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Market competition, capital regulation and cost of financial intermediation: an empirical study on the banking sector of Bangladesh

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Abstract

Purpose – This study aims to examine the impact of market competition, and capital regulation on the cost of financial intermediation of banks of the Bangladesh banking industry.

Design/methodology/approach – This study has used a balanced panel dataset comprised of 340 firm-year observations for 34 commercial banks in the Bangladesh banking industry from 2011 to 2020. The Prais Winsten panel estimator has been used to assess the impact of market competition and capital regulation on the cost of financial intermediation of banks.

Findings – Based on the regression results, this study has documented that greater market competition results in a lower cost of financial intermediation for banks. Similarly, an increase in the regulatory capital of banks increases the cost of financial intermediation of banks. The main findings of this study are found robust by using alternative proxies for the cost of financial intermediation, market competition and capital regulation. The regression results also suggest that private commercial banks tend to have a higher cost of financial intermediation than state-owned commercial banks.

Research limitations/implications – The regulatory reforms should aim to foster sustainable and optimal market competition for the Bangladesh banking industry to regulate the market power of banks to reduce the cost of financial intermediation. The regulatory authority of Bangladesh should find the optimal policy measures for implementing the capital regulation in the banking industry which would reduce the cost of financial intermediation margin of banks.

Originality/value – Unlike previous studies which have used structural market competition measures, this study has used non-structural market competition measures to assess the relationship between market competition and cost of financial intermediation in the Bangladesh banking industry.

Keywords Market competition, Lerner index, H-statistic, Cost of financial intermediation

Paper type Research paper

1. Introduction

Bank as a financial intermediary accepts deposits from suppliers of funds and extends credit to the demander of funds. Thus, one of the important characteristics of a bank is financial intermediation in the form of simultaneous engagement in deposit-taking activities and lending activities (Kashyap *et al.*, 2002). Through this financial intermediation process, banks help to improve the social welfare of the economy by channeling funds from suppliers of

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funds (depositors) to the demanders of funds (borrowers). This optimal social welfare largely depends on the efficiency of the financial intermediation of the bank at the lowest possible cost of financial intermediation. The cost of financial intermediation refers to the net interest margin derived by the bank for channeling funds from savers/lenders to the borrower of funds (Bernanke, 1983). The effectiveness and efficiency of a banking system in the financial intermediation process are often measured by assessing the cost of financial intermediation charged by banks. The determinants of the cost of financial intermediation margin of banks are first addressed in the seminal study of Ho and Saunders (1981) which is later extended by many empirical studies over the years. In their seminal study, Ho and Saunders (1981) identified market structure (market power or competitive condition) as one of the important determinants of optimal financial intermediation cost for banks. But empirical studies regarding the relationship between market structure and cost of financial intermediation have yielded baffling results over the years. Kasman *et al.* (2010) have pointed out the market power as one of the important factors of intermediation margin in both new and old European Union (EU) member countries but a contrasting impact has been overserved in the two groups. A positive relationship is observed between market power and intermediation margin in the banking industry of new EU member countries whereas a negative relationship is observed between market power and intermediation margin in the banking industry of old EU member countries.

To improve the stability of the banking sector, the Basel Committee on Banking Supervision (BCBS) introduced the regulatory capital requirements, Basel I in 1988 for financial institutions to reduce the risk-taking behavior of financial institutions for improving financial stability and managing unexpected financial losses arising from the idiosyncratic events. However, Basel I was replaced by Basel II in 2004 and Basel III in 2010 due to the structural weaknesses of the regulatory capital requirement exposed by the financial crises in the last two decades. With the introduction of Basel III in 2010 as a response to the 2008 global financial crisis and the subsequent European sovereign debt crisis, banks around the world are required to comply with the regulatory capital requirements under Basel III to strengthen their capital adequacy. However, the cost of financial intermediation is expected to increase with this new regulatory capital requirement. For example, Naceur and Kandil (2009) have found that an increase in capital adequacy of banks has increased the cost of financial intermediation of Egyptian banks. Similarly, Taskinsoy (2019a) have found that the higher capital adequacy ratio under Basel III will drive up the cost of equity which bank will compensate by channeling a portion of the increased cost of equity to the bank's customers in the form of either increased lending spread or increased fees and commission charged by the banks for financial services rendered to them. Slovik and Cournède (2011) have also opined that banks are likely to increase their cost of lending to comply with the regulatory capital standard set under Basel III.

Following the financial deregulatory measures of developed economies, the regulatory authority of Bangladesh introduced several financial deregulatory measures in the early 1980s, thus paving the way for forming private banks in the Bangladesh banking industry and the denationalization of two state-owned commercial banks (SCBs) which resulted in an increase in the private commercial banks (PCB) during 1980s (Moral, 2012). As a result, the number of banks has increased two-fold as the number of banks increased from 24 in 1990 to 61 in 2021. A total number of 12 PCBs have been awarded the banking license by the Central bank of Bangladesh, Bangladesh Bank (BB) in the last decade. Thus, the market competition in the Bangladesh banking industry is expected to be intensified with the entrance of these fourth-generation banks in recent years. The market structure of the Bangladesh banking industry has changed significantly in recent years as indicated in Table A2 in appendix. With the inclusion of banks in different generations, both asset market share and deposit market share of SCBs have declined but increased for PCBs. Similarly, the net interest margin of

SCBs has declined severely in recent years but the net interest margin of PCBs has increased to some extent. On the other hand, banks in Bangladesh started the transition process into the Basel III capital regime on 1st January 2015. The transition process for smooth adoption of the Basel III accord in the Bangladesh banking industry will increase the regulatory capital requirements for banks which may be complied by banks at a higher operating cost but the cost is expected to be offset by increasing operating efficiency, curtailing dividend payment, raising the cost of financial intermediation, increasing fee and commission for financial services (Sultana and Sharmin, 2015).

Based on these arguments and background, the main objective of this study is to assess how the changing market structure (market competition) and regulatory capital requirements in recent years are influencing the cost of financial intermediation of banks.

To examine these empirical issues, this study has used a panel database of 34 Bangladeshi commercial banks over a sample period from 2011 to 2020. Using the Prais Winsten panel estimator, the regression result of this study has found that greater market competition in the banking industry helps to lower the cost of financial intermediation of banks, and the cost of financial intermediation of banks increases with an increase in the regulatory capital of banks. The robustness of these findings is checked by using different proxies for the cost of financial intermediation, market competition and capital regulation. In the additional analysis, the persistency of the cost of financial intermediation and the endogeneity issue are addressed by using the two-stage least square method. The additional analysis indicates that the cost of financial intermediation in the previous period helps to amplify the cost of financial intermediation in the current period.

This study contributes to the empirical literature in at least two ways. First, this is the first study that has employed non-structural market competition measures to assess the relationship between the market competition and the cost of financial intermediation of banks in the Bangladesh banking industry. Most of the studies focused on the Bangladesh banking industry in this empirical issue have used structural market competition measures. For example, Hossain (2012) has used the structural market competition measure, Herfindahl-Hirschman Index, on this empirical issue. Schaeck *et al.* (2009) have opined that concentration and competition capture different characteristics of the banking industry. Claessens and Laeven (2004), Schaeck *et al.* (2009), and Moch (2013) have considered the structural market concentration measures as an inappropriate measure for measuring market competition in the banking industry as these measures focus on the structural conduct performance (SCP) paradigm. The use of structural market competition measures may lead to ambiguous results as the SCP paradigm suffers from conceptual and practical limitations (Leon, 2015). The contestability theory of Baumol *et al.* (1988) has suggested that a concentrated market with a lower degree of entry and exit barrier can exhibit a higher degree of competitive behavior as the lower entry barriers can exert pressure on industry incumbents and make the market competitive. Thus, this study employs the non-structural market competition measures that focus on estimating the market competition based on the competitive conduct or behavior of banks. The use of non-structural market competition measures such as Lerner Index and *H*-statistic in the main regression result and Boone Indicator in the robustness test not only provides new evidence regarding the relationship between the market competition and the cost of financial intermediation of banks in the Bangladesh banking industry but also complements the study of Hossain (2012).

Second, this study has focused on the transition period from Basel II to Basel III to examine the impact of regulatory capital requirements on the cost of financial intermediation in the Bangladesh banking industry. Previous studies like Das Gupta *et al.* (2021), Rahman *et al.* (2018) and Zheng *et al.* (2017) have focused on the regime of Basel I and Basel II to assess the relationship between capital regulation and cost of financial intermediation in context of Bangladesh banking industry. Thus, concentrating on the period of Basel II and Basel III, this

study not only aims to provide new empirical evidence but also complements the previous studies.

The rest of the study is organized in the following way. A review of empirical literature regarding the effect of market competition and capital regulation on the cost of financial intermediation is presented in section 2. Section 3 contains a discussion of the data and methodology associated with this study. The empirical results of the study are presented in section 4 while section 5 contains the conclusion of the study with policy implications.

2. Literature review

2.1 Theoretical review

The cost of financial intermediation refers to the net interest margin derived by the bank for channeling funds from savers/lenders to the borrower of funds (Bernanke, 1983). The determinants of the cost of financial intermediation or intermediation margin are initially addressed in the *Dealership Model* proposed by Ho and Saunders (1981) in which banks are viewed as the risk-averse dealer in both loan and deposit markets. As a stochastic process is followed in the demand for loans and supply of deposits the supply of deposits and the request for loans are non-synchronous. Thus, banks are required to charge a positive interest spread or fee for providing the immediate liquidity service to the customers in the presence of transaction uncertainty arising from non-synchronization of demand for loans and supply of deposits. As a result, the bank sets loan price as R_L and deposit price as R_D in which the bank disburses new loans and accepts deposits. These prices can be defined as:

$$\mathrm{R_D} = \mathrm{r} - \mathrm{a}$$

$$\mathrm{R_L} = \mathrm{r} + \mathrm{b}$$

here, r represents the "true" price of the loan or deposit based on the opinion of the bank's management, a is the fee charged by the bank for providing the immediate liquidity service and b is the risk premium charged by the bank as compensation of the transaction uncertainty or refinancing risk. Thus, the intermediation margin or cost of financial intermediation of each bank participating in the market can be expressed as:

$$\mathrm{s} = \mathrm{R_L} - \mathrm{R_D} = (\mathrm{a} + \mathrm{b})$$

According to this *Dealership Model*, the optimal intermediation margin or cost of financial intermediation of a bank can be expressed:

$$s = (\mathrm{a} + \mathrm{b}) = \frac{\alpha}{\beta} + \frac{1}{2}\mathrm{R}\sigma_I^2 Q$$

here, s represents the *Pure* intermediation margin of a bank. α/β represents the cost of financial intermediation of a risk-neutral bank in a given market structure, R represents the degree of risk aversion of bank management, σ_I^2 represents the volatility in the interest rate of deposit and loan, and Q represents the transaction size. According to Ho and Saunders (1981), a large α/β will be the result of a small β and a large α which will, in turn, lead to a larger intermediation margin, s. This model articulates four factors influencing the optimal cost of financial intermediation of banks which are (1) degree of risk aversion of bank's management, (2) market structure of banking industry, (3) interest rate volatility and (4) average transition size.

In the empirical literature, several extensions of this *Dealership Model* can be found which have relaxed some assumptions of this model. For example, Mcshane and Sharpe (1985) have replaced the volatility of the deposit or loan rates of the *Dealership Model* with volatility in the

interest rate of the money market to assess the determinants of the Australian banking industry from 1962 to 1981. Through the inclusion of the heterogeneous nature of the banks' loan portfolio, Allen (1988) has found that the intermediation margin is influenced by the diversification of the bank's product and service. Similarly, Angbazo (1997) has extended the model by incorporating default risk and interacting the default risk with the interest rate risk for assessing how intermediation is affected by these risks across bank size classes. Saunders and Schumacher (2000) have extended the *Dealership Model* by incorporating three regulatory costs, the implicit interest expense, the opportunity cost of holding statutory reserves and the cost of complying with regulatory capital standards. Maudos and De Guevara (2004) have extended the basic *Dealership Model* by incorporating the operating cost of banks as well as using a direct measure of market power, Lerner Index, in addition to the traditional structural market concentration measures. Valverde and Fernández (2007) have extended the model by proposing a multi-output framework, emphasizing the bank's involvement in nontraditional banking activities to analyze the relationship between bank specialization and intermediation margin.

2.2 Market competition and cost of financial intermediation

The empirical literature has produced mixed results regarding the relationship between market structure and the cost of financial intermediation. In the *Dealership Model*, Ho and Saunders (1981) have identified the market structure as one of the important determinants of optimal intermediation margin for a bank assuming that higher market competition or lower market power results in a lower intermediation margin for banks. But the study of Saunders and Schumacher (2000) has found that the market structure of the banking industry is heterogeneous across countries due to restrictions on the banking industry. As a result, the impact of market structure on banks' intermediation margin is heterogeneous across countries. The study has also found that banks operating in more segmented or restricted banking systems tend to have larger monopoly power and higher intermediation margin. This positive relationship between market power and intermediation margin or negative relationship between market competition and intermediation margin is observed in different empirical studies. For example, Gischer and Juttner (2003) have opined that bank in a competitive market tends to have lower intermediation margin. Using bank data from 14 Organisation for Economic Co-operation and Development (OCED) countries, Hawtrey and Liang (2008) have found a positive relationship between market power and intermediation margin, thus suggesting that banks with monopoly market power in a less competitive market are able to generate higher intermediation margin by charging higher interest rates on loans and by paying lower interest rates on deposit. Chortareas *et al.* (2012) have found that increased market competition is one of the influencing factors for lower intermediation margin in the Latin American banking industry. A similar finding is also observed in the studies of Aboagye *et al.* (2008) for the Ghanaian banking industry, Maudos and Solís (2009) for the Mexican banking industry, Hossain (2012) for Bangladesh banking industry and Léon (2015) for West African countries.

Along with these studies, Ahokpossi (2013) has found a positive relationship between intermediation margin and market concentration in the sub-Saharan Africa countries but such a positive relationship is mediated by the efficiency of banks as banks operating in a concentrated market with a higher degree of operational efficiency can charge higher intermediation margin. Amidu and Wolfe (2013) have found that higher intermediation margins in emerging and developing economies can be explained the degree of market power of banks. Examining the factors driving the higher cost of financial intermediation in low-income countries relative to the cost of financial intermediation in emerging market economies, Poghosyan (2013) has found that concentrated market structure is one of the

primary factors responsible for the higher cost of financial intermediation in the low-income countries.

On the contrary, Demirguc-Kunt *et al.* (2003) have found that the positive relationship between the cost of financial intermediation and market concentration breaks down when different factors of regulatory restriction, institutional environment and macro-economic stability are considered. Similarly, Beck and Hesse (2009) have found little evidence of changes in the market structure of the Ugandan banking industry in explaining the disparity in intermediation margin over time.

2.3 Capital regulation and cost of financial intermediation

After the collapse of the Bretton Woods fixed exchange rate system in the 1970s, BCBS was formed in 1974 which developed and implemented the Basel I capital accord in 1988 to converge the banks into a standardized regulatory capital standard (Taskinsoy, 2019b). Though the adoption of Basel I was expected to strengthen the financial stability of banks, it influenced the moral hazard of banks in the form of increased risk-taking behavior through disintermediation (Blundell-Wignall *et al.*, 2014). The adoption of regulatory capital standards under Basel I caused rampant regulatory capital arbitrage (Jones, 2000), acted as a tax imposed on banks (Jackson *et al.*, 1999) which might have resulted in the credit crunch in the late 1990s (Elizalde, 2007). As a result, Basel I failed to prevent the occurrence of the Asian financial crisis in the late 1990s. The structural weakness of the Basel I capital accord exposed by the Asian financial crisis led to the development and implementation of Basel II in 2004. Despite the higher hope of improved financial stability of the global banking system, Basel II failed to assess the risk associated with securitized derivatives and other financially engineered products which subsequently contributed to the financial instability and 2008 global financial crisis (Jobst *et al.*, 2013). As the Asian financial crisis, 2008 global financial crisis exposed the inherent deficiencies of Basel II to promote financial resilience of the global banking system which led to the adoption of Basel III in 2010 aimed at improving the financial stability of the banking sector with improved regulatory capital and liquidity standards (Taskinsoy, 2019b). The implementation of Basel III has caused a mixed reaction in the empirical literature. Proponents of strict capital regulation such as the study of Angelini *et al.* (2015) has opined that increased capital and liquidity requirement imposed under Basel III is assumed to reduce the likelihood of future baking crisis. Similarly, Hossain *et al.* (2018) have found that the additional regulatory capital and liquidity requirement would increase the financial stability of the Brazil, Russia, India, China and South Africa (BRICS) economies. On the contrary, Haldane and Madouros (2012) have doubted the ability of the Basel 3 capital accord to prevent the potential financial crises in the global banking system. Similarly, Carmassi and Micossi (2012) have opined that the mandatory compliance of the banks to stringent regulatory capital and liquidity requirements would result in a reduction in capital and increase leverage for banks, thus making the banking system financially more fragile.

The empirical literature has generated mixed results regarding the relationship between capital regulation and the cost of financial intermediation. Demirguc-Kunt *et al.* (2003) have opined that highly capitalized banks tend to have increased interest rate margins. The study of IIF (2011) has estimated the potential impact of Basel III accord on the lending spread of banks and found that the lending spreads of banks are expected to be increased by an average of 320 basis points after the four-year implementation of Basel III. Slovik and Cournède (2011) have opined that the compliance of banks to the increased regulatory capital standard of Basel III will increase the lending spreads of banks. Elliott and Santos (2012) have opined that banks in the USA, Europe, and Japan are likely to increase the lending margin during the Basel III regime. From a sample of 2000–2014, Rahman *et al.* (2018) have observed a positive relationship between capital regulation and cost of financial intermediation in the

Bangladesh banking industry. On the contrary, Zheng *et al.* (2017) have reported a negative relationship between capital regulation and cost of financial intermediation in the Bangladesh banking industry. Similarly, a negative relationship between capital regulation and the cost of financial intermediation is reported by Afzal and Mirza (2012) in the Pakistan banking industry.

3. Data and methodology

3.1 Data

The panel data of this study is comprised of 34 commercial banks of the Bangladesh banking industry for a sample period of 2011–2020. The data used in this study is collected from the annual reports of the banks. Thus, 340 balanced panel observations have been taken for this study.

3.2 Variable description

3.2.1 Measuring cost of financial intermediation. Following the study of Demirguc-Kunt *et al.* (2003), the cost of financial intermediation is proxied by the variable, cost of financial intermediation (CFI) which is the ratio of net interest margin to average earning assets of the banks. The selection of earning assets over the total assets of the bank in determining the cost of financial intermediation is derived by the fact that the net interest margin of the banks is generated from the conventional financial intermediation activity which is conventional borrowing and lending operations of the bank. For robustness analysis, an alternative measure of financial intermediation cost, NIM proxied by the ratio of net interest margin to average total assets of banks is employed in this study.

3.2.2 Measuring market competition. The market competition measure used in this study is the Lerner Index to measure the market competition of the Bangladesh banking industry. It is a widely used measure of market competition in the empirical literature. Lerner Index (LERNER) is a non-structural market competition measure based on the methodology of Lerner (1934) which is an inverse measure of market competition and direct measure of market power. It represents the degree to which a bank can exert market power to fix the product price over the marginal cost. The higher (lower) value of LERNER implies greater (lesser) market power and lesser (greater) competition in the industry. The value of LERNER ranges from zero to unity. Thus, a value of LERNER equal to zero implies a competitive market and a value of LERNER equal to unity implies a monopoly market. LERNER is determined by using the following equation

$$LERNER = \frac{P_{rt} - MC_{rt}}{P_{rt}} \tag{1}$$

In equation (1), P_{rt} is the ratio of total income (sum of total interest income and total non-interest income) to total asset, representing the price of total asset of bank r at time t. MC_{rt} is the marginal cost of bank r at time t. Marginal cost is estimated by the following translog cost function based on one output and three input prices through a constrained linear regression with linear homogeneity restrictions:

$$\begin{aligned} ln\,(C_{rt}) = {} & \alpha + \beta_1 ln\,(Q_{rt}) + \beta_2 ln\,(Q_{rt})^2 + \beta_3 ln\,(W1_{rt}) + \beta_4 ln\,(W2_{rt}) + \beta_5 ln\,(W3_{rt}) \\ & + \beta_6 ln\,(Y_{rt}) ln\,(W1_{rt}) + \beta_7 ln\,(Y_{rt}) ln\,(W2_{rt}) + \beta_8 ln\,(Y_{rt}) ln\,(W3_{rt}) + \beta_9 ln\,(W1_{rt})^2 \\ & + \beta_{10} ln\,(W2_{rt})^2 + \beta_{11} ln\,(W3_{rt})^2 + \beta_{12} ln\,(W1_{rt}) ln\,(W2_{rt}) + \beta_{13} ln\,(W2_{rt}) ln\,(W3_{rt}) \\ & + \beta_{14} ln\,(W1_{rt}) \ln\,(W3_{rt}) + \varepsilon_{rt}. \end{aligned} \tag{2}$$

the term *ln* in equation (2) refers to the natural logarithm operator, *r* refers to the banks and *t* refers to the year. *C* refers to the total cost of banks which is the sum of interest expense and non-interest expense of banks, denominated in Bangladeshi taka (BDT). *Q* refers to the total asset of banks, denominated in BDT which is used as a proxy measure of bank output. The three input prices of banks are represented by *W*1 which is the price of borrowed funds proxied by the ratio of total interest expense to total deposit, *W*2 which is the price of labor proxied by the ratio of total personnel expenses to total asset, and *W*3 which is the price of fixed capital proxied by the ratio of non-interest expenses (excluding personnel expenses) to total assets.

The marginal cost of each bank *r* at time *t* can be derived by using the estimated coefficients of the translog cost function specified in equation (2) in the following equation:

$$\mathrm{MC}_{rt} = \frac{C_{rt}}{Y_{rt}} \left[\beta_1 + 2\beta_2 ln(\mathrm{Y}_{rt}) + \beta_6 ln(\mathrm{W1}_{rt}) + \beta_7 ln(\mathrm{W2}_{rt}) + \beta_8 ln(\mathrm{W3}_{rt})\right] \tag{3}$$

The marginal cost of each bank *r* at time *t* MC_{rt} derived from equation (3) is required to be substituted in equation (1) to obtain the LERNER for each bank *r* at time *t*. The annual value of Lerner for each year is calculated by averaging the value of Lerner of all banks at time *t* for inclusion in the regression analysis as a proxy for market competition.

Following the study of Chortareas *et al.* (2012), *H*-statistic, another non-structural market competition measure, is employed which is a direct measure of market competition and an indirect measure of market power. *H*-statistic (HSTAT) is estimated as the sum of the responsiveness of a bank's revenue relative to three input prices. The HSTAT is estimated based on the methodology outlined by Panzar and Rosse (1987). The following standard reduced-form equation is used to measure the value of HSTAT of each year as well as the composite value of HSTAT of the overall sample period:

$$ln(\mathrm{R}_{it}) = \alpha + \beta_1 ln(\mathrm{W1}_{it}) + \beta_2 ln(\mathrm{W2}_{it}) + \beta_3 ln(\mathrm{W3}_{it}) + \gamma_1 ln(\mathrm{X1}_{\mathrm{it}}) + \gamma_2 ln(\mathrm{X2}_{it}) + \gamma_3 ln(\mathrm{X3}_{it}) + \gamma_4 ln(\mathrm{X4}_{it}) + \gamma_5 ln(\mathrm{X5}_{it}) + \gamma_6 ln(\mathrm{X6}_{it}) + \varepsilon_{it} \tag{4}$$

In equation (4), *i* denotes banks and *t* denotes tear; *ln* denotes natural logarithm. *R* is the dependent variable proxied by the ratio of interest income to total assets to represent the output price of banks following the intermediation approach. *W*1 is the cost of borrowed funds proxied by the ratio of interest expense to total deposit, *W*2 is the input price of labor proxied by the ratio of total personnel expense to the total number of bank employees. *W*3 is the input price of fixed capital proxied by the ratio of total noninterest expense (excluding personnel expense) to total assets. *X*1, *X*2, *X*3, *X*4, *X*5 and *X*6 are bank-specific control variables included in equation (4). Specifically, *X*1 is the natural logarithm of total assets of the bank, *X*2 is the ratio of total non-interest income to total assets, *X*3 is the ratio of non-performing loan to total loan; *X*4 is the ratio of total equity to total assets, *X*5 is the ratio of total loans to total assets and *X*6 is the natural logarithm of the total number of bank's branches.

The HSTAT is calculated by summing up the coefficients of the three input prices, that is, $\mathrm{HSTAT} = \beta_1 + \beta_2 + \beta_3$. The value of HSTAT ranges from $-\infty$ to $+1$. A higher (lower) value of HSTAT implies increased (decreased) market competition and decreased (increased) market power. HSTAT in a monopoly market will exhibit a value of either zero or negative whereas HSTAT in a competitive market will be equal to 1. HSTAT in a monopolistic market exhibits a value ranging from zero to unity.

One of the important conditions for validating the value of HSTAT is to determine whether the market is in the long-run equilibrium or not. In the long-run equilibrium, the

return on assets (ROA) will not be affected by any changes in the three input prices. To measure the existence of long-run equilibrium, the following equation is estimated:

$$ln(\mathrm{ROA}_{it}) = \alpha + \beta_1 ln(\mathrm{W1}_{it}) + \beta_2 ln(\mathrm{W2}_{it}) + \beta_3 ln(\mathrm{W3}_{it}) + \gamma_1 ln(\mathrm{X1}_{it}) + \gamma_2 ln(\mathrm{X2}_{it}) + \gamma_3 ln(\mathrm{X3}_{it}) + \gamma_4 ln(\mathrm{X4}_{it}) + \gamma_5 ln(\mathrm{X5}_{it}) + \gamma_6 ln(\mathrm{X6}_{it}) + \varepsilon_{it} \quad (5)$$

here, ROA is the return on assets of banks in equation (5). $\beta_1+\beta_2+\beta_3 = 0$ indicates the presence of a long-run equilibrium condition in which the three input prices do not correlate with the return on the bank's assets. The ordinary least square (OLS) model will be used to estimate equations (4) and (5).

For robustness test, this study has also employed Boone Indicator and Herfindahl-Hirschman Index based on the loan market share of banks as alternative market competition measure.

Boone Indicator is estimated by using the following equation:

$$ln(\mathrm{ROA}_{rt}) = \alpha + \beta ln(\mathrm{MC}_{rt}) + \varepsilon_{rt} \quad (6)$$

here, ROA is the return on assets of bank r at time t and MC_{rt} is the marginal cost of bank r at time t which is based on equation (3). The coefficient, β, in equation (6) is the Boone indicator (BOONE). The BOONE usually has negative values. Thus, a larger (smaller) negative value of BOONE signifies greater (lesser) market competition in the banking industry.

The Herfindahl-Hirschman Index (HHI) is calculated by using the following equation:

$$\mathrm{HHI} = \sum_{t=1}^{n} LS_i^2 \quad (7)$$

here, LS is the loan market share of a bank and n is the total number of banks. Aggregating the squared value of the loan market share of each bank will result in the HHI for each year. A higher (lower) value of HHI implies greater (lesser) market concentration and lesser (greater) market competition in the banking industry.

3.2.3 Measuring capital regulation. Following the study of Anginer *et al.* (2021), this study has employed two measures of capital regulation. The first measure of capital regulation is the Capital adequacy ratio of banks, CAR, proxied by the ratio of total regulatory capital (sum of tier 1 and tier 2 regulatory capital) to total risk-weighted assets of banks. The other one is the Tier 1 capital ratio, TIER1, proxied by the ratio of total tier 1 regulatory capital to total risk-weighted assets of banks. Theoretically, it is assumed that the compliance of banks with increased regulatory capital standards will increase the funding cost of banks which will influence the banks to pass this increased funding cost to the customers by making a subsequent increase in the lending rates of the banks to protect profit margin of banks.

For robustness analysis, this study has employed two alternative measures of capital regulation which are capitalization (CAP) proxied by the ratio of total equity to total asset, and Tier1 Stringency proxied by the ratio of total tier 1 regulatory capital to total regulatory capital of banks.

3.2.4 Control variable. Several bank-specific, industry-specific and macroeconomic control variables are included in this study in assessing the impact of market competition and capital regulation on the financial intermediation cost of banks.

The bank-specific control variables used in this study are management efficiency, implicit cost, revenue diversification, bank size, credit risk, financial intermediation, funding structure and bank ownership. Management efficiency (EFF) proxied by the ratio of total earning assets to total assets of banks is used to measure the efficiency of a bank in managing the assets to generate earnings for the bank. A higher value of EFF implies higher efficiency

of the bank's management as a greater proportion of earning assets in the asset structure of banks signifies the greater efficiency of bank management in striving for more earning, thus influencing the management to increase the cost of financial intermediation. The Implicit cost (IMPLICIT) is proxied by the ratio of total operating expenses to total noninterest income. The profitability of banks is expected to be dampened with a higher degree of IMPLICIT, thus influencing the banks to increase the intermediation margin (Naceur and Kandil, 2009). Revenue diversification (RD) proxied by the ratio of total noninterest income to total assets is used to measure the impact of RD of banks into the cost of financial intermediation. A higher degree of RD is expected to have a negative relationship with the cost of financial intermediation as banks with a greater degree of RD tend to have less pressure to generate more revenue from banks' financial intermediation activities (Rahman *et al.*, 2018). Bank size (SIZE) proxied by the natural logarithm of total assets of the bank is included to measure the impact of SIZE on the cost of financial intermediation. Larger banks tend to have economies of scale in their business operation which enables them to charge a lower margin on loans. Similarly, larger banks tend to possess a higher degree of market power which enables them to charge a higher margin on loans (Naceur and Kandil, 2009). Credit risk (LLS) proxied by the ratio of loan loss provision to total loan is used to assess the relationship between the LLS and the cost of financial intermediation of banks. It is assumed that banks with increased LLS exposure are expected to increase the lending rate for loans which in turn increases the cost of financial intermediation of banks (Amidu and Wolfe, 2013). The degree of a bank's financial intermediation (INTERMEDIATION) is measured by the ratio of total loan to the total deposit. The degree of financial intermediation tends to influence the profitability of banks as banks with a higher degree of financial intermediation would be able to improve profit margin which is only possible through a reduction in the cost of financial intermediation. Funding structure (FUND) proxied by the ratio of deposit to total liabilities is used to assess the impact of FUND on the cost of financial intermediation margin of banks. It is assumed that well-capitalized banks with higher market power can pay lower interest rates on deposits which increase the cost of financial intermediation of banks (Amidu and Wolfe, 2013). Ownership structure (OWND) is a dummy variable equal to 1 if the bank is a PCB while zero for SCB. The inclusion of this variable will help to provide insights regarding which type of banks have the higher cost of financial intermediation in the Bangladesh banking industry.

Banking sector development (BSD) is proxied by the ratio of total assets of the banking industry to the total gross domestic product (GDP), the annual growth rate of GDP, and annual inflation rate (INF) are used to capture macroeconomic characteristics. The definition of all the variables is listed in Table A1 in appendix.

3.3 Model specification

To assess the impact of market competition, and capital regulation on the cost of financial intermediation of the Bangladeshi banks, the following regression equation will be employed:

$$\mathrm{CFI}_{it} = \beta_0 + \beta_1 \mathrm{COMP}_{jt} + \beta \mathrm{BANK}_{it} + + \gamma_1 \mathrm{MACRO}_t + \varepsilon_{it}. \tag{8}$$

$$\mathrm{CFI}_{it} = \beta_0 + \beta_1 \,\mathrm{REGULATION}_{it} + \beta \mathrm{BANK}_{it} + + \gamma_1 \mathrm{MACRO}_t + \varepsilon_{it}. \tag{9}$$

here, the subscripts i represents the bank, j represents the banking industry and t represents time. The dependent variable, CFI_{it}, represents the cost of financial intermediation proxied by the ratio of net interest margin to average earning assets in both equations (8) and (9).

COMP_{jt} represents the market competition of the Bangladesh banking industry proxied by LERNER and HSTAT in equation (8) and $\mathrm{REGULATION}_{it}$ represents the capital regulation proxied by CAR which is the ratio of total regulatory capital (sum of tier 1 and tier 2 regulatory

capital) to total risk-weighted assets of banks and by TIER1, proxied by the ratio of total tier 1 regulatory capital to total risk-weighted assets of banks in equation (9).

$BANK_{it}$ represents the bank-specific control variables which include EFF, IMPLICIT, RD, SIZE, LLS, INTERMEDIATION, FUND and OWND

$MACRO_{ct}$ represents country-specific macroeconomic variables which are the economic growth (GDP) and inflationary pressure (INF), and BSD.

Before the selection of an appropriate panel estimator, a series of diagnostic tests is performed to inquire about the presence of heteroskedasticity, autocorrelation and cross-sectional dependence across panels. The statistical significance of The Breusch and Pagan Lagrangian multiplier test, LM (χ^2), for panel-specific effects in Table A3 in appendix indicates the significant differences across banks; thus suggesting that Pooled OLS panel estimator is not efficient for panel estimation of this study. The rejection of the Hausman test at 1% significance level indicates that the fixed effect panel estimator is appropriate. The strong rejection of the Modified Wald Test and the White test at the 1% significance level indicates the presence of heteroskedasticity in the panel data. The Woolridge test for autocorrelation rejects the null hypothesis of no autocorrelation at the 1% significance level, thus suggesting the presence of autocorrelation in the panel data. Pesaran's test for cross-sectional dependence indicates the presence of contemporaneous correlation across the banks.

These preliminary diagnostic tests suggest that the panel data is restricted as the regression estimates of this study are plagued by the presence of heteroskedasticity, autocorrelation and contemporaneous correlation. These limitations can be overcome with the use of the Feasible Generalized Least Square panel estimator and the Prais Winsten Panel Estimator with panel corrected standard errors and first-order autocorrelation disturbances. The Feasible Generalized Least Square panel estimator can be employed only if the condition of the number of periods (T) is equal or larger than the number of cross-sections (N) is satisfied (Beck and Katz, 1995). Since this study has a panel database that has a property of $N > T$, The Feasible Generalized Least Square panel estimator is not appropriate. Thus, the Prais Winsten Panel Estimator with panel corrected standard errors and first-order autocorrelation disturbances is employed for the panel estimation of this study which enables the error term to be heteroskedastic, autocorrelated and contemporaneously correlated across panels.

Both equations (8) and (9) are estimated by using the Prais Winsten Panel Estimator.

4. Empirical results

4.1 Summary statistics

Table 1 shows the summary statistics of all the variables used in this study.

From Table 1, it can be observed that the average value of CFI in the Bangladesh banking industry is 2.6% with a maximum and a minimum value of 7.8% and −4.2% respectively. The negative value of CFI is indicating that some of the banks especially SCBs have failed to earn sufficient interest income from their lending operations to cover the interest expense paid to the depositors. The mean value of the LERNER from 2011 to 2020 is 0.224 which is close to 0. This is indicating that a moderate competitive condition exists in the Bangladesh banking industry. The minimum and the maximum value of HSTAT is 0.243 and 0.71, respectively which is suggesting the presence of monopolistic competition in the Bangladesh banking industry. This is evident in column 1 of Table A4 in appendix as the composite HSTAT for the sample period estimated by summing up the coefficients of three input prices is 0.692 which indicates the existence of monopolistic competition in the Bangladesh banking industry. The Wald test has been performed to check whether the H-statistic is statistically different from zero and unity. The Wald test for monopoly market ($H = 0$), and perfectly competitive market ($H = 1$) are rejected at 1% significance level, thus suggesting the prevalence of monopolistic competition in the Bangladesh banking industry. This finding is

Variable	Observation	Mean	Standard deviation	Minimum	Maximum
CFI	340	0.026	0.017	−0.042	0.078
LERNER	340	0.224	0.025	0.179	0.262
HSTAT	340	0.476	0.159	0.243	0.71
CAR	340	0.117	0.048	−0.142	0.256
TIER 1	340	0.085	0.042	−0.146	0.211
EFF	340	0.782	0.135	0.239	0.92
IMPLICIT	340	1.058	0.572	0.345	5.424
RD	340	0.024	0.009	0.003	0.05
SIZE	340	26.118	0.75	23.579	28.096
INTERMEDIATION	340	0.853	0.163	0.375	2.134
FUND	340	0.843	0.068	0.337	0.953
OWND	340	0.824	0.382	0	1
BSD	340	63.487	3.061	59.08	67.91
GDP	340	6.44	1.518	2.376	8.153
INF	340	6.637	1.713	5.514	11.395

Note(s): For definition of variables, refer to Table A1

Table 1.
Descriptive statistics of the variables

consistent with the finding of Uddin and Suzuki (2015) and Repon and Islam (2016). Column 2 of Table A4 shows the market equilibrium test for the Bangladesh banking industry during the sample period. The statistical significance of the Wald test for market equilibrium at 1% significance level indicates that the Bangladesh banking industry is in the long-run equilibrium. The average value of CAR and TIER 1 is 11.7 and 8.5% which is higher than the minimum regulatory capital standards set under the regulatory capital standards. Surprisingly, the minimum value for both variables is negative which is suggesting that some banks in Bangladesh have sustained continuous financial losses which have resulted in negative capitalization for banks.

4.2 Correlation matrix

Table 2 shows the result of Pearson's correlation matrix used to determine the relationship between the variables of this study. The correlation between two regulatory capital measures, CAR and TIER 1, is 0.94 which is high because of their nature. It is not going to be an issue for panel estimation as these two explanatory variables, are used separately in equation (9). Apart from these two variables, the highest correlation coefficient is observed between RD and IMPLICIT which is lower than the maximum threshold of 0.7 specified by Kennedy (2008), thus the explanatory variables are less likely to have multicollinearity problem. To be more certain on this issue, variance inflation factor (VIF) test, a formal test of multicollinearity, is performed and the results are shown in Table 3.

The results of the VIF test indicate that the highest variance inflation is 3.72 with the highest mean variance inflation being 2.39. Wooldridge (2015) has stated that multicollinearity is likely to be a problem if the value of VIF exceeds common threshold of 10. Similarly, Hair *et al.* (2012) have recommended that multicollinearity is a concern if the value of VIF exceeds 5. It is evident from Table 3 that all VIF values are lower than the maximum threshold of 5 recommended by Hair *et al.* (2012) and 10 recommended by Wooldridge (2015). Thus, it can be concluded that the multicollinearity is not a concern for this study.

4.3 Impact of market competition and capital regulation on the cost of financial intermediation

Table 4 shows regression results regarding the impact of market competition and capital regulation on the cost of financial intermediation in the Bangladesh banking industry. Four

Table 2. Pearson's correlation matrix

	CFI	LERNER	HSTAT	CAR	TIER 1	EFF	IMPLICIT	RD	SIZE	LLS	INTERMEDIATION	FUND	OWND	BSD	GDP	INF
CFI	1															
LERNER	0.16**	1														
HSTAT	−0.06	−0.63***	1													
CAR	0.34***	−0.06	0.09	1												
TIER 1	0.38***	0.01	−0.01	0.94***	1											
EFF	0.13*	0.02	0.03	0.21***	0.19***	1										
IMPLICIT	0.38***	−0.10	0.08	−0.042	−0.06	0.0475	1									
RD	−0.19***	0.18***	−0.22***	0.09	0.15**	−0.0731	−0.69***	1								
SIZE	−0.38***	−0.24***	0.20***	−0.01	−0.14*	0.253***	−0.03	−0.12*	1							
LLS	−0.05	0.02	−0.05	−0.36***	−0.38***	−0.250***	−0.15**	0.20***	0.01	1						
INTERMEDIATION	0.38***	0.03	0.12*	0.27***	0.19***	0.233***	0.17**	−0.28***	−0.16**	−0.086	1					
FUND	−0.10	0.07	−0.15**	−0.35***	−0.25***	0.240***	0.14**	−0.14*	0.05	−0.15**	−0.56***	1				
OWND	0.5***	0	0	0.19***	0.18***	0.573***	0.28***	−0.17**	−0.23***	−0.23***	0.36***	0.22***	1			
BSD	−0.24***	−0.31***	0.24***	0.09	−0.07	−0.03	0.18***	−0.32***	0.46***	−0.12*	0.12*	−0.23***	0	1		
GDP	0.19***	0.15**	−0.17**	−0.03	−0.02	−0.01	0.06	−0.05	−0.05	0.08	0.057	0.01	0	−0.14*	1	
INF	0.19***	0.41***	−0.09	−0.03	0.07	0.06	−0.18**	0.28***	−0.37***	−0.06	−0.01	0.16**	0	−0.68***	−0.06	1

Note(s): This table reports Pearson's correlation matrix for all variables in the baseline specification. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively. For the definition of variables, refer to Table A1

	Dependent variables			
	CFI	CFI	CFI	CFI
LERNER	1.29			
HSTAT		1.2		
CAR			1.62	
TIER 1				1.54
EFF	2.5	2.49	2.54	2.54
IMPLICIT	2.11	2.12	2.1	2.1
RD	2.84	2.97	2.81	2.82
SIZE	2.22	2.23	2.19	2.2
LLS	1.2	1.2	1.47	1.49
INTERMEDIATION	3.45	3.44	3.45	3.47
FUND	3.2	3.28	3.72	3.58
OWND	2.88	2.88	2.92	2.89
BSD	2.63	2.63	2.63	2.68
GDP	1.12	1.11	1.09	1.09
INF	2.3	2.18	2.15	2.15
Mean VIF	*2.31*	*2.31*	*2.39*	*2.38*

Table 3. Variance inflation factor analysis

Source(s): Author's calculation. For the definition of variables, refer to Table A1 in appendix

models are estimated and presented in Table 4. Model 1 and 2 represents the regression results regarding the relationship between market competition and cost of financial intermediation based on equation (8) whereas model 3 and 4 represents the regression results regarding the relationship between capital regulation and cost of financial intermediation based on equation (9). The dependent variable in all four models is CFI. The main explanatory variable in models 1 and 2 is the market competition measure proxied by LERNER in model 1 and HSTAT in model 2. On the other hand, the main explanatory variable in models 3 and 4 is the regulatory capital measures proxied by CAR in model 3 and TIER 1 in model 4.

The regression results show a positive and statistically significant coefficient between LERNER and CFI in model 1 which is suggesting that an increase in market power or a decline in market competition increases the cost of financial intermediation of banks as the higher value of LERNER signifies higher market power and lower market competition. Similarly, the negative and statistically significant coefficient between HSTAT and CFI in model 2 is suggesting that an increase in market competition or a decline in market power results in a decline in the cost of financial intermediation of banks as the higher value of HSTAT signifies higher market competition and lower market power. The negative relationship between market competition and the cost of financial intermediation or the positive relationship between market power and cost of financial intermediation is suggesting that the higher degree of market competition in the banking industry results in a decline in the cost of financial intermediation of banks. This finding is consistent with the studies of Chortareas *et al.* (2012), Hawtrey and Liang (2008), Hossain (2012), Amidu and Wolfe (2013), and Sarpong-Kumankoma *et al.* (2019) who have found that the cost of financial intermediation of banks increases in a less competitive market as the banks gain more market power.

Regarding the relationship between capital regulation and cost of financial intermediation, the regression results show that both capital regulation measures, CAR and TIER 1, are showing a positive relationship with CFI which is suggesting that holding higher regulatory capital to minimize risk exposure of banks will increase the funding cost for banks which will in turn influence the banks to compensate this increased funding cost by channeling a portion of the increased cost of bank capital to the bank customers through

Dependent variable	(1) CFI	(2) CFI	(3) CFI	(4) CFI
LERNER	0.0673***			
	(0.0245)			
HSTAT		−0.0087**		
		(0.0042)		
CAR			0.0954***	
			(0.0262)	
TIER 1				0.1072***
				(0.0312)
EFF	0.0047	0.0056	−0.0042	−0.0054
	(0.0122)	(0.0123)	(0.0108)	(0.0106)
IMPLICIT	0.0071***	0.0066***	0.0069***	0.007***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
RD	−0.255**	−0.2789**	−0.2704**	−0.2732**
	(0.1258)	(0.1251)	(0.1179)	(0.1175)
SIZE	−0.0024	−0.0026	−0.0035	−0.0025
	(0.0025)	(0.0026)	(0.0022)	(0.0022)
LLS	0.0974*	0.0997*	0.188***	0.1832***
	(0.057)	(0.0576)	(0.0583)	(0.0599)
INTERMEDIATION	−0.0107	−0.009	−0.0047	−0.0047
	(0.0118)	(0.0117)	(0.0103)	(0.0107)
FUND	−0.0678***	−0.0694***	−0.0389**	−0.0458**
	(0.0217)	(0.0216)	(0.0188)	(0.019)
OWND	0.0187***	0.0184***	0.017***	0.0181***
	(0.0072)	(0.0071)	(0.0062)	(0.0061)
BSD	−0.0008**	−0.0008*	−0.0006	−0.0005
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
GDP	0.0017***	0.0015***	0.0016***	0.0016***
	(0.0004)	(0.0004)	(0.0005)	(0.0005)
INF	0.001**	0.0013***	0.0013**	0.0013**
	(0.0004)	(0.0005)	(0.0005)	(0.0005)
Constant	0.1525**	0.1737***	0.1495***	0.1263**
	(0.0639)	(0.0621)	(0.0568)	(0.0554)
Observations	340	340	340	340
Wald χ^2	142.58	115.54	123.81	120.72
Prob > F	0	0	0	0
R-squared	0.5311	0.5265	0.5661	0.5667

Note(s): This table portrays Panel-Westin panel estimator results showing the impact of market power on the cost of financial intermediation in Model 1 and 2 by using equation (8) and the impact of capital regulation on the cost of financial intermediation in Model 3 and 4 by using equation (9) ***, **, and * indicate the level of significance at 1%, 5% and 10% respectively. Standard errors are in parentheses. For the definition of variables, see Table A1 in appendix

Table 4.
Effects of market competition and capital regulation on the cost of financial intermediation

increased lending rate for loans, thus raising the cost of financial intermediation of banks. The positive relationship between capital regulation and cost of financial intermediation of this study is consistent with the studies of Kosmidou *et al.* (2005), Naceur and Kandil (2009), Rahman *et al.* (2018), Taskinsoy (2019a) but contradicts the studies of Afzal and Mirza (2012) and Zheng *et al.* (2017).

Regarding the control variables, IMPLICIT is showing a statistically positive relationship in all the models which is suggesting that an increase in the IMPLICIT of banks is expected to reduce the profitability of banks which will in turn influence the banks to increase the cost of financial intermediation to protect the profit margin of banks. RD is also showing a

statistically negative relationship with CFI in all the four models which is suggesting that banks that concentrate their revenue structure into more nontraditional banking activities do not feel pressure to generate higher intermediation margins from traditional financial intermediation activities (Rahman *et al.*, 2018). LLS tends to have a significant and positive relationship with CFI in all the models which is suggesting that banks tend to charge increased interest rates on loans to compensate for the increased credit risk exposure which increases the cost of financial intermediation (Amidu and Wolfe, 2013). Surprisingly, FUND is showing a statically significant negative coefficient with CFI in all the models, suggesting that an increase in low-cost depository funding does not improve the cost of financial intermediation of banks. One possible reason for such a negative relationship is the increased non-performing loans (NPL) in the Bangladesh banking industry. The Bangladesh banking industry is always plagued with a high NPL ratio which has increased significantly in the last decade (Dey, 2019), making the NPL ratio of the Bangladesh banking system the 2nd largest in Asia and the 24th largest in the world (Islam, 2020). The increase in NPL means foregone interest income in the lending activities but the bank has to repay the interest on the customer's deposit which results in a decline in the intermediation margin of banks. OWND is showing a positive and statistically positive relationship in all models which is suggesting that PCBs tend to have a higher cost of financial intermediation than the SCBs in the Bangladesh banking industry. Surprisingly, INTERMEDIATION tends to have a negative relationship with CFI but it is not statistically significant.

Regarding the macroeconomic variables, BSD is showing a negative relationship with CFI in all the models but the significant relationship is found in models 1 and 2, which is suggesting the BSD has helped to reduce the cost of financial intermediation. Surprisingly, GDP tends to have a positive and statistically significant relationship with CFI in all models, thus suggesting that the cost of financial intermediation increases with economic growth. A possible explanation for such a positive relationship is that the demand for financing from different economic units increases with the economic growth and this increased demand for financing may have influenced the banks to increase their intermediation margin. INF is also showing a significant and positive relationship with CFI. This positive relationship suggests that the real rate of return declines during the period of increased inflationary pressure. As a result, banks increase the lending rate on loans to compensate for the adverse impact of inflation, thus increasing the cost of financial intermediation. This finding is consistent with Hossain (2012).

4.4 Robustness test: alternative proxies of dependent variables and explanatory variables

The robustness of the main results of this study is checked by using alternative proxies of dependent variables and explanatory variables. NIM is used as an alternative proxy for measuring the cost of financial intermediation of each bank. BOONE and HHI are used as alternative proxies for measuring the market competition in the Bangladesh banking industry. CAP and TIER1STRINGENCY are used as alternative proxies for measuring the capital regulation of the banking industry.

Table 5 shows the robustness of the main regression results reported in Table 4 by using alternative proxies of dependent and explanatory variables in equations (8) and (9). The robustness test indicates that the results are largely similar to the main regression results. The two alternative measures for market competition, BOONE and HHI, are showing a positive relationship with the alternative measure of the cost of financial intermediation, NIM. As BOONE usually has negative values, the sign of the BOONE's coefficient will imply the opposite meaning. As a result, the positive coefficient of BOONE is suggesting that cost of financial intermediation declines (increases) with an increase (decline) in market competition. The positive coefficient of HHI is suggesting that the cost of financial intermediation increases with an increase in market concentration or a decline in market competition as a higher value of HHI

Dependent variable	(1) NIM	(2) NIM	(3) NIM	(4) NIM
BOONE	0.071**			
	(0.0306)			
HHI		1.4886***		
		(0.2902)		
CAP			0.0662***	
			(0.0169)	
TIER1STRINGENCY				0.0057***
				(0.0019)
EFF	0.0201***	0.0186***	0.0252***	0.0169***
	(0.0061)	(0.006)	(0.0056)	(0.0055)
IMPLICIT	0.0053***	0.0053***	0.005***	0.0053***
	(0.0011)	(0.0011)	(0.0011)	(0.0012)
RD	−0.1861**	−0.1507*	−0.2421***	−0.1982**
	(0.0821)	(0.0802)	(0.0781)	(0.0796)
SIZE	−0.0012	−0.0008	0.0005	−0.0012
	(0.0013)	(0.0012)	(0.0013)	(0.0013)
LLS	0.0396	0.0327	0.0698**	0.0943***
	(0.0314)	(0.0308)	(0.032)	(0.0363)
INTERMEDIATION	−0.0011	−0.0014	−0.0021	0.0012
	(0.0056)	(0.0057)	(0.0054)	(0.0055)
FUND	−0.0354***	−0.03**	−0.0305**	−0.0337**
	(0.0135)	(0.0136)	(0.0125)	(0.0132)
OWND	0.0131***	0.0133***	0.0149***	0.013***
	(0.004)	(0.0041)	(0.0036)	(0.0036)
BSD	−0.0003	0.0002	−0.0006*	−0.0006*
	(0.0003)	(0.0003)	(0.0004)	(0.0003)
GDP	0.0012***	0.0018***	0.0012***	0.0011***
	(0.0003)	(0.0002)	(0.0004)	(0.0004)
INF	0.0013***	0.0005*	0.0008*	0.0008**
	(0.0004)	(0.0003)	(0.0004)	(0.0004)
Constant	0.0558	−0.0497	0.0257	0.0731**
	(0.0364)	(0.0413)	(0.0378)	(0.0342)
Wald χ^2	166.43	246.98	155.88	176.45
Prob > F	0	0	0	0
Observations	340	340	340	340
R-squared	0.6353	0.6542	0.6426	0.6407

Note(s): This table portrays Panel-Westin panel estimator results showing the impact of market power on the cost of financial intermediation in Model 1 and 2 by using equation (8) and the impact of capital regulation on the cost of financial intermediation in Model 3 and 4 by using equation (9). ***, ** and * indicate the level of significance at 1%, 5% and 10% respectively. Standard errors are in parentheses

Table 5.
Robustness results

implies greater market concentration and lesser market competition in the industry. The regulatory capital measures, CAP and TIER1STRINGENCY, are showing a positive coefficient with NIM which suggests that well-capitalized banks tend to have the higher cost of financial intermediation. The results of other control variables mostly remained the same.

4.5 Additional analysis

In the additional analysis, the persistence of the cost of financial intermediation is checked. In other words, it is assessed whether the cost of financial intermediation of the previous period has any impact on the cost of financial intermediation of the current period. Apart from this, the explanatory variables of this study, market competition measures (LERNER and HSTAT) and

regulatory capital measures (CAR and TIER 1) may suffer from endogeneity issues as the degree of market competition in the banking industry and the capital management of banks are determined by bank-specific and country-specific characteristics. To check the persistence of the cost of financial intermediation over the sample period and to control the endogeneity issue, this study has employed the two-stage least squares (2SLS) method which is presented in Table 6. LERNER, HSTAT, CAR and TIER 1 are treated as endogenous variables separately in models 1

Dependent variable	(1) CFI	(2) CFI	(3) CFI	(4) CFI
CFI_{t-1}	0.746***	0.7545***	0.6657***	0.6573***
	(0.0351)	(0.0351)	(0.0359)	(0.0357)
LERNER	0.0953***			
	(0.0226)			
HSTAT		−0.0111***		
		(0.0028)		
CAR			0.0779***	
			(0.0126)	
TIER 1				0.0938***
				(0.0141)
EFF	0.0049	0.0057	−0.0011	−0.002
	(0.005)	(0.005)	(0.0049)	(0.0049)
IMPLICIT	0.0022**	0.002*	0.003***	0.003***
	(0.0011)	(0.0011)	(0.001)	(0.001)
RD	−0.0447	−0.0519	−0.0275	−0.0392
	(0.0823)	(0.0827)	(0.0779)	(0.0773)
SIZE	−0.0005	−0.0006	−0.0013	−0.0008
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
LLS	0.0051	0.0084	0.1234***	0.1375***
	(0.0321)	(0.032)	(0.0362)	(0.0363)
INTERMEDIATION	−0.0067	−0.0059	0.0003	0.0015
	(0.0049)	(0.0049)	(0.0048)	(0.0047)
FUND	−0.0271**	−0.0265**	0.0096	0.0065
	(0.0116)	(0.0115)	(0.0118)	(0.0114)
OWND	0.0088***	0.0083***	0.0076***	0.0082***
	(0.0021)	(0.002)	(0.002)	(0.002)
BSD	−0.0001	−0.0002	−0.0003	−0.0001
	(0.0003)	(0.0002)	(0.0002)	(0.0002)
GDP	0.0019***	0.0018***	0.0019***	0.0019***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
INF	0.0004	−0.0007	−0.001	−0.0009
	(0.001)	(0.001)	(0.0009)	(0.0009)
Constant	0.0002	0.0415	0.0257	0.0065
	(0.0307)	(0.0286)	(0.0278)	(0.028)
R-squared	0.8219	0.8234	0.8346	0.8381
Hausman Test	5.547**	4.171**	4.257**	4.319**
First-Stage *F*-statistic	180.482***	120.49***	218.475***	215.128***
Critical value at 5% relative bias	16.85	16.85	13.91	13.91
Sargan test (*p*-value)	0.1877	0.1431	0.7686	0.3752

Note(s): This table portrays the regression results of the Two-stage least squares (2SLS) method showing the impact of market power on the cost of financial intermediation in Model 1 and 2 and the impact of capital regulation on the cost of financial intermediation in Model 3 and 4. ***, ** and * indicate the level of significance at 1%, 5% and 10% respectively. Standard errors are in parentheses. For the definition of variables, see Table A1 in appendix

Table 6.
Additional analysis using 2SLS method

to 4 respectively and the one-year time lag value of the cost of financial intermediation (CFI_{t-1}) is used as a dependent variable in all four models.

The regression results derived from the 2SLS method is showing the positive and statistically significant coefficients of lagged dependent variable, (CFI_{t-1}) in all the four models which is suggesting the persistency of financial intermediation cost from one year to next year. The results of explanatory variables are similar to the main results of this study. The positive coefficient of LERNER and the negative coefficient of HSTAT in models 1 and 2 is suggesting that the cost of financial intermediation declines with an increase in market competition or a decline in market power. Similarly, the positive coefficient of CAR and TIER 1 in models 3 and 4 is suggesting that the cost of financial intermediation increases with an increase in the regulatory capital requirement of banks.

The statistical significance of the Hausman test for endogeneity is suggesting that market structure measures (LERNER and HSTAT) and regulatory capital measures (CAR and TIER 1) are not exogenous variables and this study is correct to treat these variables as endogenous variables. According to Staiger and Stock (1997), the value of the *F*-statistic of first stage regression greater than 10 in the case of a single endogenous variable suggests that instruments are not weak. The value of the *F*-statistic of First stage regression in all the four models is greater than 10, suggesting that the instruments are relevant and not weak. Besides, the Stock and Yogo (2005) test for weak instruments is also performed. According to this test, instruments are deemed to be weak and invalid if the value of First stage *F*-statistic is lower than the critical value at a certain relative bias. Here, the value of First stage *F*-statistic is larger than the critical value at 5% relative bias in all the four models which suggests that the instruments are valid and not weak. The statistically insignificant *p*-value of the Sargan test of overidentifying restrictions is implying that the instruments are uncorrelated with the error term in all four models and the models are well specified.

5. Conclusion

The objective of this study is to investigate the impact of market competition and capital regulation on the cost of financial intermediation of banks in the Bangladesh banking industry. The cost of financial intermediation is proxied by CFI which is the ratio of net interest income to average earning assets. The market competition is proxied by the LERNER which is Lerner Index and the HSTAT which is *H*-statistic. The capital regulation is proxied by CAR, the ratio of total regulatory capital to total risk-weighted assets, and TIER 1, the ratio of total tier 1 capital to total risk-weighted assets.

The regression results derived by using the Prais Winsten panel estimator indicate a negative relationship between market competition and the cost of financial intermediation, thus suggesting that greater market competition in the Bangladesh banking industry lowers the cost of financial intermediation of banks. The regression results are also showing a positive relationship between capital regulation and the cost of financial intermediation suggesting that the cost of financial intermediation of banks increases with an increase in the regulatory capital of banks. This indicates that the increase in regulatory capital usually increases the funding cost of the banks which are passed on to the customers by banks by charging higher loan rates. The robustness of these findings is checked by using alternative measures of the cost of financial intermediation, the market competition and the capital regulation of banks. In the additional analysis, the persistency in the cost of financial intermediation margin and the endogeneity issue is addressed by using the 2SLS method (Two-stage least square method) and found that cost of financial intermediation of bank is persistent from one year to another year. This finding suggests that the cost of financial intermediation of the previous period helps to amplify the cost of financial intermediation of the current period.

This study has several important policy implications. First, the ability of banks with higher market power to charge higher loan rates may impede the financial intermediation activities (Soedarmono and Tarazi, 2016) and the economic growth (Cetorelli and Gambera, 2001). Thus, the regulatory reforms should aim to foster sustainable and optimal market competition for the banking industry to regulate the market power of banks. Second, as the capital regulation of banks has transitioned from Basel II to Basel III, the cost of financial intermediation of banks has also increased. Thus, the regulatory authority of Bangladesh should find the optimal policy measures for implementing the capital regulation in the banking industry which would reduce the cost of financial intermediation of banks.

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Appendix

Variables	Description	Notation	Source
Dependent variable			
Cost of financial intermediation measure			
Cost of financial intermediation	The ratio of net interest margin to average total earning asset	CFI	Annual reports of banks
Explanatory variables			
Competition measure			
Lerner index	A nonstructural market competition indicator based on equation (1)	LERNER	Author's calculation
H-statistic	A nonstructure market competition indicator based on equation (4)	HSTAT	Author's calculation
Capital regulation measure			
Capital adequacy ratio	The ratio of total regulatory capital to total risk-weighted asset	CAR	Annual reports of banks
Tier 1 capital ratio	The ratio of total tier 1 capital to total risk-weighted asset	TIER 1	Annual reports of banks
Bank-specific control variables			
Management efficiency	The ratio of total earning asset to total asset	EFF	Annual reports of banks
Implicit cost	The ratio of total operating expenses to total non-interest income	IMPLICIT	Annual reports of banks
Revenue diversification	The ratio of total non-interest income to total asset	RD	Annual reports of banks
Bank size	The natural logarithm of the bank's total asset	SIZE	Annual reports of banks
Credit risk	The ratio of loan loss provision to total loan	LLS	Annual reports of banks
Financial intermediation	The ratio of total loan to total asset	INTERMEDIATION	Annual reports of banks
Funding structure	The ratio of deposit to total liabilities	FUND	Annual reports of banks
Ownership dummy	A dummy variable takes a value of 1 if the bank is a private commercial bank while 0 for a state-owned commercial bank	OWND	Author's calculation
Macroeconomic variables			
Banking sector development	The ratio of total asset of the banking industry to total gross domestic product	BSD	World Bank- Global Financial Development Database
Economic growth	Annual Growth rate in Gross Domestic Product	GDP	World Bank- Global Financial Development Database
Inflation	Annual Inflation Rate	DEP	World Bank- Global Financial Development Database

Table A1.
Definition of variables

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019
Asset market share of banks (in %)									
SCB	27.8	26	26.4	27.5	27.5	27.6	25.9	25.6	24.51
SB	5.6	5.5	5.7	3.7	2.8	2.6	2.4	2.2	2.2
PCB	60	62.2	61.8	63.3	64.5	65	67.1	67	67.8
FCB	6.6	6.3	6.1	5.5	5.2	4.8	4.6	5.2	5.5
Deposit market share of banks (in %)									
SCB	27.5	25.5	26	28	28.4	28.4	27.35	26.6	25
SB	4.8	3.8	5.5	3.4	2.9	2.8	2.77	2.6	2.6
PCB	61.8	63.6	62.8	63.9	64.5	64.8	65.91	66	68.1
FCB	6	6.1	5.7	4.7	4.3	4	3.98	4.8	4.3
Net interest margin of banks (in %)									
SCB	3.66	1.18	−0.32	1.96	1.62	1.75	1.98	2.35	1.94
SB	3.7	2.92	1.98	1.5	1.43	0.76	2.05	0.62	0.01
PCB	3.19	3.06	2.77	4.11	3.85	3.89	3.52	3.55	3.52
FCB	5.57	5.56	3.73	5.98	6.08	4.99	4.35	4.3	4.21
Average	3.48	2.79	2.02	3.56	3.28	3.27	3.13	3.22	3.12

Note(s): SCB-State-owned commercial bank, SB-Specialized bank, PCB-Private commercial banks, FCB-Foreign commercial bank
Source(s): Annual Reports of BB

Table A2. Financial characteristics of Bangladesh banking industry

Dependent variable Explanatory variable	CFI LERNER	CFI HSTAT	CFI CAR	CFI TIER1
LM (χ^2)	216.81***	215.55***	209.17***	189.87***
White Test (χ^2)	229.01***	235.53***	236.72***	252.63***
Hausman test	25.44***	25.73***	15.76**	15.75**
Modified wald test (χ^2)	2879.38***	3019.22***	2366.24***	2104.31***
Wooldridge test	64.29***	65.14***	80.08***	78.42***
Pesaran's test for fixed effects	2.72***	2.98**	4.02***	4.36***
Pesaran's test for random effects	2.78***	2.69***	5.01***	4.67***

Source(s): Author's calculation. ***, ** and * indicate level of significance at 1%, 5% and 10% respectively

Table A3. Specification tests

Dependent variable	(1) $ln(R_{it})$	(2) $ln(ROA_{it})$
$ln(W_1)$	0.572***	−0.3375
	(0.0283)	(0.2695)
$ln(W_2)$	−0.0875***	−0.7357***
	(0.0235)	(0.2233)
$ln(W_3)$	0.2073***	−0.5041***
	(0.0191)	(0.1821)
$ln(X_1)$	−0.1162***	−0.052
	(0.0197)	(0.1874)
$ln(X_2)$	−0.1445***	0.81***
	(0.0181)	(0.1721)
$ln(X_3)$	−0.1073***	0.3419***
	(0.0111)	(0.1057)
$ln(X_4)$	−0.426***	1.4619***
	(0.0572)	(0.5441)
$ln(X_5)$	0.124***	−0.6327***
	(0.022)	(0.2094)
$ln(X_6)$	0.1114***	−0.5683***
	(0.0214)	(0.2037)
Constant	3.2596***	9.8582***
	(0.377)	(3.5881)
HSTAT ($\beta_1+\beta_2+\beta_3$)	0.692	
F-value on Wald test for $H = 0$	195.64***	
F-value on Wald test for $H = 1$	38.82***	
F-value on Wald test for Equilibrium Test		11.22***
Observations	340	340
R-squared	0.8122	0.1578

Note(s): ***, ** and * indicate level of significance at 1%, 5% and 10% respectively. Standard errors are in parentheses

Table A4.
Long run equilibrium test

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