: 2009-2013




Source: Scheduled Bank Statistics, Bangladesh Bank, different issues

Since the banking sector plays a vital role in the economic development of the country their efficiency in transforming financial resources is intensively looked at by the stakeholders, government, regulators and the investors. In addition, the efficiency of the banking firms

is closely related to the competitiveness and contestability within and outside the industry.

## 3. Measurement of Competitiveness and Literature Review

Competition and concentration are very much linked to the product markets and geographical vicinities. Since banks produce and offer varieties of products and serve in different types of market, the structural characteristics, e.g. concentration and competition, are also relevant for banking. It is also argued that concentration and consolidation may affect the structure of competition; and the measure of competition is essential for welfare induced banking related public policy (Bikker and Haaf, 2002a).

In economic literature, there are broadly two typical approaches for measuring competition: structural and non-structural. To model competition, the structural approach roots with industrial organization theory and includes a number of formal measures. Despite the fact that the structural approach presents a theoretical relationship between market concentration and competition, it has some deficiencies in empirical modeling. As a measure, a handful of non-structural or New Empirical Industrial Organization (NEIO) Approaches has been developed which includes Iwata model (1974), the Bresnahan (1982) model, the Lau (1982) model and the Panzar-Rosse (1987) model. These approaches emphasize the competitive conduct by banks without considering the explicit information about the bank market structure.[2]

The Iwata (1974) model estimates the conjectural variations for individual banks that supply homogeneous product in an oligopolistic market. This model requires the estimation of market demand and cost functions of individual banks for obtaining a numerical value of conjectural variation of each bank. This model has been applied once by Shaffer and Di Salvo (1994), as Bikker & Haaf (2002a) reported.

Bresnahan (1982, 1989) and Lau (1982) model are based on the condition of general market equilibrium. These models need an estimation of simultaneous equations of market demand and supply over industry aggregate data. The market power of the average bank is determined by using this supply and demand. However, for empirical study this model needs to define geographic market a priori and a broad range of samples (Shaffer, 1994).

The alternative and the most widely used approach is that developed by Panzar-Rosse (1987). This model allows using firm (bank) level data. Advantages of this model are that no geographic market needs to be defined, and the model also provides a good result even with small samples. One drawback of this method is that it assumes the banking industry is in long-run equilibrium. However, there exists a separate methodology for testing the equilibrium assumption (Claessens&Laeven, 2004). The studies performed by Claessens and Leaven (2004), Goddard and Wilson (2009), Bikker, Spierdijk and Finnie (2006), Bikker and Spierdijk (2008) and Bikker, Shaffer and Spierdijk (2009) are important for the case

2 For details see Bikker & Haaf (2002a)

of Bangladesh, since these studies also include Bangladesh in the samples. These studies cover the period from 1986 to 2005. All the studies observed that monopolistic competition with long-run equilibrium is the nature of the bank market structure of Bangladesh. The estimated H-statistic (P-R Statistic) varies from 0.69 (Claessens& Leaven, 2004) to 0.987 (Goddard & Wilson, 2009). Bikker and Spierdijk (2008), on the contrary, found a decline in H-statistic from 0.96 (1992) to 0.87 (2004); which implies a decline in the competitiveness in the banking market of Bangladesh over time.

The concept of conjectural variation first appeared in static contexts of oligopoly market. A conjectural variation (CV) is a conjecture by one firm in a duopoly about how the other firm will adjust its action with respect to potential adjustments in the first firm's action (Bowley, 1924). As a result, the earliest models of oligopolistic behavior assumed that firms formed expectations about the reactions (or variations) of other firms, now called conjectural variations[3].

Many researchers have used Conjectural Variation Approach (also known as Bresnahan, 1982 and Lau, 1982-referred to as BL method) to study competitive conduct with market power in the banking industry. Shaffer (1989) used the BL method for US banking and strongly rejected collusion, but not perfect competition. Later on, Shaffer (1993) tested the degree of market power for Canadian banking using time series data for 1965-1989 and found perfect competition. Other studies include Angelini and Cetorilli (2003) for Italian banking, Sjoberg (2005) for Swedish banking, Coccorese (2005, 2009) for Italian banking, Rezitis (2010) for Greek banking and so on. However, no studies have been reported yet for the Bangladesh banking industry.

Even though, no empirical study has been found yet that examines the degree of competitiveness solely of the banking industry of Bangladesh. This paper, at least for Bangladesh banking industry, thus contributes in the existing literature on competitive conduct in banking industry and fills the gap in the literature on Bangladesh banking covering recent bank-level panel data.

## 4. Conjectural Variation Approach & Data:

The conjectural variation approach (a non-structural approach) estimates the conduct or market power directly from the economic model as a free parameter. Appelbaum (1982) suggests a variant measure conjectural variation (CV) approach where conduct along with cost is estimated efficiently. The basic notion of this approach is that it assumes firms' (banks') profit maximizing behavior by setting equilibrium prices and quantities with respect to cost consideration and the degree of competition in the market. The degree of competition, however, depends on the market demand characteristics and firm (bank) conduct.

This model, basically, consists of an inverse demand function and a cost function, of which

3 For details about conjectural variation see Figuierset. al. (2004),"Theory of Conjectural Variations."

the first-order condition of the later defines the supply function. Assume thatthere are N banks in the industry. Consider the industry is producing Q output at price P. Also, let $q_i$ be the output of bank *i*, such that-

$$Q=\Sigma q_i i=1,2\ldots N \qquad \text{(i)}$$

Suppose that, the inverse market demand function (Bresnahan, 1989; Angelini and Cetorilli,2003) can be written as-

$$P=P\,(Q,\, z) \qquad \text{(ii)}$$

where, z is a vector of exogenous variables that affect demand.

The cost function for bank iis defined by the following way which depends on the level of output ($q_i$) and on the exogenous vector of input prices ($\omega_i$)-

$$C_i = C_i\,(q_i,\omega_i) \quad \text{(iii)} \qquad \text{(iii)}$$

Thus, the profit function for bank i is-

$$\pi_i = P(Q,z).\, q_i - C_i(q_i,\omega_i) \qquad \text{(iv)}$$

Maximization of (iv) w.r.t $q_i$ yields-

$$\frac{\delta\pi_i}{\delta q_i} = P+q_i \frac{\delta P}{\delta Q} \times \frac{\delta Q}{\delta q_i} - \frac{\delta C_i(qi,\omega_i)}{\delta q_i} = 0$$

$$\text{Or,} \qquad P = MC_i(q_i,\omega_i) - q_i \quad \frac{\delta P}{\delta Q} \times \frac{\delta Q}{\delta q_i} \qquad \text{(v)}$$

$MC(q_i,\omega_i)=\delta C_i/\delta q_i$ is the marginal cost for bank i. By rearranging, equation (v) can be written in a stylized from as-

$$P= MCi(qi,\omega i) - Q\left(\frac{\delta P}{\delta Q}\right)\left(\frac{\delta Q}{\delta q_i}\right)\left(\frac{q_i}{Q}\right) \qquad \text{(vii)}$$

$$P= MC_i\,(q_i,\omega_i) - \lambda.\, h\,(Q,z)$$

Here, $(\delta Q/P)/\delta Q)^{-1}= \eta$ is market demand semi-elasticity of price and $(\delta Q/q_j)(\delta q_j/Q)=\varnothing_i$ is the conjectural elasticity of total industry output in respect to the output of bank i.

And, $\lambda=\delta Q/\delta q_i$ is the conjectural variation parameter/derivative of bank i and measures the degree of market power. If $\lambda=0$, the market is said to be perfectly competitive since it yields Eq. (5.7) P=MC. If $\lambda=1$, a perfect cartel we perceive and $0<\lambda<1$ reflects various oligopoly regime (e.g. monopolistic competition). A value of $\lambda=-1$, reveals a Bertrand competitive conjecture (Telser, 1972), wherein an increase in output by one bank is exactly offset by a decrease of its rival banks, so that the market price remains unchanged.

The estimation of the conjectural variation parameter $\lambda$ requires the simultaneous estimation of equations (i), (iii) and (vii).

### 4.1. Empirical Modeling:

To estimate λ, a demand function, a cost function and a supply relation are required. Note that the marginal cost function is attributed as the supply relation.

In this paper, a log-linear demand function is applied[4]. It is not necessary to include an interactive term in the demand function for identification purpose (Sjoberg, 2005) due to the log-linear form. Corresponding to Eq. (i), the market demand function is specified as-

$$\ln Q_t = \alpha_0 + \alpha_1 \ln P_t + \alpha_2 \ln Y_t + \alpha_3 \ln Z_t + \in_t \qquad \text{(viii)}$$

where $Q_t$= Quantity of market output at time t

$P_t$= Market price of output of at time t

$Y_t$= National income which reflects economic activity at time t

$Z_{t,}$= an exogenous variable substituting for banking service at time t

$\omega_t$ =error term.

Like many studies on the banking industry (Mester, 1987; Berger et al., 1987; Shaffer, 1993; Coccorese, 2004, 2009), I also employ a trans-log cost function which is a second order Taylor expansion of any cost function[5]. Consistent with the intermediation approach and considering a three-input (funds e.g. deposits, employee and physical capital) specification, the corresponding trans-log cost function can be written as-

$$\begin{aligned}\ln C_{it} = {} & \beta_0 + \beta_1 \ln q_{it} + \beta_2/2(\ln q_{it})^2 + \beta_3 \ln \omega_{1it} + \beta_4 \ln \omega_{2it} + \beta_5 \ln \omega_{3it} \\ & + \ln q_{it}\beta_6 \ln \omega_{1it} + \ln q_{it}\beta_7 \ln \omega_{2it} + \ln q_{it}\beta_8 \ln \omega_{3it} \\ & + \beta_9/2(\ln \omega_{1it})^2 + \beta_{10}/2(\ln \omega_{2it})^2 + \beta_{11}/2(\ln \omega_{3it})^2 \\ & + \beta_{12} \ln \omega_{1it} \ln \omega_{2it} + \beta_{13} \ln \omega_{1it} \ln \omega_{3it} + \beta_{14} \ln \omega_{2it} \ln \omega_{3it} + \varphi_{it} \qquad \text{(ix)}\end{aligned}$$

where, $\varphi_{it}$ is the error term. C is the total cost and $\omega_k$ (k=1, 2, 3) is the input prices for bank i. Some usual conditions on the trans-log cost function are imposed as specified by Berger et al. (1987). Particularly, Eq. (ix) does not require the test for symmetry condition as banks produce composite products (Sjoberg, 2005; Coccorese 2004, 2009). However, according to Bresnahan (1989), proper identification of λ requires the property of linear homogeneity (of degree 1) in input prices on the marginal cost function. That is, the following restriction is imposed:

$$\beta_3 + \beta_4 + \beta_5 = 1 \qquad \text{(R1)}$$

$$\beta_6 + \beta_7 + \beta_8 = 0 \qquad \text{(R2)}$$

$$\beta_{12} + \beta_{13} + \beta_{14} = 0 \qquad \text{(R3)}$$

4 See Berg and Kim (1994), Coccorese (2004, 2009), Sjoberg (2005).
5 It is also a generalization of Cobb-Douglas functional form.

The trans-log cost Eq. (ix) implies the following marginal cost function:

$$MC_{it} = \delta C_{it}/\delta q_{it} = C_{it}/qi_t(\beta_1+\beta_2 lnq_{it}+\beta_6 ln\omega_{1it}+\beta_7 ln\omega_{2it}+\beta_8 ln\omega_{3it}) \quad (x)$$

Substituting (x) into (vii) and simple manipulation yields the supply relation as-

$$P_{it} = C_{it}/qi_t\ (\beta_1+\beta_2 lnq_{it}+\beta_6 ln\omega_{1it}+\beta_7 ln\omega_{2it}+\beta_8 ln\omega_{3it}) - \lambda(P/\alpha_1)+\gamma_{it} \quad (xi)$$

where, $\gamma$ is an error term.

Thus, to identify $\lambda$ the system of equations (viii), (ix) and (xi) are estimated simultaneously. A positive value of $\lambda$ shows the presence of collusive behavior; while a negative value reflects competitive behavior. Since, average output data is employed; thus, $\lambda$ reflects average conduct over separate product markets and over the years under the sample. It also reflects the conduct of an average sample bank even though banks enjoy varying degree of market power. Shaffer (2001) also acknowledged that the interpretation of $\lambda$ as average conduct is valid regardless of the holding of long-run equilibrium condition during the period under sample. Note that, the system of equations (viii), (ix) and (xi) does not suffer from the identification problem[6].

### 4.2. Model Specification:

For estimating $\lambda$ using a panel data framework, the system of equation (viii), (ix) and (xi) are re-specified under the following manner:

$$lnTLNS_t = \alpha_0+\alpha_1 lnMPL_t+\alpha_2 lnGDP_t+\alpha_3 lnTBILL91_t+\in_{it} \quad (xii)$$

$$\begin{aligned} lnTC_{it} = {} & \beta_0+\beta_1 lnLNS_{it}+\beta_2/2(lnLNS_{it})^2+\beta_3 lnPD_{it}+\beta_4 lnPP_{it}+\beta_5 lnPK_{it} \\ & +lnLNS_{it}\beta_6 lnPD_{it}+ lnLNS_{it}\beta_7 lnPP_{it}+ lnLNS_{it}\beta_8 lnPK_{it} \\ & +\beta_9/2(lnPD_{it})^2+\beta_{10}/2(lnPP_{it})^2+\beta_{11}/2(lnPK_{it})^2 \\ & +\beta_{12} lnPD_{it} lnPP_{it}+\beta_{13} lnPD_{it} lnPK_{it}+\beta_{14} lnPP_{it} lnPK_{it}+\varphi_{it} \quad (xiii) \end{aligned}$$

$$\begin{aligned} PL_{it} = {} & TC_{it}/LNSi_t\ (\beta_1+\beta_2 lnLNS_{it}+\beta_6 lnPD_{it}+\beta_7 lnPP_{it}+\beta_8 lnPK_{it}) \\ & -\lambda(MPL_t/\alpha_1)+\gamma_{it} \quad (xiv) \end{aligned}$$

Relying on the intermediation model (Klein, 1971; Sealey and Lindley, 1977) of a bank, which assumes labor (employees) with other physical capital are used to obtain deposit and finally to originate loans, we consider here loans (LNS) as the output of a bank. The variables are defined as follows-

$LNS_{it}$ = Loans and Advances of Bank I at time t.

$TLNS_t$ = Total amount of Loans and Advances of all banks at time t

$MPL_t$ = Market Price of Loans at time t (measured as weighted average market interest rate of loans)

6 For details, see Hill, Griffiths and Lim (2008), p-308.

$GDP_t$ = Gross Domestic Product at current prices at time t.

$TBILL91_t$ = Rate of 91 days Treasury bill (as a proxy for substitute of bank loans)

$TC_{it}$ = Total Cost of Bank i at time t.

$PD_{it}$ = Price of Deposit of Bank i at time t (measured as ratio of interest expense to deposits).

$PP_{it}$ = Price of Personnel of Bank i at time t (measured as ratio of personnel expense to total assets).

$PL_{it}$ = Price of Loans of Bank i at time t (measured by interest rate)

$PK_{it}$ = Price of physical capital of Bank i at time t (measured as ratio of operating expenses net of personnel expense to total assets).

$TC_{it}/LNS_{it}$ = Average Cost at time t (measured as ratio of Total Cost to Loans).

Since the number of employees is not available for all banks, I consider total assets as a proxy as denominator for calculating the price of labor and physical capital.

### 4.3. Data Structure:

This study covers bank-level data on 36 commercial banks in Bangladesh for the period 2001 to 2013. A panel of data has been prepared by gathering data from the annual reports of the said years for the sample banks except GDP, 91 days T-Bill (TBILL91) rate, and market interest rate of loans (MPL). Data on GDP, TBILL91, and MPL have been collected form Economic Trends, a publication of Bangladesh Bank.

The panel data framework allows identifying different conduct parameters for different groups of banks. From the whole sample we, thus, also make two other sub-samples based on the ownership structure of the sample banks. The first sub-sample covers 5 state-owned banks (SCBs) for the year 2001 to 2013. On the contrary, the second sub-sample covers 31 privately owned banks (PCBs) for a period of 2001 to 2013.

The system of equation (xii), (xiii) and (xiv) have been estimated simultaneously through iterative nonlinear seemingly unrelated regression (SUR) and full information maximum likelihood (FIML) method. The simultaneous equation system could also be estimated through generalized method of moments (GMM), two-stage least squares (2SLS) or three-stage least squares (3SLS). However, GMM, 2SLS and 3SLS are instrumental variable estimators and problems were encountered selecting relevant instruments.

SUR, also known as joint generalized least squares, can be used to estimate systems of equations with correlated random errors. On the other hand, FIML is a system generalization of the limited information maximum likelihood (LIML) estimator and assumes that the equations errors have a multivariate normal distribution. Compared to the instrumental variables methods (e.g.2SLS ,3SLS), the FIML method has the advantages that it does not require instrumental variables, includes the full equation system, with as many equations

as there are endogenous variables[7]. This paper, thus, uses SUR and FIML estimation methods.

## 5. Empirical Results and Discussions

The estimation of the system of equations (xii), (xiii) and (xiv) is reported in Table-4(for SUR) and Table-5(for FIML). The goodness of fit of each of three equations is satisfactory as reported by the values of $R^2$. Both of the SUR and FIML method returns almost the same values of $R^2$.

**Table-4: System Estimation Results (Software: Eviews 6.0)**

| | SUR | | | | | |
|---|---|---|---|---|---|---|
| **Regressor (Parameter)** | **All Banks** | | **SCBs** | | **PCBs** | |
| | Parameter | t-value | Parameter | t-value | Parameter | t-value |
| | Demand Function (Dependent Variable: ln TLNS) | | | | | |
| Constant ($\alpha_0$) | -6.180* | -66.195 | -6.740* | -25.987 | -6.182* | -61.433 |
| ln MPL ($\alpha_1$) | -0.140* | -7.906 | -0.190* | -3.600 | -0.141* | -7.385 |
| ln GDP($\alpha_2$) | 1.297* | 269.455 | 1.325* | 97.106 | 1.297* | 249.990 |
| ln TBILL91($\alpha_3$) | -0.019** | -2.237 | -0.024 | -0.902 | -0.019** | -2.072 |
| $R^2$ | 0.996 | | 0.995 | | 0.996 | |
| | Cost Function (Dependent Variable: ln$TC_i$) | | | | | |
| Constant ($\beta_0$) | -0.561 | -0.185 | 14.705 | 1.234 | 2.809 | 0.817 |
| ln LNS ($\beta_1$) | 0.629* | 4.163 | 1.844* | 3.793 | 0.383** | 2.095 |
| $(\ln LNS)^2$ ($\beta_2$) | 0.021* | 3.745 | -0.162* | -5.456 | 0.027* | 4.140 |
| ln PD ($\beta_3$) | -0.474 | -0.801 | -1.197 | -0.376 | -0.113 | -0.172 |
| ln PP ($\beta_4$) | -0.687 | -0.892 | 4.774 | 1.395 | -0.481 | -0.549 |
| ln PK ($\beta_5$) | 0.204 | 0.563 | 4.229* | 2.813 | 0.691 | 1.629 |
| ln LNS*lnPD ($\beta_6$) | -0.013 | -0.573 | -0.210*** | -1.944 | -0.027 | -0.988 |
| ln LNS*lnPP ($\beta_7$) | 0.011 | 0.595 | 0.006 | 0.064 | 0.020 | 0.936 |
| ln LNS*lnPK ($\beta_8$) | -0.025*** | -1.730 | -0.062 | -1.188 | -0.063* | -3.868 |
| $(\ln PD)^2$ ($\beta_9$) | 0.088* | 2.935 | -1.187** | -2.077 | 0.097* | 2.864 |
| $(\ln PP)^2$ ($\beta_{10}$) | -0.061 | -0.580 | 0.522 | 0.839 | -0.096 | -0.857 |
| $(\ln PK)^2$ ($\beta_{11}$) | 0.171* | 2.745 | 0.498* | 2.712 | 0.100 | 1.268 |
| ln PD*lnPP ($\beta_{12}$) | -0.057 | -0.600 | 0.204 | 0.471 | -0.041 | -0.375 |
| ln PD*lnPK ($\beta_{13}$) | -0.239* | -3.718 | -0.274 | -0.865 | -0.216* | -2.824 |

7 For more details SAS/ETS 9.2 user guide, SAS Institute Inc. (2008)

| | | | | | | |
|---|---|---|---|---|---|---|
| ln PP*lnPK ($\beta_{14}$) | -0.059 | -0.948 | 0.345 | 1.3336 | 0.025 | 0.338 |
| $R^2$ | 0.982 | | 0.995 | | 0.977 | |
| | Supply Relation (Dependent Variable: $PL_i$) | | | | | |
| Conduct ($\lambda$) | 0.011* | 4.164 | -0.021** | -2.595 | 0.016* | 5.007 |
| Wald Test | | | | | | |
| $\chi_2$ value ,$H_0$:$\lambda$=0<br>P Value | 17.428<br>0.0000[a] | | 6.793<br>0.0092[a] | | 25.074<br>0.0000[a] | |
| $\chi_2$ value, $H_0$:$\lambda$ =1<br>P Value | 149511.1<br>0.0000[a] | | 16404.5<br>0.0000[a] | | 96237.96<br>0.0000[a] | |
| $\chi_2$ Value $H_0$:$\lambda$ =-1<br>P Value | 156037.7<br>0.0000[a] | | 15096.4<br>0.0000[a] | | 102551.9<br>0.0000[a] | |
| $R^2$ | 0.610 | | 0.609 | | 0.669 | |
| No. of Observation | 324 | | 50 | | 279 | |

t-values in the Parentheses. *,**and *** indicates significant at 1%, 5% and 10% level respectively. a. Rejects the null hypothesis.

**Table-5: System Estimation Results (Software: Eviews 6.0)**

| | **FIML** | | | | | |
|---|---|---|---|---|---|---|
| **Regressor (Parameter)** | **All Banks** | | **SCBs** | | **PCBs** | |
| | Parameter | Z-Stat | Parameter | Z-stat | Parameter | Z-Stat |
| Demand Function(Dependent Variable: ln TLNS) | | | | | | |
| Constant ($\alpha_0$) | -6.184* | -26.642 | -6.607* | -14.384 | -6.187* | -24.586 |
| ln MPL ($\alpha_1$) | -0.141* | -6.793 | -0.187** | -2.059 | -0.141* | -6.361 |
| ln GDP($\alpha_2$) | 1.297* | 97.516 | 1.316* | 44.097 | 1.297* | 90.193 |
| ln TBILL91($\alpha_3$) | -0.019 | -1.364 | -0.030 | -0.737 | -0.019 | -1.264 |
| $R^2$ | 0.996 | | 0.995 | | 0.996 | |
| Cost Function (Dependent Variable: $lnTC_i$) | | | | | | |
| Constant ($\beta_0$) | -0.225 | -0.072 | 16.284 | 1.108 | 5.477 | 1.579 |
| ln LNS ($\beta_1$) | 0.659* | 3.625 | 1.556*** | 1.704 | 0.218 | 0.998 |
| $(\ln LNS)^2$ ($\beta_2$) | 0.012 | 1.529 | -0.181* | -3.310 | 0.026* | 3.311 |
| ln PD ($\beta_3$) | -0.642 | -1.177 | -2.238 | -0.358 | 0.015 | 0.024 |
| ln PP ($\beta_4$) | -0.459 | -0.596 | 5.141 | 1.289 | -0.060 | -0.068 |
| ln PK ($\beta_5$) | 0.339 | 0.554 | 4.485 | 1.288 | 1.050** | 2.237 |
| ln LNS*lnPD ($\beta_6$) | -0.006 | -0.215 | -0.255** | -1.973 | -0.033 | -1.105 |
| ln LNS*lnPP ($\beta_7$) | -0.002 | -0.069 | -0.038 | -0.264 | 0.003 | 0.135 |
| ln LNS*lnPK ($\beta_8$) | -0.029 | -1.528 | -0.088 | -0.755 | -0.082* | -4.008 |
| $(\ln PD)^2$ ($\beta_9$) | 0.062*** | 1.852 | -1.320 | -0.864 | 0.072*** | 1.686 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $(\ln PP)^2$ ($\beta_{10}$) | -0.077 | -0.633 | 0.244 | 0.259 | -0.100 | -0.759 |
| $(\ln PK)^2$ ($\beta_{11}$) | 0.097 | 1.216 | 0.532 | 1.350 | 0.040 | 0.506 |
| ln PD*lnPP ($\beta_{12}$) | -0.098 | -1.031 | 0.300 | 0.438 | -0.051 | -0.446 |
| ln PD*lnPK ($\beta_{13}$) | -0.194* | -2.842 | -0.560 | -0.986 | -0.170** | -2.042 |
| ln PP*lnPK ($\beta_{14}$) | 0.011 | 0.143 | 0.498 | 1.022 | 0.099 | 1.086 |
| $R^2$ | 0.980 | | 0.994 | | 0.975 | |
| Supply Relation (Dependent Variable: $PL_1$) | | | | | | |
| Conduct ($\lambda$) | 0.011* | 3.956 | -0.016 | -1.389 | 0.016* | 4.548 |
| Wald Test | | | | | | |
| $\chi_2$ value ,$H_0$:$\lambda$ =0<br>P Value | 15.653<br>0.0001[a] | | 1.930<br>0.1648 | | 20.686<br>0.0000[a] | |
| $\chi_2$ value, $H_0$:$\lambda$ =1<br>P Value | 125030.1<br>0.0000[a] | | 7450.3<br>0.0000[a] | | 77835.3<br>0.0000[a] | |
| $\chi_2$ Value $H_0$:$\lambda$ =-1<br>P Value | 130688.6<br>0.0000[a] | | 6978.4<br>0.0000[a] | | 82993.7<br>0.0000[a] | |
| $R^2$ | 0.623 | | 0.635 | | 0.687 | |
| No. of Observation | 324 | | 50 | | 279 | |

t-values in the Parentheses. *,**and *** indicates significant at 1%, 5% and 10% level respectively. a. Rejects the null hypothesis.

As it is evident in Table-4 and Table-5, the estimated coefficients obtained by the two methods are very similar both in sign and significance. The magnitude of the estimated parameters is, albeit, similar in both of the estimation methods. Table-4 and Table-5 reports the estimation results for three sets of samples: all banks, state-banks (SCBs) and private banks (PCBs). Last two samples (SCBs and PCBs) are categorized in terms of the ownership structure.

**Both State Owned and Private Banks:**

In the demand equation, both SUR and FIML estimates yields parameters that are statistically significant at 1% and 5% level of significance. The sign of the coefficient of market price ($\alpha_1$) is negative and significantly different from zero which is consistent with the downward sloping market demand curve. In terms of magnitude the value of $\alpha_1$ is -0.14 (in both SUR and FIML). The variable GDP has an expected significantly positive coefficient ($\alpha_2$). The coefficient of TBILL91, proxy of a substitute of banking services, is expected to be positive[8]. However, the sign of estimated coefficient ($\alpha_3$) is negative and significant at 5% level only in the SUR method. The lower magnitude of TBILL91

8 TBILL91 has been considered as a proxy of the price of substitute of bank loans. If this is a good measure, then it should take a positive coefficient. For example, if TBILL91 reflects the short term market interest rate, then it may be the case that the investors have less inclination to go for alternative source of financing if the rate of TBILL91 is higher. Therefore, the demand for bank loans may also be higher.

indicating that the demand for the banking output (e.g. loans) is not so sensitive to the price changes of the substitute product.

The overall fit of the cost equation is very good as indicated by the estimated $R^2$. Both SUR and FIML report the coefficient loans ($\beta_1$) is significantly positive and the magnitude (0.629 and 0.659) reflects that in Bangladesh, banks have to bear significant searching and scrutinizing cost for extending loans. The sign of the price of deposit ($\beta_3$) and personnel ($\beta_4$) are expected to be positive. However, the results (in both methods) show a negative sign though these are not statistically significant. It can be explained by the way in that the overall banking market does not suffer from a liquidity problem.

In the supply relation, the value of the estimated conduct parameter ($\lambda$) is positive and statistically significant at the 1% level. The magnitude of this parameter (0.011) is small and indicates that banks on average exercised a very low degree of market power.

**SCBs and PCBs**

Table-4 and Table-5 also report the result for the sub-samples of SCBs and PCBs. The sign of the parameters are similar to the case of all banks.

In the demand equation, most of the parameters are statistically significant except TBILL91 for the case of SCBs. In the cost equation, the magnitude of the parameter loans ($\beta_1$) varies between the two categories of banks (1.844 for SCBs and 0.383 for PCBs). The greater magnitude for SCBs may be attributed to the presence of huge non-performing loans in the portfolio. Though the coefficient of the price of personnel ($\beta_4$) is not significant, the positive sign and magnitude indicates that SCBs are, albeit, overstuffed.

A notable difference was observed in the estimated conduct parameter ($\lambda$) in the supply relation. In case of SCBs the sign of conduct parameter is negative (-0.021 and -0.016), wherein it is only significant in SUR estimation method. On the contrary, the sign of the conduct parameter for PCBs is positive (0.016) and statistically significant at 1% level.

### 5.1. Hypothesis Testing and Interpretations of Parameters

The full sample SUR and FIML estimation of the conduct parameter ($\lambda$) is 0.011. The Wald Chi-square ($\chi_2$) testshows that the value is significantly different from zero at 1% level of significance; that is the hypothesis of perfect competition is rejected. By the same Wald test the hypothesis of perfect collusion ($\lambda$=1) and Bertrand competitive conjecture ($\lambda$=-1) are strongly rejected as shown in Table-4 and Table-5. The positive value of $\lambda$ (but <1) indicating that the overall market can be defined as a nature of monopolistic competition. It is also true for the samples of private banks (PCBs).

However, the sample of state banks (SCBs) shows a different result. The conduct parameter ($\lambda$) is significantly different from zero in case of SUR estimation, while the FIML does not reject the null hypothesis of $\lambda$=0. The Wald test rejects the hypotheses of perfect competition, perfect cartel as well as the Bertrand competitive conjecture. The negative value of $\lambda$ (-0.021) can be interpreted as a local estimate of the percentage deviation of aggregate output from the competitive equilibrium level (Shaffer, 1993). Consistent with Eq. (vii), it can be said that SCBs charge a markup above the MC to the borrowers; this may

indicate a power of transferring the cost of non-performing loans to the existing borrowers.

**Table-6: Measures of Performance**

| Sample | $P_i$ | MC | AC | $L^9$ (%) | λ |
|---|---|---|---|---|---|
| All Sample | 0.115243 | 0.087358 | 0.113488 | 24.20 | 0.011 |
| SCBs | 0.084109 | 0.080920 | 0.097762 | 3.79 | -0.021 |
| PCBs | 0.120196 | 0.085943 | 0.114760 | 28.50 | 0.016 |

In Table-6, the key performance measures are summarized for all samples, SCBs and PCBs. The values of prices ($P_i$), marginal cost (MC) and average cost (AC) are calculated average values for the respective samples. Since the AC is higher than the MC, there exist scale economies in the banking industry of Bangladesh. Hence it is evident from the Table-6, that the average conduct and average degree of market power, represented by L, varies between SCBs and PCBs. PCBs enjoy a greater market power (28.5%) compared to that of SCBs (3.79%). The average learner index for market power is 24.20% which is a development of the earlier study over the period of 1995-99 by Maudos-Villaroya, J. (2005)[10].

## 6. Conclusions

In the modern age, commercial banks are considered as the nerve system of a country's economic development. The roles of banks are manifold: capital formation, monetization, implementation of monetary policy, payment functions and many more. Not only that, banks perform as an actor to transform the corn[11] economy to monetary economy by certifying the credit worthiness of the borrowers, reducing information asymmetry between creditors and borrowers as well as supplying credit (Stiglitz & Greenwald, 2003).In other words, an effective, efficient and disciplined banking and financial system fosters economic growth in various sectors of the economy.

This paper has investigated the efficiency, productivity change and competitiveness of the banking industry in Bangladesh. Employing a non-structural conjectural variation approach on a panel data framework consisting of 36 banks for 2000-2009, this paper finds that the overall banking market is characterized as being monopolistic competition. The results, however, shows that PCBs are more competitive than the SCBs. Eventually, SCBs market seem to be a conjectural variation. In addition, the result of conjectural variation approach reveals more market power is exercised by the PCBs (28.5%) than the SCBs (3.79%). This result is consistent with the hypothesis of a contestable market as referred by Baumol (1982).

The results may reveal that banks in Bangladesh could have taken relationship lending/ banking strategies (Petersen & Rajan, 1998) and might have ensure stability in the financial

9 The Learner Index, L is calculated as L=(P-MC)/P.

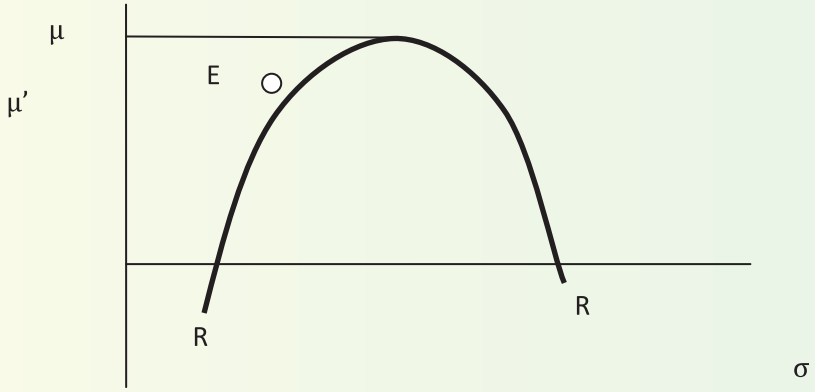
10 Maudos-Villaroya, J. (2005) estimated the learner index of the banking industry of 58 countries including Bangladesh. The estimated learner index over the period of 1995-99 was 4.80%

11 Corn economy refers to a primitive non-monetary economy i.e. an economy without the presence of money.

market protecting themselves encountered from the lemon market (Shaffer, 1998). Under the relationship banking banks are more risk averse and charge interest rate for loans below the point where the expected return is maximized (Stiglitz& Greenwald, 2003).

**Figure-1: Loan Opportunity Set**

The economic growth of Bangladesh is largely influenced by the efficient and successive performance of commercial banks, since other participants have a minor contribution in the financial system. Due to a volatile capital market, and banks participation both as major listed companies and in share trading, Bangladesh Bank[12] has to be more vigilant on the performance of the commercial banks. As such, this research paper advocates the following recommendations.




The government of Bangladesh should be careful about the competitiveness of the banking industry as a whole. Competition does not always be a welfare maximizing. For instance, perfect competition in banks in Bangladesh means regulations should be relaxed for easy entry and exit of the banks. That might not be a good choice since banking product is purely different from conventional goods.

The findings also may help the regulators whether to increase competition in the banking industry by allowing more banks, but with the fortune of "winner's curse". Henceforth, stability in the financial market is also determined or influenced by the existing bank market structure.

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