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Governance and Competitiveness: An Econometric Analysis of the Banking Sector of Bangladesh

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Abstract

Banks play a pivotal role in the financial sector, especially in least developed countries where financial markets are small. In recent years, the banking sector of Bangladesh has been beset with problems, such as numerous financial scams and high volume of non-performing loans. Since the existing literature does not address this issue, it is hitherto unclear as to what impact governance may have on the competitiveness of the banking sector. This paper aims to fill in this research gap by investigating the relationship between governance and competitiveness, in the context of the banking sector of Bangladesh. Based on time series data from 1996 to 2016, the techniques of seemingly unrelated regression and three stage least squares are utilized to examine the effect of governance on competitiveness. The results of this study show that improved governance, in the form of better voice and accountability, political stability, regulatory quality, government effectiveness, rule of law, and control over corruption, tend to improve competitiveness in the banking sector, as measured by the Lerner index. These findings imply that good governance is conducive to improving the competitiveness of the banking sector. Policies concerning the sector must prioritize governance in order to have favourable outcomes.

JEL classification numbers: G21, G34, O16
Keywords: banking, competitiveness, governance, Bangladesh

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1 Introduction

The quintessential purpose of a bank is to act as an intermediary between borrowers and savers, and enable efficient allocation of financial resources. However, in the modern society, banks tend to play many different roles that transcend beyond the realm of their elementary function. Whilst most of these activities are benign, there are some which often undermine the welfare of the general public. When banks transform from being financial intermediaries to becoming monopolies, they become a growing cause for concern [1]. As the structure of the banking market changes, so does the conduct and performance of the individual banks (Annex Figure 1). Big banks start to absorb, annex, or subordinate small banks. The monopolization of banking is usually accompanied with a deterioration in governance. Bankers, businessmen, and politicians join forces in an unholy trinity that engages in unscrupulous activities. When financial capital becomes concentrated into the hands of few, monopolies extract supernormal profits at the cost of the welfare of the ordinary population [2]. Crony capitalists use banks as vehicles for reaching their goal of financial oligarchy [1].

In recent years, the banking sector of Bangladesh has been plagued with a plethora of problems which include high volume of non-performing loans, increased financial crimes, and bank heists. Meanwhile, businesses have set their sights on the banking sector. In 2017, a single corporation gained control over 7 private commercial banks in Bangladesh [3]. Following this development, there were major changes in the top management of these banks [4]. However, monopolization of banking was not only limited to corporations, but also spread to elite business families. Despite being cautioned by the central bank in 2014, two private commercial banks still had four or more members from the same family in their Board of Directors, as of 12th January 2018 [5]. These incidences indicate weakening of governance in banking, which could lead to detrimental consequences for the overall competitiveness of the sector.

How governance can impact on the competitiveness of the banking sector in Bangladesh is an issue that needs to be investigated in order for the policy makers to take corrective measures. This paper sets out on this goal by determining whether governance can influence the competitiveness of the banking sector. The novelty of this research is that it incorporates both conventional financial indicators as well as governance indicators to examine the issue of competitiveness. The reason for including multiple and diversified indicators is to have a more robust and clearer picture on the banking sector.

Modelling of the banking market is a prerequisite for understanding the factors that influence the overall competitiveness of the sector. Such exercise can also help formulate appropriate policies. The findings of this research will provide

evidence of the link between governance and competitiveness, and improve our understanding of the banking sector as a whole.

The remainder of this paper is structured as follows. Section 2 outlines the theoretical underpinnings of the topic by explaining the Lerner Index in the context of banking. Section 3 contains a brief review of some of the relevant past literature. Section 4 defines the variables used in this paper, and mentions the sources of data. Section 5 describes the methodology used in this study. Section 6 highlights the findings of this study, as well as the major implications of these results. Section 7 concludes the paper with some recommendations for policy and future research.

2 Theoretical Framework

The Lerner Index is a measure of a firm's market power proposed by Abba P. Lerner [6]. In theory, a pure monopoly is a market with a single seller whereas a perfectly competitive market has an infinite number of sellers. Therefore, there may be an inclination to construct a measure of market power as the inverse of the number of sellers. Such a measure would entail a value of one for monopoly and a value of zero for perfect competition. However, Lerner warns against the use of such measures, since significant monopoly power can exist even in markets with many sellers [6]. Therefore, Lerner puts forward an index of a firm's market power which is the ratio of the divergence of price from marginal cost to price.

The Lerner index may be derived in the following way. The total revenue function is given as

$$R(Q) = P(Q) * Q$$

Differentiating with respect to quantity, we get the marginal revenue function

$$MR\ (Q) = \frac{\delta R(Q)}{\delta Q}$$

Rearranging the marginal revenue function gives

$$MR\ (Q) = \frac{\delta p(Q) * Q}{\delta Q}$$

$$MR\ (Q) = p(Q)\frac{\delta Q}{\delta Q} + \frac{\delta p(Q)}{\delta (Q)}Q$$

$$MR\ (Q) = p(Q) + \frac{\delta p(Q)}{\delta (Q)}$$

$$MR\ (Q) = p + \frac{\delta p}{\delta Q} Q$$

$$MR\ (Q) = p + p \frac{\delta p}{\delta Q}$$

$$MR\ (Q) = p \left[1 + \frac{1}{\left(\frac{\delta Q}{\delta p}\right)\left(\frac{p}{Q}\right)} \right]$$

Since price elasticity of demand is given as $\lim_{\Delta Q \to 0} \varepsilon = \left(\frac{\delta Q}{\delta p}\right)\left(\frac{p}{Q}\right)$, we can write

$$MR\ (Q) = p + \left[1 + \frac{1}{\varepsilon} \right]$$

Profit is maximized where marginal revenue equals marginal cost, so

$$MR = MC$$

$$\therefore p + \left[1 + \frac{1}{\varepsilon} \right] = MC$$

$$p + \frac{p}{\varepsilon} = MC$$

$$\frac{p}{\varepsilon} = MC - p$$

From this we get the Lerner Index as

$$-\frac{1}{\varepsilon} = \frac{P - MC}{P} = Lerner\ Index$$

Hence, the Lerner index is mathematically equivalent to the negative inverse of the price elasticity of demand. When the price elasticity of demand is elastic, the value of the Lerner index is low and the profit margin is low. Low profit margins indicate greater competitiveness, so lower values of the Lerner index correspond to greater market competitiveness. Alternatively, when the price elasticity of demand is inelastic, the value of the Lerner index is high and the profit margin is high. High profit margins indicate lower market competitiveness, so higher values of the Lerner index correspond to lower market competitiveness. This is illustrated in Figure 1.

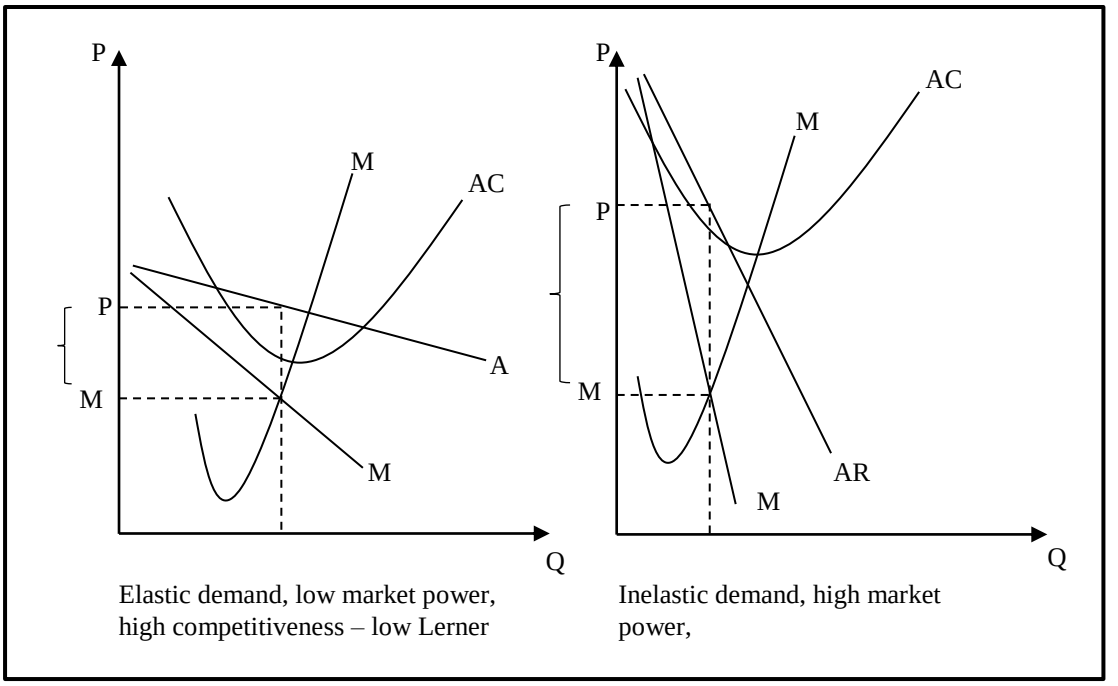


Figure 1: price elasticity of demand, lerner index, and market power
Source: authors' illustration

Since a rational producer will not sell at a price below marginal cost, the value of the Lerner index is always positive.

$$\therefore 0 \leq Lerner\ Index \leq 1$$

A Lerner index value of zero indicates a perfectly competitive market, whilst a Lerner index value of one indicates a pure monopoly. Hence Lerner index values are inversely proportional to the level of market competitiveness.

In order to obtain a Lerner index for the banking sector, we need to know the price and marginal costs facing banks. Following [7] [8] [9] the marginal costs can be estimated from panel data of banks using a transcendental log total cost function for bank $j = 1, \dots, m$ at time $t = 1, \dots, T$.

$$logTOC_{tj} = \alpha + \sum_{i=1}^{3} \beta_i logw_{tij} + \gamma_1 log\, TA_{tj} + \left(\frac{\gamma_2}{2}\right)(logTA_{tj})^2 + \sum_{i=1}^{3} \left(\frac{\delta_i}{2}\right)(logw_{tij})^2 + \sum_{i<k} \sum \delta_{ij} logw_{tij} logw_{tkj} + \sum_{i=1}^{3} \xi_i logw_{tij} logTA_{tj} + \sum_{k=1}^{2} \eta_k trend^k + \sum_{i=1}^{3} \zeta_i logw_{tij} trend + vlogTA_{tj} trend + \varepsilon_j$$

where,
$TOC_{tj} = total\ operating\ cost\ of\ bank\ j\ at\ time\ t$
$TA_{tj} = total\ assets\ of\ bank\ j\ at\ time\ t$
$w_{tij} = input\ factors\ i$
$= 1,2,3\ (borrowed\ funds, labor, and\ capital)\ of\ bank\ j\ at\ time\ t$
$trend = a\ time\ trend\ to\ capture\ technical\ change$

Assuming homogeneity of degree one on input prices, we get $\sum_{i=1}^{3} \beta_i = 1$, $\sum_{i=1}^{3} \xi_i = 0$, and $\sum_{i<k} \delta_{ik} = 0$. Differentiating with respect to TA_{tj} gives the marginal cost function

$$MC_{tj} = \left(\frac{TOC_{tj}}{TA_{tj}}\right)[\gamma_1 + \gamma_2 logTA_{tj} + \sum_{i=1}^{3} \xi logw_{ti} + vtrend]$$

where,
$MC_{tj} = marginal\ cost\ for\ bank\ j\ at\ time\ t$

Price can be substituted for average revenue, since

$$AR = \frac{TR}{Q}$$
$$AR = \frac{P * Q}{Q}, \because TR = P * Q$$
$$\therefore AR = P$$

Average revenue can be derived as the sum of average profit and average cost, since

$$A\pi + AC = \frac{TR - TC}{Q} + \frac{TC}{Q}$$
$$A\pi + AC = \frac{TR}{Q} - \frac{TC}{Q} + \frac{TC}{Q}$$
$$A\pi + AC = \frac{TR}{Q}$$
$$A\pi + AC = AR$$

where,
$A\pi = average\ profit$

Therefore, the Lerner index for bank 'j' at time 't' is calculated as:

$$Lerner_{jt} = \frac{P_{TA_{jt}} - MC_{TA_{jt}}}{P_{TA_{jt}}}$$

where,
$P_{TA_{jt}}$ *= price of total assets (proxied by the ratio of total revenues to total assets) for bank j at time t*
$MC_{TA_{jt}}$ *=marginal cost of total assets for bank j at time t.*

To incorporate the aforementioned cost and profit functions, the Lerner index can be alternatively calculated as

$$Lerner\ index = \frac{\left(\frac{\widehat{PBT}}{TA} + \frac{\widehat{TOC}}{TA}\right) - \widehat{MC}}{\frac{\widehat{PBT}}{TA} + \frac{\widehat{TOC}}{TA}}$$

where,
$\widehat{PBT} = estimated\ profit\ function$
$\widehat{TOC} = estimated\ total\ operating\ cost\ function$
$\widehat{MC} = estimated\ marginal\ cost$
$TA = total\ assets$

One approach to modelling the banking sector, which has gained popularity in the literature, is the industrial organization approach. In this approach, banks are defined as financial intermediaries that buy loans and sell deposits.

Let us consider the monopoly form of the Monti-Klein model [10] [11] which adopts an industrial organization approach to banking. The profit function of the bank is given as

$$\pi = \pi(L, D) = (r_L(L) - r)L + (r(1 - \alpha) - r_D(D))D - C(D, L)$$

where,

$\pi = profit\ of\ the\ bank$
$L = amount\ of\ loans$
$D = amount\ of\ deposits$
$r_L = rate\ of\ interest\ on\ loans$
$r = rate\ of\ interest\ in\ interbank\ market$
$\alpha =\ proportion\ of\ deposits\ held\ as\ cash\ reserves$
$r_D = rate\ of\ interest\ on\ deposits$
$C(D, L) = cost\ of\ management\ as\ a\ function\ of\ deposits\ and\ loans$

The first-order conditions for profit maximization are

$$\frac{\partial \pi}{\partial L} = r'_L(L)L + r_L - r - C'_L(D, L) = 0$$
$$\frac{\partial \pi}{\partial D} = -r'_D(D)D + r(1 - \alpha) - r_D - C'_D(D, L) = 0$$

The elasticity of demand for loans is

$$\varepsilon_L = -\frac{r_L L'(r_L)}{L(r_L)} > 0$$

And the elasticity of supply of deposits is

$$\varepsilon_D = \frac{r_D D(r_D)}{D(r_D)} > 0$$

Assuming that $\varepsilon_L > 1$, the optimization problem of the bank can be solved as

$$\frac{r_L^* - (r + C'_L)}{r_L^*} = \frac{1}{\boldsymbol{\varepsilon_L}(r_L^*)}$$

$$\frac{r(1 - \alpha) - C'_D - r_D^*}{r_D^*} = \frac{1}{\varepsilon_D(r_D^*)}$$

Since r_D^* is the price of the bank's products and C'_D is the marginal cost, this result is equivalent to the Lerner index for the banking sector. Therefore, a profit maximizing monopolistic bank sets its volume of loans and deposits in such a way that the Lerner indices equal inverse elasticities [12]. From this we can imply that as the elasticity of demand for deposits falls, a bank's market power on deposits increases, and the Lerner index also increases. Moreover, we can also see that higher values of the Lerner index are linked to greater profit margins, and hence lower competitiveness.

Similar results can be derived from the oligopolistic form of the Monti-Klein model, which is arguably a more realistic market structure for the banking sector. Suppose that there are N banks in the market, each with an identical linear cost function defined as

$$C(D, L) = \gamma_D D + \gamma_L L$$

where,
$\gamma_D = marginal\ cost\ of\ intermediation\ of\ deposits$
$\gamma_L = marginal\ costs\ of\ intermediation\ of\ loans$

A Cournot equilibrium of the banking industry is an N-tuple of couples $(D^*_n, L^*_n)_{n=1,\dots N}$ such that for every n, (D^*_n, L^*_n) maximizes the profit of bank n.

$$\max_{(D_n, L_n)} \left\{ \left(r_L \left(L_n + \sum_{m \neq n} L_m^* \right) - r \right) L_n + \left(r(1-\alpha) - r_D \left(D_n + \sum_{m \neq n} D_m^* \right) \right) D_n - C(D_n, L_n) \right\}$$

In equilibrium, each bank sets $D_n^* = \frac{D^*}{N}$ and $L_n^* = \frac{L^*}{N}$. So the first order conditions are

$$\frac{\partial \pi_n}{\partial L_n} = r'_L(L^*)\frac{L^*}{N} + r_L(L^*) - r - \gamma_L = 0$$
$$\frac{\partial \pi_n}{\partial D_n} = -r'_D(D^*)\frac{D^*}{N} + r(1-\alpha) - r_D(D^*) - \gamma_D = 0$$

Alternatively, these first order conditions may also be written as

$$\frac{r_L^* - (r + \gamma_L)}{r_L^*} = \frac{1}{N\varepsilon_L(r_L^*)}$$

$$\frac{r(1-\alpha) - \gamma_D - r_D^*}{r_D^*} = \frac{1}{N\varepsilon_D(r_D^*)}$$

where,
$N = number\ of\ banks\ in\ the\ market$

Again we reach a version of the Lerner index, this time for the oligopolistic form of the Monti-Klein model. From this we can see that as the number of banks, N, increases, the competitiveness of the market increases, and the Lerner index

falls. Therefore, if we estimate a model, we can expect a negative relationship between number of banks and the Lerner index.

3 Literature Review

Studies on the competitiveness of the banking sector have come to mixed conclusions. Some authors have found a positive relationship between competitiveness and stability of the banking sector [13] [14] [15]. According to these studies, competition is believed to induce more diversified risk taking which makes the banking sector more stable.

An alternative rationale that justifies the positive relationship between competitiveness and stability explains banking sector fragility as a phenomenon originating from the borrowers. According to this view, in relatively less competitive banking markets, individual banks tend to have greater market power, so they can charge higher interest rates on loans. In turn, this induces borrowers to undertake more risky investments which increases the chances of a loan turning bad [16]. Individual banks in relatively less competitive banking markets tend to be large, and thus have greater capacity to give out large loans. Such loans may have higher possibility of becoming non-performing [17]. Therefore, less competitive banking markets may have higher volume of non-performing loans which are an indicative of financial instability.

On the other hand, some other studies have found a negative relationship between competitiveness and stability of the banking sector [18] [19] [20]. A negative relationship between competitiveness and stability is also implied in the 'charter value' view of banking, [21] [22] [23] which proposes that competitiveness in the banking market reduces profits and encourages risk taking which may undermine the stability of the banking sector. According to this perspective, in markets with higher barriers to entry and less competition, banks have more scope for making profits and therefore do not opt for taking unnecessary risks. Such markets foster financial stability, and government measures that increase competition – such as deregulation – makes these markets unstable.

In a perfectly competitive banking market, all banks become price takers so no individual bank has any incentive to provide liquidity to a distressed bank [24]. Under such circumstances, the distressed bank may fail and trigger a systemic banking crisis. Mergers of failing banks with healthy banks can incentivise prudent risk, thus promoting stability at the cost of lower competition [25]. Historically, countries which have fewer banks and less competitive banking markets tend to have greater financial stability. One of the reasons behind this is that the task of

regulating banks can be accomplished more efficiently if the number of banks is small [24].

It is no surprise that research on the corporate governance practices of banks in Bangladesh has discovered a weak regulatory framework, domination of individual investors, limited transparency, weak disclosure, and poor institutional control [26]. Studies have also cited poor bankruptcy laws, lack of shareholder participation, [27] and political interference [28] as significant obstacles to attaining good governance in the banking sector of Bangladesh. The power of social elites also came to the forefront in some studies [29] [28] which mentioned that certain families tend to dominate bank ownership and act as an impediment to fairness, accountability, and transparency. There is now a pressing need for an independent regulatory body or commission for the banking sector of Bangladesh to prevent the repeated collusion between businesses, banks, and the government [30] [31]. Otherwise, most governance issues such as transparency and accountability will continue to be merely 'box ticking' exercises.

An analysis of the existing literature reveals that hitherto studies on the banking sector have only considered governance and competitiveness separately, and have failed to acknowledge the possibility of any connection between these two issues. This gap in the literature provides an impetus for evidence based research which links governance and competitiveness, with particular focus on the banking sector of Bangladesh.

4 Data

This study is based on the time series data of the banking sector of Bangladesh over the period 1996-2016. For the purpose of this research, governance is defined as "the traditions and institutions by which authority in a country is exercised". This includes (a) the process by which governments are selected, monitored and replaced; (b) the capacity of the government to effectively formulate and implement sound policies; and (c) the respect of citizens and the state for the institutions that govern economic and social interactions among them" [32]. Based on the aforementioned definition, two measures are employed for each of the three dimensions, so that there are a total of six indicators of governance. The process by which governments are selected, monitored, and replaced is reflected by the voice and accountability index and the political stability index. The capacity of the government to effectively formulate and implement sound policies is reflected through the government effectiveness index and the regulatory quality index. Finally, the respect of citizens and the state for the institutions that govern economic and social interactions among them is reflected through the rule of law index and the control of corruption index. These indicators are based on several hundred variables obtained from 31 different data sources, capturing

governance perceptions as reported by survey respondents, nongovernmental organizations, commercial business information providers, and public sector organizations worldwide. Each index ranges from approximately -2.5, indicating weak governance, to 2.5, indicating strong governance. Altman's Z-score [33] is an indicator which can predict the probability that a firm will become bankrupt in two years. Altman designed the Z-score by utilizing a multiple discriminant analysis methodology using a set of financial ratios. The Z-score is defined as:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

where,

$Z = Altman's\ Z - score$
$X_1 = Working\ capital/Total\ assets$
$X_2 = Retained\ Earnings/Total\ assets$
$X_3 = \ Earnings\ before\ interest\ and\ taxes/Total\ assets$
$X_4 = Market\ value\ equity/Book\ value\ of\ total\ debt$
$X_5 = Sales/Total\ assets$

The variables used in this paper, along with their source and definition, are mentioned in Table I.

TABLE I: VARIABLES USED

Name	Variable	Definition	Source
lerner	Lerner index	Difference between output prices and marginal costs (relative to prices). Prices are calculated as total bank revenue over assets, whereas marginal costs are obtained from an estimated translog cost function with respect to output. Higher values of the Lerner index indicate less bank competition.	Global Financial Development Database
va	Voice and accountability index	Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
ps	Political stability index	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including	Worldwide Governance Indicators

		terrorism. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
ge	Government effectiveness index	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
rq	Regulatory quality index	Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
rol	Rule of law index	Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
coc	Control of corruption index	Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Ranges from approximately -2.5 (weak governance) to 2.5 (strong governance).	
roa	Return on asset	Commercial bank's net income to yearly averaged total assets.	
roe	Return on equity	Commercial banks' net income to yearly averaged equity.	
nim	Net interest margin	Accounting value of bank's net interest revenue as a share of its average	Global Financial

		interest-bearing (total earning) assets.	Development
zscore	Bank z score	Probability of default of a country's banking system, calculated as a weighted average of the z-scores of a country's individual banks (the weights are based on the individual banks' total assets). Z-score compares a bank's buffers (capitalization and returns) with the volatility of those returns. It is estimated as (ROA+(equity/assets))/ standard deviation (ROA).	Database
branches	Number of branches	Total number of branches of scheduled banks in Bangladesh	Bangladesh Bank
stock	Stock market total value traded to GDP	Total value of all traded shares in a stock market exchange as a percentage of GDP.	Global Financial Development Database

SOURCE: AUTHORS' COMPILATION

5 Methodology

If the variables in a regression model are random walks or near random walks, then the regression might be spurious [34]. Such variables are said to be non-stationary and contain a unit root or a stochastic trend. Models constructed with these variables often have high goodness of fit, but owing to the strongly auto-correlated errors, however, they cannot be used to conclude any true relationships. A spurious regression has a high goodness of fit and t-statistics that seem to be significant. Nevertheless, the results of such a regression have no economic meaning [35]. Under such circumstances, it is recommended to take first differences of any series with highly auto-correlated errors, in order to obtain estimates that are more efficient. [34]. In order to check for unit roots in the variables, augmented Dickey-Fuller and Phillips-Perron unit root tests were conducted.

The augmented Dickey-Fuller test [36] [37] constitutes of estimating one or more equations using ordinary least squares in order to obtain an estimated value for the coefficient of interest, γ, and the associated standard error. Comparison of the subsequent t-statistic with the corresponding value reported in the Dickey-Fuller results enables us to decide whether to reject or not to reject the null hypothesis of $\gamma = 0$. The unit root can be detected using the Dickey-Fuller statistic. If the model has no intercept or trend, then we use the τ statistic, if the model has an intercept then we use the τ_μ statistic, and if the model has both an

intercept and a trend then we use the τ_τ statistic [35]. The augmented Dickey-Fuller test uses the p^{th} order autoregressive process defined as:

$$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_i$$

where,

$$\gamma = -\left(1 - \sum_{i=1}^{p} a_i\right) \text{ and } \beta_i = -\sum_{i=1}^{p} a_j$$

The null hypothesis is that the variable contains a unit root. The alternative hypothesis is that the variable was generated by a stationary process. If $\gamma = 0$, then we cannot reject the null hypothesis that the variable has a unit root. The augmented Dickey-Fuller test assumes that the errors are uncorrelated with each other and have constant variance.

The Phillips-Perron test [38] is non-parametric unit root test that modifies the test statistics after estimation in order to consider the effect of autocorrelated errors. This procedure allows for drawing valid inferences from large samples without estimating additional parameters in the regression model [39]. The error term in the Phillip-Perron test regression model does not follow a white-noise process.

Whilst a stationary process has a mean and variance that is constant over time, a non-stationary process has a mean and variance that may change over time. Hence a non-stationary process may exhibit a stochastic trend over time. If the first difference of a non-stationary process is stationary, then it is said to be integrated of the first order, or I(1). When a linear combination of multiple I(1) time series is stationary, the time series are said to be cointegrated [40]. Cointegrated time series are in long-run equilibrium and tend to move together over time. In other words, cointegration is the degree to which two values are sensitive to the same mean over a given time period. Two time series are said to be cointegrated if their linear combination is stationary. Therefore, testing for cointegration is effectively equivalent to testing for a long run association between variables. Cointegration, however, does not indicate the direction of the relationship between two time series. Once cointegration between the variables considered in the model is confirmed, it is possible to proceed to causality analyses. To check if there is any long-run association between the variables used in this study, Engle-Granger cointegration test was conducted.

If two variables are cointegrated, then they will also have a causal relationship between them in at least one direction [40] [41]. Therefore, causality analysis is conducted using a Granger causality approach for long run causality.

The Granger causality test [42] checks the ability of past values of one time series to predict the future values of another time series. Granger's definition of causality, was based on his two fundamental principles: (i) the effect does not precede its cause in time; (ii) the causal series contains unique information about the series being caused that is not available otherwise [42] [43]. Therefore, Granger causality implies 'predictive causality', rather than true causality in the philosophical sense. This is because of the 'post hoc ergo propter hoc' (before this, therefore because of this) fallacy which states that temporal sequence of events does not necessarily signify that events that occur first are causes of events that occur later.

In order to find the effect of governance on competitiveness of the banking sector, regression analysis was performed using the method of three stage least squares (3SLS). The three-stage least squares estimator was introduced by Zellner & Theil in 1962. It combines two-stage least squares (2SLS) with seemingly unrelated regressions (SUR). The details of the 3SLS process are as follows:
Stage 1: Regress each endogenous variable in the equation on all exogenous variables in the simultaneous equation model using the OLS estimator. Calculate the fitted values for each of these endogenous variables.
Stage 2: In the equation to be estimated, replace each endogenous variable by its fitted value. Use the 2SLS estimator to estimate each of the equations individually and estimate the errors for each equation.
Stage 3: Use the estimated errors to compute, for the system of equations, the estimated error covariance matrix and then use the SUR procedure to estimate the unknown parameters.

Since the relationship between governance and competitiveness is rather complex, and works through many different channels, single equation regression models could not be used. This is why a simultaneous equation model like 3SLS were used. The model was estimated using this methodology based on a system of six equations:

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{va} + \varepsilon_i \text{ (i)}$$

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{ps} + \varepsilon_i\text{(ii)}$$

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{ge} + \varepsilon_i\text{(iii)}$$

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{rq} + \varepsilon_i\text{(iv)}$$

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{rol} + \varepsilon_i\text{(v)}$$

$$\text{lerner} = \beta_0 + \beta_1\text{roa} + \beta_2\text{roe} + \beta_3\text{nim} + \beta_4\text{zscore} + \beta_5\text{branches} + \beta_6\text{stock} + \beta_7\text{coc} + \varepsilon_i\text{(vi)}$$

where,

lerner	=	*Lerner index*
roa	=	*Return on asset*
roe	=	*Return on equity*
nim	=	*Net interest margin*
zscore	=	*Bank z score*
branches	=	*Number of branches*
stock	=	*Stock market total value traded to GDP*
va	=	*Voice and accountability index*
ps	=	*Political stability index*
ge	=	*Government effectiveness index*
rq	=	*Regulatory quality index*
rol	=	*Rule of law index*
coc	=	*Control of corruption index*

6 Results

The results from the statistical tests and model estimation are outlined below.

TABLE II: RESULTS OF UNIT ROOT TESTS OF VARIABLES AT LEVEL

Variable	Augmented Dickey-Fuller test statistic z(t) (p value)	Phillips Perron test statistic z(t) (p value)	Variable	Augmented Dickey-Fuller test statistic z(t) (p value)	Phillips Perron test statistic z(t) (p value)
lerner	-1.613	-1.605	**va**	-1.630	-1.695
	(0.4762)	(0.4812)		(0.4673)	(0.4336)
roa	-2.637	-2.630	**ps**	-1.733	-1.644
	(0.0856)	(0.0869)		(0.4143)	(0.4603)
roe	-3.701	-3.691	**ge**	-1.409	-1.613
	(0.0041)	(0.0042)		(0.5778)	(0.4764)
nim	-1.440	-1.525	**rq**	-1.939	-2.070
	(0.5629)	(0.5209)		(0.3138)	(0.2568)
zscore	-1.825	-1.654	**rol**	-0.783	-0.833
	(0.3682)	(0.4550)		(0.8240)	(0.8091)
branches	5.910	4.932	**coc**	-1.058	-1.303
	(1.0000)	(1.0000)		(0.7314)	(0.6279)
stock	-1.600	-1.911			
	(0.4834)	(0.3268)			

NOTE: (I) PROBABILITY VALUES IN PARENTHESES

The results of the unit root tests in Table II show that most of the variables are non-stationary at level. The findings are consistent across augmented Dickey-Fuller test and Phillips-Perron test. Therefore, it becomes necessary to check the stationarity of the variables at first difference.

TABLE III: RESULTS OF UNIT ROOT TESTS OF VARIABLES AT FIRST DIFFERENCE

Variable	Augmented Dickey-Fuller test statistic (p value)	Phillips Perron test statistic (p value)	Variable	Augmented Dickey-Fuller test statistic (p value)	Phillips Perron test statistic (p value)
lerner	-5.027	-5.005	**va**	-3.086	-3.039
	(0.0000)	(0.0000)		(0.0276)	(0.0314)
roa	-4.341	-4.475	**ps**	-5.735	-5.752
	(0.0004)	(0.0002)		(0.0000)	(0.0000)
roe	-6.388	-7.322	**ge**	-3.263	-3.232
	(0.0000)	(0.0000)		(0.0166)	(0.0182)
nim	-3.368	-3.364	**rq**	-4.735	-4.731
	(0.0121)	(0.0122)		(0.0001)	(0.0001)
zscore	-6.873	-7.729	**rol**	-4.120	-4.121
	(0.0000)	(0.0000)		(0.0009)	(0.0009)
branches	-1.238	-1.039	**coc**	-3.648	-3.662
	(0.6569)	(0.7388)		(0.0049)	(0.0047)
stock	-3.099	-3.096			
	(0.0266)	(0.0268)			

NOTE: (I) PROBABILITY VALUES IN PARENTHESES

The results of the unit root tests in Table III show that almost all the variables are stationary at their first difference. Both the augmented Dickey-Fuller test and the Phillips Perron unit root test give the same results. Hence the possibility of conducting a spurious regression can be ruled out.

TABLE IV: RESULTS OF ENGLE-GRANGER COINTEGRATION TEST

Variable	z Test AR(0) (p value)	t Test AR(0) (p value)	Variable	z Test AR(0) (p value)	t Test AR(0) (p value)
roa-lerner	-10.9257	-2.7245	**lerner-roa**	-4.9299	-1.4956
	(0.0000)	(0.0032)		(0.0000)	(0.0674)
roe-lerner	-18.2260	-4.2056	**lerner-roe**	-6.6021	-1.7634
	(0.0000)	(0.0000)		(0.0000)	(0.0389)
nim-lerner	-4.9340	-1.6299	**lerner-nim**	-6.7635	-2.4562
	(0.0000)	(0.0516)		(0.0000)	(0.0070)
zscore-	-7.6401	-1.8865	**lerner-**	-6.5399	-1.5914
lerner	(0.0000)	(0.0296)	**zscore**	(0.0000)	(0.0558)
branches-	2.8188	2.0416	**lerner-**	-5.5671	-1.5463
lerner	(0.0024)	(0.0206)	**branches**	(0.0000)	(0.0610)
stock-	-5.4843	-1.6724	**lerner-**	-5.9225	-1.8452
lerner	(0.0000)	(0.0472)	**stock**	(0.0000)	(0.0325)
va-lerner	-4.4708	-1.6376	**lerner-va**	-6.5587	-1.7160
	(0.0000)	(0.0508)		(0.0000)	(0.0431)
ps-lerner	-12.6820	-2.9112	**lerner-ps**	-15.1915	-3.0783
	(0.0000)	(0.0018)		(0.0000)	(0.0010)
ge-lerner	-9.7383	-2.3998	**lerner-ge**	-12.2954	-2.7376
	(0.0000)	(0.0082)		(0.0000)	(0.0031)
rq-lerner	-8.6108	-2.3037	**lerner-gq**	-6.6069	-1.8610
	(0.0000)	(0.0106)		(0.0000)	(0.0314)
rol-lerner	-6.8645	-1.7750	**lerner-rol**	-6.0858	-1.6835
	(0.0000)	(0.0380)		(0.0000)	(0.0461)
coc-lerner	-3.6353	-1.3125	**lerner-coc**	-6.1975	-1.8171
	(0.0001)	(0.0947)		(0.0000)	(0.0346)

NOTE: (I) PROBABILITY VALUES IN PARENTHESES

From the Engle-Granger cointegration tests in Table IV we can see that there is statistically significant cointegration between the variables. This means that there is some long run association or long run relationship between the variables. However, since cointegration does not reveal any causal relationship between the variable, further tests are required. For this purpose, we conduct the Granger causality test.

TABLE V: RESULTS OF GRANGER CAUSALITY TEST

Variable	F statistic (p value)	chi square statistic (p value)	Variable	F statistic (p value)	chi square statistic (p value)
roa does not	0.05	0.06	**lerner does**	0.04	0.05

Granger cause lerner	(0.8263)	(0.8054)	**not Granger cause roa**	(0.8351)	(0.8152)
roe does not	0.03	0.04	**lerner does**	0.82	1.00
Granger cause lerner	(0.8674)	(0.8513)	**not Granger cause roe**	(0.3794)	(0.3171)
nim does not	0.12	0.15	**lerner does**	1.10	1.36
Granger cause lerner	(0.7345)	(0.7007)	**not Granger cause nim**	(0.3131)	(0.2443)
zscore does	0.31	0.37	**lerner does**	1.34	1.61
not Granger cause lerner	(0.5873)	(0.5434)	**not Granger cause zscore**	(0.2652)	(0.2048)
branches does	1.14	1.36	**lerner does**	5.19	6.17
not Granger cause lerner	(0.3011)	(0.2443)	**not Granger cause branches**	(0.0368)	(0.0130)
stock does not	0.09	0.10	**lerner does**	0.06	0.08
Granger cause lerner	(0.7716)	(0.7461)	**not Granger cause stock**	(0.8052)	(0.7833)
va does not	1.38	1.64	**lerner does**	0.74	0.87
Granger cause lerner	(0.2577)	(0.2009)	**not Granger cause va**	(0.4037)	(0.3499)
ps does not	6.26	7.44	**lerner does**	0.00	0.00
Granger cause lerner	(0.0236)	(0.0064)	**not Granger cause ps**	(0.9621)	(0.9581)
ge does not	5.27	6.26	**lerner does**	0.11	0.14
Granger cause lerner	(0.0355)	(0.0123)	**not Granger cause ge**	(0.7391)	(0.7119)
rq does not	1.67	1.98	**lerner does**	0.00	0.00
Granger cause lerner	(0.2149)	(0.1593)	**not Granger cause gq**	(0.9630)	(0.9590)
rol does not	0.21	0.24	**lerner does**	1.41	1.67
Granger cause lerner	(0.6565)	(0.6215)	**not Granger cause rol**	(0.2527)	(0.1960)
coc does not	6.43	7.63	**lerner does**	4.14	4.91
Granger cause lerner	(0.0221)	(0.0057)	**not Granger cause coc**	(0.0589)	(0.0267)

NOTE: (I) PROBABILITY VALUES IN PARENTHESES

The Granger causality test in Table V shows that there is bi-directional causality between control over corruption index and the Lerner index of competitiveness. This means that control over corruption Granger causes Lerner index of competitiveness and vice-versa. In other words, control over corruption can be a cause behind competitiveness, whilst competitiveness itself can also be a cause behind control over corruption. There is also uni-directional causality

running from political stability index and government effectiveness index to the Lerner index of competitiveness. From this we can imply that political stability and government effectiveness can be regarded as potential causes behind competitiveness.

TABLE VI: RESULTS OF THREE STAGE LEAST SQUARES ESTIMATION

VARIABLES	(i) lerner	(ii) lerner	(iii) lerner	(iv) lerner	(v) lerner	(vi) lerner
roa	-0.00416	-0.00370	0.00713	0.00734	0.0111	0.00693
	(0.0172)	(0.0169)	(0.0178)	(0.0231)	(0.0262)	(0.0224)
roe	-0.00314	-0.00202	-0.00442**	-0.00395	-0.00439	-0.00449*
	(0.00198)	(0.00199)	(0.00210)	(0.00271)	(0.00314)	(0.00263)
nim	0.0948***	0.0627***	0.0825***	0.113***	0.113***	0.111***
	(0.0228)	(0.0246)	(0.0282)	(0.0307)	(0.0336)	(0.0290)
zscore	0.0630***	0.0404	0.0664***	0.0726**	0.0798**	0.0688**
	(0.0243)	(0.0249)	(0.0256)	(0.0331)	(0.0390)	(0.0320)
branches	-0.0001***	$-8.97*10^{-05}$*	-0.0001***	-0.0001***	-0.0001**	-0.0001**
	$(5.05*10^{-05})$	$(5.27*10^{-05})$	$(5.31*10^{-05})$	$(6.80*10^{-05})$	$(7.52*10^{-05})$	$(6.81*10^{-05})$
stock	-0.0551	-0.0516	-0.0856*	-0.133**	-0.149***	-0.119**
	(0.0446)	(0.0410)	(0.0476)	(0.0540)	(0.0536)	(0.0488)
va	-0.475***					
	(0.136)					
ps		-0.205***				
		(0.0441)				
ge			-0.547**			
			(0.254)			
rq				-0.144		
				(0.210)		
rol					-0.0952	
					(0.177)	
coc						-0.195**
						(0.0803)
Constant	0.483	0.220	0.424	0.767*	0.883**	0.399

	(0.304)	(0.313)	(0.376)	(0.455)	(0.426)	(0.427)
chi2	92.86	104.04	77.44	43.56	36.26	51.98
P	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.821	0.834	0.773	0.705	0.690	0.739

NOTE: (I) STANDARD ERRORS IN PARENTHESES; (II) *** P<0.01, ** P<0.05, * P<0.1

The results of the three stage least squares in Table VI show that the relationship between the governance indicators and the Lerner index of competitiveness is negative for all the governance indicators and statistically significant for four of the governance indicators. This means an improvement in governance leads to greater competitiveness. The relationship between net interest margin and the Lerner index is positive and statistically significant, indicating that a fall in competitiveness may result in a rise in profitability. This confirms the ex-ante observation that as a market becomes less competitive, monopolies start to form that have the power to extract supernatural profits and deprive people from their consumer surplus. Our findings reinforce this fact for the banking sector of Bangladesh. The coefficients for the z-score are positive and statistically significant. This means that as the banking sector becomes less competitive, the probability of bank failure increases. This finding is consistent with the results obtained in previous literature [18] [20] [19]. The relationship between the number of branches and the Lerner index is negative and statistically significant. This is result is expected, since the competitiveness of the banking sector naturally increases when there are more bank branches. Moreover, this finding also validates our previous theoretical result which we derived from the oligopolistic form of the Monti-Klein model.

7 Conclusion

This study establishes a connection between governance and competitiveness, with particular reference to the banking sector of Bangladesh. The findings of this research are in support of the previous theory that competitiveness increases as the number of banks increases. This has been confirmed by the negative relationship between the Lerner index and the number of bank branches. Additionally, this study has also confirmed that the Lerner index and Altman z-score are positively related, which shows that a decline in competitiveness increases the probability of bank failures. Four of the governance indicators used in this study showed a negative and statistically significant relationship with the Lerner index. Thus the major revelation of this research is that an improvement in governance increases the competitiveness of the banking sector. This study has been conducive in moving forward the body of knowledge on banking by elucidating the relationship between governance and competitiveness. Results of this paper have significant policy implications for the banking sector of Bangladesh. This study indicates that policy makers have to take

actions towards improving the overall governance of the banking sector if the monopolization of the banking sector has to be avoided.

References

[1] V. Lenin, Imperialism, The Highest Stage of Capitalism, 1917.

[2] S. A. Rhoades, "Welfare loss, redistribution effect, and restriction of output due to monopoly in banking," *Journal of Monetary Economics,* vol. 9, no. 3, pp. 375-387, 1982.

[3] The Daily Star, "S Alam Group: 'Govt looking into fund sources'," The Daily Star Bangladesh, Dhaka, 2017.

[4] New Age, "Major changes in SIBL as S Alam tightens grip," New Age, Dhaka, 2017.

[5] CPD, "State of the Bangladesh Economy in FY2017-18 First Reading," Centre for Policy Dialogue, Dhaka, 2018.

[6] A. Lerner, "The Concept of Monopoly and Measurement of Monopoly Power," *The Review of Economic Studies,* vol. 1, no. 3, pp. 157-175, 1934.

[7] M. Koetter, J. W. Kolari and L. Spierdijk, "Efficient Competition? Testing the 'quiet life' of U.S. banks with adjusted Lerner indices," 2008.

[8] P. Angelini and N. Cetorelli, "The effects of regulatory reform on competition in the banking industry," *Journal of Money, Credit, and Banking,* vol. 35, pp. 663-684, 2003.

[9] J. F. d. Guevara, J. Maudos and F. Pérez, "Market power in European banking sectors," *Journal of Financial Services Research,* vol. 27, pp. 109-137, 2005.

[10] M. Monti, "Deposit, credit and interest rate determination under alternative bank objective function," *North-Holland/American Elsevier.,* 1972.

[11] M. Klein, "A theory of the banking firm," *Journal of money, credit and banking,* vol. 3, no. 2, pp. 205-218, 1971.

[12] X. Freixas and J.-C. Rochet, Microeconomics of Banking, Second Edition ed., The MIT Press, 2008.

[13] T. Beck, "Bank competition and financial stability: friends or foes?," *The World Bank Policy Research Working Paper 4656,* 2008.

[14] D. Anginer, A. Demirguc-Kunt and M. Zhu, "How does bank competition affect systemic stability?," *The World Bank Policy Research Working Paper 5981,* 2012.

[15] X. M. Fu, Y. R. Lin and P. Molyneux, "Bank competition and financial stability in Asia Pacific," *Journal of Banking and Finance,* 2014.

[16] J. H. Boyd and G. D. Nicolo, "The Theory of Bank Risk Taking and Competition Revisited," *The Journal of Finance,* vol. 60, no. 3, pp. 1329-1343, 2005.

[17] R. Caminal and C. Matutes, "Market Power and Banking Failures," *International Journal of Industrial Organization,* vol. 20, no. 9, pp. 1341-1361, 2002.

[18] M.-E. K. Agoraki, M. D. Delis and F. Pasiouras, "Regulation, competition, and bank risk-taking in transition countries," *Journal of Financial Stability,* 2011.

[19] G. Jiménez, J. A. Lopez and J. Saurina, "How does competition impact bank risk-taking?," *Federal Reserve Bank of San Francisco Working Paper 2007-23,* 2007.

[20] Z. Fungáčová and L. Weill, "Does competition influence bank failures?," 2011.

[21] A. J. Marcus, "Deregulation and Bank Financial Policy," *Journal of Banking & Finance,* vol. 8, no. 4, pp. 557-565, 1984.

[22] Y.-S. Chan, S. I. Greenbaum and A. V. Thakor, "Information Reusability, Competition and Bank Asset Quality," *Journal of Banking & Finance,* vol. 10, no. 2, pp. 243-253, 1986.

[23] M. C. Keeley, "Deposit Insurance, Risk, and Market Power in Banking," *The American Economic Review,* vol. 80, no. 5, pp. 1183-1200, 1990.

[24] F. Allen and D. Gale, Comparing Financial Systems, 1 ed., Cambridge, Massachusetts: MIT Press, 2000.

[25] E. C. Perotti and J. Suarez, "Last Bank Standing: What Do I Gain if You Fail?," *European Economic Review ,* vol. 46, no. 9, pp. 1599-1622, 2002.

[26] K. Chowdhury, "Board Composition and Firm Performance: Evidence from Bangladesh - A Sceptical View," *Australasian Accounting Business & Finance Journal,* vol. 4, no. 4, pp. 103-109, 2010.

[27] S. P. Ahmed, R. Zannat and S. U. Ahmed, "Corporate governance practices in the banking sector of Bangladesh: do they really matter?," *Banks and Bank Systems,* 2017.

[28] M. Reaz and T. Arun, "Corporate governance in developing economies: perspectives from the banking sector of Bangladesh," *Journal of Banking Regulation,* vol. 7, no. 1-2, pp. 94-105, 2006.

[29] A. E. Haque, M. B. Jalil and F. Naz, "State of corporate governance in Bangladesh: an analysis of public limited companies, financial and non-financial institutions, and state-owned enterprises," *East West University Center for Research and Training Working Paper Series Number 2,* 2007.

[30] M. S. Mustafa, S. M. Hossain, M. N. Hossain, R. Banu and M. A. Halim, "Corporate governance in banks - impact on profitability," *Bangladesh Institute of Bank Management (BIBM) Research Monograph 27,* 2017.

[31] F. Khatun, "State of Governance in the Banking Sector: Dealing with the Recent Shocks," Centre for Policy Dialogue (CPD), 2012.

[32] D. Kaufmann, A. Kraay and M. Mastruzzi, "The Worldwide Governance Indicators: Methodology and Analytical Issues," *Policy Research Working Paper 5430,* 2010.

[33] E. I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *The Journal of Finance,* vol. 23, no. 4, pp. 589-609, 1968.

[34] C. W. Granger and P. Newbold, "Spurious regressions in econometrics," *Journal of econometrics,* vol. 2, pp. 111-120, 1974.

[35] W. Enders, Applied econometric time series, Fourth Edition ed., John Wiley & Sons, Inc., 2015.

[36] D. A. Dickey and W. A. Fuller, "Distribution of the estimators for autoregressive time series with a unit root," *Journal of the American statistical association,* vol. 74, no. 366a, pp. 427-431, 1979.

[37] D. A. Dickey and W. A. Fuller, "Likelihood ratio statistics for autoregressive time series with a unit root," *Econometrica: Journal of the Econometric Society,* pp. 1057-1072, 1981.

[38] P. C. Phillips and P. Perron, "Testing for a unit root in time series regression," *Biometrika,* vol. 75, no. 2, pp. 335-346, 1988.

[39] A. Banerjee, J. J. Dolado, J. W. Galbraith and D. F. Hendry, Co-integration,

error-correction, and the econometric analysis of non-stationary data, New York: Oxford University Press Inc, 1993.

[40] R. F. Engle and C. W. Granger, "Co-integration and error correction: representation, estimation, and testing," *Econometrica: journal of the Econometric Society* , pp. 251-276, 1987.

[41] H. Lütkepohl and M. Krätzig, Applied time series econometrics, New York: Cambridge University Press, 2004, p. 150.

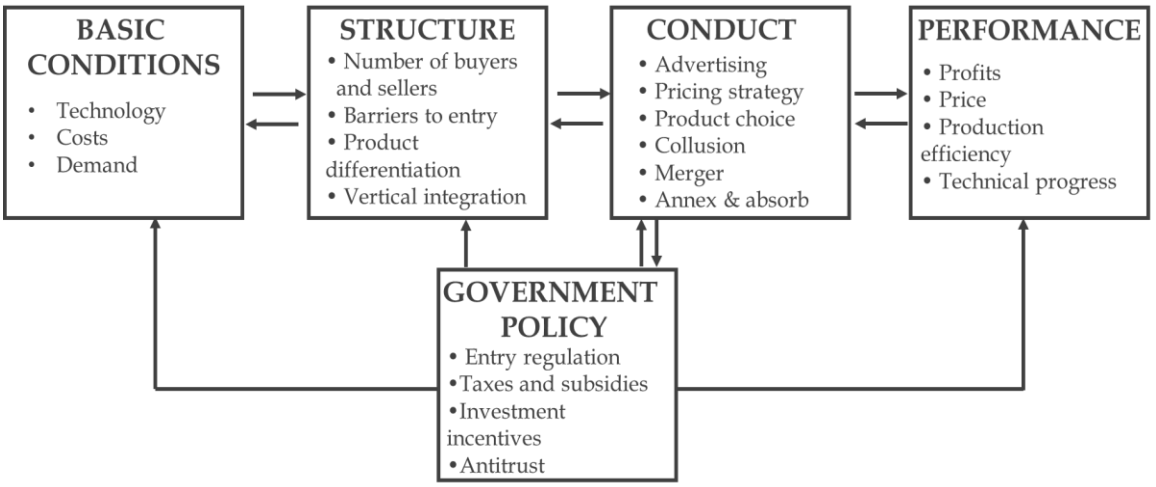
[42] C. W. Granger, "Investigating causal relations by econometric models and cross-spectral methods," *Econometrica*, vol. 37, no. 3, pp. 424-438, 1969.

[43] C. W. Granger, "Testing for causality, a personal viewpoint," *Journal of Economic Dynamics and Control*, vol. 2, p. 329–352, 1980.

[44] D. W. Carlton and J. M. Perloff, Modern Industrial Organization, Pearson/Addison Wesley, 2005.

ANNEX

ANNEX FIGURE 1: STRUCTURE, CONDUCT, PERFORMANCE PARADIGM



SOURCE: AUTHORS' ILLUSTRATION BASED ON CARLTON AND PERLOFF, 2005 [44].