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Market structure, efficiency and performance of banking industry in Sri Lanka

Abstract

During the period of 1977-2005, reforms in the financial-services sector, development in information and communication technologies (ICT) and globalization of the industry have drastically changed the market structure of banking industry in Sri Lanka. Financial reforms commenced in late 1970s were the main driving force of those changes. The reforms aimed to enhance both the productivity and efficiency and the degree of competition of banking market as a way of improving overall operational performance of the financial services sector in Sri Lanka. This paper reviewed how the banks' efficiency and market structure affect the overall performance of the banking firms measured in terms of profitability and net interest margin using structure conduct performance literature. The study findings suggest that traditional structure conduct performance argument is not held in the banking industry in Sri Lanka and the banks performance does not depend on either market concentration or market power of individual firms but on the level of efficiency of the banking units.

Keywords: efficiency, market structure, performance, banking.
JEL Classification: G20, G21, N20.

Introduction

During the last three decades, banking industry in Sri Lanka has experienced a transition period as a consequence of deregulation of financial services sector, development in ICT and globalization of the industry. Impacts of consequent changes were observable in areas such as the scope of banking operations, number of banks and bank branches, technologies used and quality of human resources in the banking industry as well as institutional structure of the banking industry. This paper examines how the banks' market structure and banks' efficiency have influenced the performance of the banking firms in Sri Lanka using structure conduct performance literature.

The banking industry which holds approximately 60% of the total financial assets (World Bank, 2003), is the main intermediary in the financial services sector in Sri Lanka. Therefore, efficiency and productivity of the banking industry are an important requirement for the development of the sector. After nearly 30 years of inward-looking economic policies and financial repression, the economic policy reforms package which was introduced in 1977 paved the way for structural transformation of the overall economy (Dunham & Kelegama, 1996). The reform package included some drastic policy changes in relation to deregulation of the financial services sector, along with other economic reforms.

Financial reforms in Sri Lanka commenced in late 1977 aimed to improve the performance of banks through enhancing competitiveness and efficiency of the industry. Initial reform measures have allowed some structural changes in financial services sector by giving greater freedom to the private sector. The government encouraged new entrants to the financial services market. Those changes were affected to expand the scope of the banking industry as well as to increase the number of firms in the banking industry. Structural changes in the industry aimed to enhance competition anticipating productivity and efficiency improvements in banks. Ultimately, policy makers aimed to improve the performance of overall banking industry.

These trends in the banking industry have led to creating public policy concern with the degree of concentration of banking market. Further, a policy dilemma is arisen on how firms in the banking industry might allow to compete effectively in a more liberal banking market. Previous researches have suggested two alternative policy drives (Byeongyong, Paul Choi and Mary A. Weiss, 2005; Lloyd-Williams, D. M., Phil Molyneux, and John Thornton 1994; Molyneux, Phil 1999; Moore, Robert R., 1998) for rationalizing market structure in banking industry. The first one lies in limiting the number of banking units in the market through encouraging mergers among existing banks. This will help to increase the bank size for perusing scale of economics. The second strategy is the sharing common facilities such as ATM with other banks in the industry. Both strategies may be useful in enhancing the competition in the market and improving the overall productivity and efficiency of the market.

On the other hand, the deregulation, the ICT and the globalization have changed the way of competition in the banking industry. The improved level of competition has forced banks to be more efficient. As explained in the efficient structure hypothesis (ESH), there is no need to encourage mergers, since the efficient entities can improve their market share by providing more economical banking services in the market. Therefore, ESH suggests that public

policy makers should focuse on identification and implementation of policies leading to enhancing productivity and efficiency. Instead of encouraging bank mergers, the ESH supports policies which may encourage sharing common facilities to avoid duplication of capital cost. However, the first alternative policy is very much aligned with the structure market paradigm which praises the significance of the market power in taking operational decisions. Accordingly, this paper empirically reviews what policy option is more appropriate to the banking industry in Sri Lanka using the Berger and Hannan's (1993) framework.

This paper is organized as follows. The next section presents a brief review of literature related with market structure and bank efficiency giving special reference to the banking industry. The second section detalized the empirical framework used. The third section presents results and implication of the analysis. The last section presents conclusions of the analysis.

1. Literature review

Previous studies have used structural and non-structural approaches to investigate behavior of the banking market. Structural approaches are mainly based on the traditional industrial organization theory which focuses on the structure-conduct-performance (SCP) paradigm and on the efficient structure paradigm. Literature based on structural approaches has investigated how the market concentration weakens the market competition by fostering collusive behavior among firms. Conversely, non-structural approaches assume that factors other than market structure and concentration may affect competitive behavior, such as entry/exit barriers and the general contestability of the market (Panzar, J.C. and J. N. Rosse, 1987; Rosse, J.N. and J.C Panzar, 1977). Non-structural approaches have been developed in the context of the new empirical industrial organization (NEIO) literature. This study is based on structural approaches expecting to uncover the advantage of enhancing banks operational efficiency against bank concentration. The next section presents basic arguments of structure conduct performance hypothesis (SCH) and efficient structure hypothesis (ESH), application in banking industry and their findings.

SCP was first introduced by Mason in 1939 as a method of analyzing markets and firms (Worthington, Ian, Chris Briton, and Andy Rees, 2001). As explained in the SCP, the market concentration fosters collusion among large firms in the industry which subsequently leads to higher profits. Hence, SCP pointed out that changes in market concentration may have a positive influence on a firm's financial performance (Goldberg, Lawrence G. and Anoop Rai, 1996). Furthermore, SCP recognized the consequent positive relationship between market concentration and performance as a result of anti-competitive behavior of firms with large market share (Berger, Allan N. and T. Hannan, 1989). The relative market hypothesis (RMPH) which is a special case of SCP posited that only firms with large market shares and well differentiated product lines are able to exercise market power to gain superior profit on non-competitive price setting behavior (Berger, Allan N., 1995).

An alternative theory, the efficient structure hypothesis (ESH) states that aggressive behavior of efficient firms in the market leads to increase in those firms' size and market share. This behavior of the efficient firms allowed such firms to concentrate and earn higher profits with further enhancing their market share. Those firms can maximize profits either by maintaining the present level of price and firms' size or by reducing price and expanding the firm size (Lloyd-Williams, D. M., Phil Molyneux, and John Thornton, 1994). Berger and Hannan (1989) stated that "firms in markets with a large dispersion of efficiency within market create unequal market share and high level of concentration". Accordingly, the ESH stated that the positive relationship between profit and concentration results from the lower cost achieved through superior management and efficient production process (Goldberg, Lawrence G. and Anoop Rai, 1996). However, proponents of ESH argued that efficiency differences among DMUs within markets create high levels of concentration. The high concentration ratio in the market creates greater than average efficiency in these markets yielding a positive profit concentration relationship (Berger, Allan N. and T. Hannan, 1989). As explained by Berger and Hannan (1989), ESH and SPC stand on similar observation on the relationship between concentration and performance (profitability). But the difference in two theories consisted mainly in ways of interpretation of the relationship.

Some contemporary studies have challenged the acceptability of the positive relationship predicted between market concentration and profitability. Smirlock (1985) posited that there is no relationship between concentration and profitability but between profitability and market share. His study which used 2,700 unit-banks in state found no evidence for the relationship between concentration and profitability. However, he found strong evidence for the relationship between market shares (which are used as proxy for the firm's efficiency) and firms' profitability. Smirlock (1985) showed that market concentration is not a signal of collusive behavior but rather the superior efficiency of the leading firms.

Berger and Hannan (1994) pointed out four sources of anti-competitive behaviors may be arisen as a consequence of high market concentration:

1. If a firm is enjoying a large share of market and it is able to set the prices in excess of competitive levels with a lesser pressure on managers for maintaining operation costs at or near their competitive level.
2. Managers' self-interest behavior may lead to making more risky financing decisions (which are above the shareholders' expectation) to reduce the variation in earnings to protect their positions.
3. Increase in the political cost associated with obtaining and depending on the existing market power.
4. The retention of inefficient managers or the maintenance of inefficient practices allowing managers to live a quiet life to pursue other objectives or maintain market power gains.

The above explanation has led to using the 'quiet life' hypothesis as an alternative hypothesis to the SCP and HSH. This hypothesis assumes that the managers of firms with relatively large market shares give less attention to the efficient use of resources since they can make profits using their price-setting power (Punt, L.W. and M.C.J. Van Rooij, 1999). This hypothesis predicts that large firms in the market use their market power to be quiet in the market and earn profit without improving productivity and efficiency. The behavior of such firms creates economic rent to the market.

Early ESH studies had not used direct efficiency measures. They had used firms' market shares as a proxy to a firm's efficiency (Molyneux, Phil and William Forbes, 1995). Berger and Hannan (1995) have first incorporated direct method of efficiency measures to empirical models. The main disadvantage of using a firm market share is that it does not represent overall productivity and efficiency level of firms. Incorporation of direct measures of efficiency captures impact of all factors affecting the firm's performance.

SCP, in general, provides two main benefits to studies which investigate market behavior. First, it shows the way the market is operating. Thus, it explains different forces which restrict or expand the scope of a firm's operations in the market. Especially with productivity and efficiency studies, SCP helps to interpret different sources of productivity and efficiency gains or losses. Second, SCP provides a rational basis for analyzing the market behavior.

Even after 50 years of emerging the theoretical basis of market structure and performance, there was very limited number of studies, investigating the market structure of developing countries. Previous empirical studies mainly focused on few developed countries in North America and Europe. Gilbert (1984) has summarized 44 such studies which were based on US banking industry. The findings in those studies have less empirical validity in relation to an emerging developing country. However, those findings are of greater importance to understand the theory behind the market structure. Therefore, a brief account of previous application is presented below.

One main issue to be addressed in market structure and performance research is selecting an appropriate measure to represent a firm's performance. In previous studies there has been used price information (Berger, Allan N. and T. Hannan, 1989) or profitability information to proxy the firms' performance (Molyneux, Phil and William Forbes, 1995). In a multi-product environment use of single measure of price to represent a firm's overall performance may be inappropriate. Profitability measures can be used as a comprehensive performance indicator since it integrates both cost and revenue into one measure. In some studies, increased market concentration was found to be associated with higher prices and greater than normal profits. Smirlock (1985) stated that higher profits in concentrated markets could be the result of greater productive efficiency. Berger (1995) finds some evidence that the efficiency hypothesis holds in US banking.

A positive relationship between bank concentration and ROE was found by Short (1979) in a study which was based on a sample of banks from Canada, Western Europe and Japan. Moore (1998) examined the impact of advanced communication technology on the ability of banks to serve distant customers. Advanced technology helped bank managers to serve distant customers using alternative banking methods, for example, tele-banking and internet banking. Moore examined the changes in relationship between concentration ratio and profitability using both univariate and multivariate regression tests and found that, even though the technology had changed, the bank concentration had positively affected the performance. Molyneux and Forbes (1995) found evidence to support traditional SCP from a study in European Banking. Lloyd-Williams, Molyneux and Thornton (1994) examined the applicability of the SCP and efficient market paradigm to analyze the Spanish banking structure using a three firms' concentration ratio and market share of an individual firm to represent firms' efficiency. The regression result indicated a positive relation between the concentration and the return on assets (proxy for performance), thus, supporting the SCP hypothesis for the Spanish banking industry.

Various studies have employed different methodologies to test SPC theory. Berger and Hannan's (1993) research framework provided a comprehensive methodology for testing potential relationships between market structure and performance under both SCP and efficient market hypotheses. They proposed to test four hypotheses: namely, the traditional SCP hypothesis, relative market hypothesis, X-efficiency hypothesis and scale-efficiency hypothesis. These hypotheses have been used to investigate whether market concentration affects performance or efficiency affects market concentration. Goldberg and Rai (1996) examined the structure-performance relationship of banks in European countries using the Berger and Hannan approach. Their study did not find a significant positive relationship between concentration and profitability. However, there was evidence in favor of the relative market hypothesis for all banks located in highly concentrated industries. Using a similar approach Fu and Heffernan (2005) examined market structure of Chinese banking market. Their results found evidence for the RMPH. Even though, Fu and Heffernan have found positive significant coefficient for efficiency variables, they were not able to find positive relationship between market share and efficiency which were one of the necessary conditions to achieve. Byeongyong and Weiss (2005) provided supportive evidence to ESH. They suggest that regulators should focus on measures which may affect to enhance the firms' efficiency rather than market power. Further to that, Yu and Neus (2005) found evidence to support a positive scale efficiency version of the ESH and SCH. These results suggest that firms can improve their performance by having an optimum scale of operation and enhancing the market concentration.

The SCP framework has been widely used in the literature to examine market structures. However, it does not account for other factors which influence firms' profitability and concentrations. Further, SCP studies ignore the long-run equilibrium in the market. Therefore, the evidence from market concentration studies may be insufficient to support firm conclusions about the relationship between market behavior and competition.

2. Methodology

To analyze the influence of market structure and efficiency on bank performance, this study uses similar framework to the empirical framework proposed by Berger and Hannan (1993).

2.1. Hypotheses. Berger and Hannan (1993) introduce a series of tests to incorporate efficiency and market structure variables directly into the reduced revenue equation to unveil the influence of market structure and efficiency on firm performance. They develop four hypotheses relying on traditional market structure paradigm and the efficient structure paradigms. The estimated coefficients of the reduced form revenue equation have been used to test the hypotheses.

H1: Structure-conduct-performance (SCP). Following the same theoretical basis which used the traditional SCP, this hypothesis predicts that the collusive behavior of dominating firms in the industry influences the price setting process in the market which allowed those firms to gain superior profit over the other firms. Accordingly, SCP predicts there is positive relationship between market concentration and firm performance. This hypothesis used concentration ratio to proxy collusive market power of dominating firms.

H2: Relative market power (RMP). Firms with relatively bigger market shares and differentiated product lines have a superior market power and use it to set market prices and, thereby, earn an above average profit. Therefore, market share and firm's performance might have a positive relationship.

The first two hypotheses test the influence of two market structure variables on firms' performance. The first one examines how the collusive behavior influences firm performance and the second one examines how individual firms are using their market power. To accept either of the hypotheses, the estimated coefficient should be positive and significantly different from zero.

The next two hypotheses examine the validity of the efficient structure paradigm. ESH argues both superior performance and high market share result in operational efficiency of individual decisions making units in the market. Accordingly, efficiency variables are incorporated as independent variables to the revenue equations. Consequently, these hypotheses predict that the influence of market structure on firm performance is insignificant and economically meaningless. Berger and Hannan proposed other two hypotheses to examine the relationship between firms' performance and efficiency.

H3: X-Efficiency (XEFF). Technically efficient firms which have superior management and/or production process are able to operate at a lower cost and subsequently gain high profits and market share. The high technical efficiency allowed respective firms to get a higher market share at the expenses of less efficient firms. Therefore, it is expected to have a positive relationship with profitability and the variables such as technical efficiency, market share and concentration.

H4: Scale-efficient firm (SEFF). This hypothesis predicts that the differences in performance among firms exist not because of differences in the

superiority of management and production approaches but because of the difference in level of economics of scale. It predicts, firms which are operating under an optimum scale produce goods and services at a relatively lower cost and are able to gain a high profit which leads to a high market share.

2.2. Empirical model. The following reduced form profit equation has been employed to determine which of the stated hypotheses best explained firms' performance. Coefficients for the unknown variables are to be estimated using simple linear regression approach.

$$p_i = \alpha + \beta_{con} CONC + \beta_{ms} MS + \beta_{EFF} TE + \beta_{SEFF} SE + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^7, \quad (1)$$

where p_i = measures of performance (profitability/net interest margin), β = estimated coefficient for concentration, market share, technical efficiency and scale efficiency, TE = technical efficiency, SE = scale efficiency, Z = vector representing the control variables, λ = estimated coefficient for control variables, MS = market share of the i^{th} bank, $CONC_i$ = concentration of the market which is measured using HHI, ε = random error, $I = i^{th}$ bank.

2.2.1. Testing SCP and RMP hypotheses. SCP and RMP hypotheses are used to test the relationship between market structure and conduct. These two hypotheses assume market power as the dominant variable in determining firm profitability. As explained before, collusive power of dominating firms sets the prices on the market and leads to high profits. If SCP holds, then the expected coefficient of Equation (1) for variables representing 'concentration' should be greater than zero with a positive sign. If RMP holds, the variable representing 'market share' should have a statistically significant positive coefficient. If either of these hypotheses remains in effect, other control variables including efficiency variables may have significant effect on profitability.

2.2.2. Testing ESH hypothesis. ESH states that cost advantage enjoyed by efficient firms leads them to have a higher profit than inefficient firms. Efficient firms pass cost advantages to their customers through adjusting prices which lead to have a higher market share. Therefore, it is expected to have following signs for estimated coefficient of Equation (1) if ESH holds.

TE>0, *SE>0*, *CON=0* and *MS=0.*

Since efficient firms are expected to have relatively low cost advantage leading to higher profit, a statistically significant positive relationship between firm performance and efficiency is assumed. One of the necessary conditions to hold the efficient structure hypothesis is the positive relationship between efficiency and market structure. Hence, parameter for the following functional forms is estimated.

$$MS_i = \alpha + \beta_{EFF} TE + \beta_{SEFF} SE + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^2. \quad (2)$$

$$CON_i = \alpha + \beta_{EFF} TE + \beta_{SEFF} SE + \sum_{i=1}^{n} \lambda_i Z_i + \varepsilon_i^3. \quad (3)$$

If the above models are able to provide a statistically positive coefficient for efficiency variables, it could be regarded as that the relationship between market structure and efficiency is unconditionally accepted.

2.2.3. Model variables. Regressions models used in this study have included ROA, market concentration (HHI), relative market share, technical efficiency and scale efficiency as main variables under study. We used market concentration and relative market share to proxy the market power for examining the influence of market structure on banks' performance. DEA estimated technical efficiency and scale efficiency scores are used to represent the banks efficiency. Other control variables are used to represent risk (loans to total assets), size (ln[total assets]), economic growth (GDP growth) and inflation. A dummy variable has been incorporated to proxy the impact of government ownership on banks' performance.

Different measures of performance have been used in prior studies in the area of market structure and firm performance. Gilbert (1984) revealed that both profitability indicators and price indicators have been applied in prior studies to proxy bank performance. Following prior studies (Goldberg, Lawrence G. and Anoop Rai, 1996; Smirlock, Michael, 1985; Yu, Peiyi and Werner Neus, 2005), this study used both profitability and net interest margin (NIM) to proxy banks' performance.

Previous studies have used ratio of profits to assets (i.e. the return on assets (ROA)) (Goldberg, Lawrence G. and Anoop Rai, 1996; Yu, Peiyi and Werner Neus, 2005) and the profits to equity ratio (i.e. the return on equity (ROE)) (Smirlock, Michael, 1985; Yu, Peiyi and Werner Neus, 2005) to represent banks performance. In principle, ROA reflects the ability of a bank's management to generate profits from the bank's assets, although it may be biased due to off-balance-sheet activities. ROE indicates the return to shareholders on their equity and equals ROA times the total assets-to-equity ratio. The latter is often referred to as the bank's equity multiplier, which measures financial leverage. Banks with lower leverage (higher equity) will generally report higher ROA, but lower ROE. Since an analysis of ROE disregards the greater risks associated with high

leverage and financial leverage is often determined by regulation, ROA emerges as the key ratio for the evaluation of bank profitability (Sundararajan, Vasudevan, Charles Enoch, Armida S. San Jose, Paul Louis Ceriel Hilbers, and Russell C. Moretti Krueger, Marina Slack, Graham L., 2002). Thus, we use ROA to proxy the banks' performance in this study.

We used NIM as an alternative measure of banks' performance which is directly linked to the market condition. NIM can be regarded as a direct measure of performance which may result in the market power of dominating firms as well as the residual of interest income resulted from efficient decision making of management. This study estimates NIM dividing net interest income (the difference between total interest income and interest expenses) by total asset.

We measure firms' efficiency (technical and scale) using data envelopment analysis (DEA)[1]. Previous studies which used DEA to estimate technical efficiency have been limited to the CCR[2] model formulated by Charnes, Cooper and Rhodes (1978) and the BCC model formulated by Banker, Charnes and Cooper (1984). Efficiency scores estimated using CCR and BCC models have been used for deriving Scale efficiency scores. The CCR model assumes constant return to scale and BCC relaxes this assumption by being based on the variables' returns to scale. CCR and BCC DEA formulations are applied to estimate the TE and PTE, respectively. Previous studies have employed an MPI like index[3] to decompose scale effect on a DMU's inefficiency. A firm's TE is a function of PTE and SE. Therefore, PTE should be separated from TE to identify SE (Coelli, Tim, D.S. Prasada Rao, and George E. Battese, 1998).

The DEA models' power of discriminating inefficient units from efficient units depends on the number of units under observation and the number of inputs and outputs in the model. Since this study is based on a relatively small sample, three-year moving windows are used to construct production frontiers for measuring efficiency (Charnes, Abraham, Williem W. Cooper, Arie Lewin, and Lawrence M. Seiford, 1997).

Efficiency measures how effectively banks use their inputs to produce a given level of output. Prior studies have used five approaches of input and output specification, namely intermediation, production, user-cost, value-added and assets (Avkiran, N.K., 2000). However, there is no apparent consensus in the literature concerning the most appropriate approach for defining banks' input and outputs. Based on intermediation approach (Sealey, C.W. and Jemes T. Lindley, 1977), this study identified interest expenses, personnel costs and premises and establishment expenses as banks' inputs and loans and other advances, interest income and other income as banks' outputs.

Since banks are multi-products firms, finding a single variable to represent the banking market is a difficult task. Total deposit held (Goldberg, Lawrence G. and Anoop Rai, 1996; Smirlock, Michael, 1985), total loans granted and total assets held are some of such variables that can be used as proxy for the market capacity. This study prefers to use total assets as a proxy for the size of market in banking industry since the total assets represented combine outcome of whole banking activities.

Previous studies have used Herfindahl-Hirshman index (HHI)[4] (Bikker, Jacob A. and Katharina Haaf, 2002; Byeongyong, Paul Choi and Mary A. Weiss, 2005; Goldberg, Lawrence G. and Anoop Rai, 1996; Molyneux, Phil, 1999; Yu, Peiyi and Werner Neus, 2005) and 'k' banks concentration ratio (CR_k)[5] to proxy the collusive power in a given market. CR_k takes the total market shares of the k^{th} largest banks in the market. Contemporary banking studies have given more preference to HHI as proxy of market concentration since, it considers the market shares of all firms in the market and 'k' bank concentration ratio takes into account only dominating banks' market shares. Accordingly, this study sticks into HHI as a better proxy for collusive power dominating in the banking market.

Together with previously specified variables, size, operational risk, ownership structure, GDP and inflation have been incorporated as other control variables. Following prior studies (Goldberg, Lawrence G. and Anoop Rai, 1996; Smirlock, Michael, 1985) bank's size is incorporated to represent bank's diversification ability. If large banks were able to capture significant cost advantages over small banks, banks size should be positively related to the profitability. To control the risk taking behavior of the profit seeking banks, loan to total

[1] Few reasons have influenced on selection of DEA as the preferred method for estimating efficiency in banks in Sri Lanka. They are: (1) non requirement of pre-specified functional form, (2) ability to incorporate a combination of input and output variables, and (3) its ability to measure the efficiency even using a small number of observations.

[2] Please, see the appendix for DEA model used in this paper.

[3] Technical efficiency (TE) is the product of pure technical efficiency (PTE) and the scale efficiency (SE). Thus, SE can be estimated by dividing the estimated efficiency scores of CCR (which measures TE) by the estimated efficiency scores of BCC (Coelli, Rao and Battese, 1998).

[4] HHI defines market shares as weights, and stresses the importance of larger banks by assigning them a greater weight than smaller banks. It accounts all banks and weights them according to their market share, thereby avoiding an arbitrary cut-off $HHI = \sum_{i=1}^{N} \left(\frac{v_i}{V} \right)^2$, N = number of firms, v_i = market share of i^{th} firm, V = total market share.

[5] 'k' bank concentration ratio indicates the percentage of a market or an industry accounted for by dominating firms.

assets ratio is included. Further, factors such as inflation and GDP growth rate may greatly influence the profit making opportunities in banking firms, these two variables are included to control general economic environment. Ownership structure of the banks may limit the decision making capabilities of banking institution especially in state-owned banks (Goldberg, Lawrence G. and Anoop Rai, 1996; Molyneux, Phil, 1999). Most previous studies have shown that privately owned banks have relatively more freedom to set firms' operational policies and procedures. Therefore, it is expected a positive influence of private ownership on firms profitability.

2.2.4. Data and samples. The information about all variables except banks' efficiency is gathered from an unbalanced panel data set spread over a sixteen-year cross section of time period from published financial statements of local commercial banks. Since the bank efficiency scores are estimated based on 3-year mowing windows, all data collected were adjusted accordingly.

3. Results and discussion

This section presents the findings of the empirical analysis. First, it reviews descriptive statistics and correlation coefficient of data related to variables used in the analysis. Next subsection presents the results of the analysis.

3.1. Descriptive statistics of test data. Table 1 and 2 summarize the descriptive data and Pearson correlation coefficient of test data. The standard deviation shows small statistical dispersion in data used for estimating equations. Recorded low standard deviations pointed out that the data points are not highly variable. Further, these statistics show that there are no outliers in the data set.

Table 1. Descriptive statistics of test data

Variable	Definition	Mean	Std. dev.
Profitability	Return on assets (ROA)	0.008	0.008
Net interest margin (NIM)	Interest expenses to interest income	0.037	0.011
Technical efficiency (TE)	CCR DEA estimated scores in first phase	0.931	0.090
Scale efficiency (SE)	BCC DEA estimated scores in first phase	0.945	0.079
Concentration ratio	HHRF Total assets	0.202	0.030
Market power	Total assets share in the market	0.112	0.104
Risk	Loan and advances to total assets	0.544	0.176
Size	Ln[Total assets]	0.149	1.472
GDP growth	National accounts	0.046	0.011
Inflation	Change in Colombo consumer price index	0.101	0.023
Ownership	A dummy variable (private banks = 0 and state banks = 1)		

The estimated correlation coefficients show that there is a very little correlation among variables included into the model. As explained by Gujarati (2003), if the pair-wise correlation coefficient between two regresses exceeds 0.8, a serious problem of multicollinearity will arise. Estimated pair-wise correlation coefficient for explanatory variables shows two such relationships between SE and TE, and ownership and market power. Existence of multicollinearity limits the explanatory power of the independent variable even if the regression has shown a high R^2 value. However, the reported regression results in Table 4 show a relatively high R^2 value with individually significant regression coefficients for the model variables. Gujarati (2003) states that 'in one situation multicollinearity may not pose a serious problem, when R^2 is high and the regression coefficients are individually significant as revealed by the higher *t* value'. Therefore, it is clear that there is no serious multicollinearity problem related to the model.

Table 2. Pearson correlation coefficient

Variables	Profitability	Technical efficiency	Scale efficiency	Concentration ratio	Market power	Owner-ship	Risk	Size	GDP	Inflation
Technical efficiency	0.439									
Scale efficiency	0.356	0.973								
Concentration ratio	0.256	0.163	0.114							
Market power	-0.060	-0.384	-0.469	.234						
Ownership	-0.229	-0.354	-0.413	0.153	0.884					
Risk	0.168	-0.069	-0.036	0.077	-0.351	-0.613				
Size	-0.059	-0.405	-0.477	0.109	0.759	0.645	-0.230			
GDP	0.332	0.040	0.020	0.574	0.131	0.085	-0.089	-0.030		
Inflation	0.279	0.158	0.129	0.639	0.158	0.104	-0.064	-0.101	0.226	
Interest margin	- 0.081	-0.132	-0.067	0.005	-0.137	0.140	0.311	-0.119	-0.077	-0.029

Table 3 exhibits the aggregated efficiency scores on different banking segments in Sri Lanka. Overall, the statistics shows that there is a very little variation in estimated efficiency scores. Further, the savings banking sector indicates relatively higher efficiency than the commercial banking sector. However, in this paper greater emphasis has been put on the nature of ownership. The estimated efficiency scores indicate that state-owned banks are less efficient than the private banks. Further, these results indicated that the inefficiency of state-sector has resulted in the excessive scale of operations.

Table 3. Descriptive statistics of estimated efficiency scores (1989-2004)

Form of DMUs (banks)	Technical efficiency	Pure technical efficiency	Scale efficiency
All	0.931 [0.090]	0.984 [0.026]	0.945 [0.079]
Commercial	0.922 [0.095]	0.981 [0.028]	0.939 [0.085]
Saving	0.973 [0.028]	0.996 [0.008]	0.978 [0.026]
State commercial	0.843 [0.135]	0.977 [0.037]	0.860 [0.118]
Private commercial	0.951 [0.051]	0.982 [0.023]	0.967 [0.042]
Old commercial	0.906 [0.117]	0.987 [0.028]	0.916 [0.103]
New commercial	0.940 [0.055]	0.974 [0.026]	0.964 [0.045]

3.2. Regression results. The main research question raised in this paper is whether market power which results from high market concentration and firms' relative market share or the firms' efficiency is important in determining overall firm performance. The first two regressions have used reduced-form-revenue equation to investigate factors influencing the banks performance. Both ROA and NIM based regressions have given similar evidence for the influence of market structure and efficiency on the firm's performance. The estimated coefficient for market power and concentration variables in both models were not statistically different from zero. Therefore, results found that neither market concentration nor market power have significant associations with banks' profitability and NIM. Therefore, this study rejects traditional MSH and concludes that neither collusive power enjoying by large banks nor high market power enjoying by individual banks have a significant influence on firm performance in banking industry in Sri Lanka.

The first regression provided statistically significant evidence that the main source of superior performance is the managerial efficiency and not the collusive power. Further, scale efficiency variables have shown a statistically significant negative relation with the performance by rejecting the scale-efficiency version of ESH. These empirical findings show that scale of operation is not a pre-condition to have superior performance. The second regression provided statistically significant evidence for associations of SE and TE with NIM. However, the sign of the estimated parameter of the TE is not similar to the predicted. Therefore, the evidence derived on the second model rejects the TE version of ESH. Further, the recorded negative sign implied that the managerially efficient banks are charging relatively small interest margin. Nevertheless, the statistically significant positive coefficient of SE fails to reject the SE version of ESH.

Equation (2) also rejects the SCP arguments having statistically insignificant coefficient for both variables which represent market structure. The results have supported the scale efficiency version of ESH. The regression result pointed out a statistically significant negative relationship between technical efficiency and NIM indicating that efficient banks charge lower net interest margin than less efficient banks. Furthermore, statistically significant positive coefficient identified for SE indicates that in relation to NIM, SE is the main determinant. It shows that scale efficient firms can gain higher NIM supporting the scale efficiency version of ESH which says firms in optimum scale produce goods and services at relatively lower cost.

Table 4. Estimated regression coefficient

Independent variables	Dependent variables			
	Profitability	Gross interest margin	Concentration	Market power
Technical efficiency	0.134*** [4.82]	-0.129*** [-2.53]	0.166 *** [2.23]	0.461*** [2.97]
Scale efficiency	-0.111*** [-3.44]	0.134 *** [2.28]	-0.159*** [-1.82]	-0.512*** [-2.82]
Concentration	-0.053 [-1.58]	0.102 [1.65]		
Market power	0.025 [1.51]	-0.045 [-1.51]		
Ownership	0.008*** [2.28]	-0.011 [-1.77]	-0.016 *** [-2.78]	-0.180 *** [-15.17]
Risk	0.005 [1.08]	0.028 *** [3.24]	0.021 [1.81]	0.141*** [5.75]
Size	0.001 [1.08]	0.000 [0.27]	-0.004*** [-2.44]	0.019*** [6.28]
GDP growth	0.257*** [4.26]	-0.128 [-1.16]	1.059 *** [7.64]	0.590*** [2.05]
Inflation	0.082*** [2.67]	-0.033 [-0.59]	0.550*** [7.93]	0.405*** [2.82]
Intercept	-0.039*** [-2.96]	0.012 [0.52]	0.123*** [3.57]	-0.051 [-0.71]
R-squared Adjusted R^2 S.E. of regression F-statistic	0.50 0.46 0.0058 11.929	0.202 0.140 0.011 3.243	0.64 0.62 0.0163 30.133	0.90 0.89 0.0339 149.672

Estimated parameters for equations (1) and (2) pointed at some interesting findings on the relationship of market power and concentration with ROA and NIM. The variable representing market power has shown a positive relationship with ROA and a negative relationship with NIM. These results predict the firms with high market power are capable to earn higher profit with the lowering interest

margin. On the other hand, the concentration variable indicated completely opposite relationships. Since, any of the estimated coefficients were not statistically different from zero, those findings were not able to make use of any conclusion.

The results of auxiliary regression which addresses the multicollinearity problem are not different from the original regression results. It indicates significant negative relationships of profitability with concentration and market power rejecting the both hypotheses. As explained in the ESH version of market structure hypotheses say that efficiency influences market share of the firm and concentration. Therefore, it is a necessary condition that technical efficiency should have a positive relationship with both market power and concentration. Testing two supplementary regressions has been run. The statistical evidence derived from two regressions has not given supportive evidence to reject the ESH. Further, both regressions have provided the conditional support for the existence of ESH in Sri Lankan banking market.

The coefficients of control variables seem to be mixed with the results of two regressions. The regression results pointed out that privately-owned banks have earned relatively higher profitability and lower interest margin than state-owned banks. It implies that privately-owned banks are in a better position of managing operational cost other than the interest expenses and subsequently earn higher profit than state-owned banks. Both regressions have exhibited positive sign for the estimated coefficient for variable represented operational risk. This variable measured the significance of the bank's lending portfolio in relation with the total assets. Keeping a large portion of assets on risk lending portfolio increases the riskiness of the operation. On the other hand, lowering this ratio may lead to reducing the total earnings assets of the firm. The regression results confirmed the positive relationship between risk and the bank's profitability indicating that incurring higher risk forces banks to earn superior profit. Keeping more assets on lending portfolio also may assist to earn high interest income lowering the investment in idle assets. Therefore, positive relationship between NIM and risk can be expected. The results provided statistically insignificant evidence to support the above relationship. The control variable used to incorporate size was not able to provide evidence for significant association with either variable.

GDP growth and inflation rate have been incorporated to the regression model to control the influence from macroeconomic environment. Results indicated that profitability has statistically significant positive relationships with GDP growth and rate of inflation. On the other hand, both variables were not able to provide statistical evidence to prove that, influences of variables are not significantly different from zero. The positive coefficient of inflation both with NIM corroborates that lower inflation has more pronounced downward effect on long-term interest rates leading to declining interest margin. Consequently, this result forces reduction in profitability.

4. Policy implication of empirical findings

On this phase, the effect of contemporary policy on bank concentration is addressed. It is believed that high market power and concentration improve the bank concentration. Policy makers predicted the high concentration together with few firms with large market share may help to reduce the unnecessary overhead cost in the industry. The both performance measures used clearly reject that either market share or concentration are directly related to the market share. The results show while profitability is positively related with the technical efficiency, it is negatively related with scale efficiency. Further, the results show the higher the technical efficiency bankers gained, the lower the NIM they charged. The results also evidence scale efficiency is the main factor influencing the banks interest margin. Gaining optimum scale banks can minimize the overhead cost and enjoyed higher NIM. Therefore, these results suggest policy makers to focus on policy reforms which enhance the banks efficiency.

Conclusion

This paper has examined main structural and performance features of banking industry in Sri Lanka. The study used four hypotheses proposed by Berger and Hannan (1997) and two performance measures, namely ROA (profitability) and NIM. Empirical results are not consistent with both market power hypothesis and structure-conduct-performance hypothesis. It is appeared that high market concentration with small number of large banks in the industry has intensified the competition. Confirming the major arguments raised by Molyneux (1999) against the profit-concentration relationship, this study totally rejects the traditional SCP hypothesis. However, the study's findings rejected Goldberg and Ra (1996)'s findings which showed significant profit-market power relationship. Empirical results pointed out that efficient operation of banking firms are vital for having higher profitability with better NIM.

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Appendix 1. Measures of efficiency

Data envelopment analysis

This paper utilizes data envelopment analysis (DEA) techniques (a non-parametric approach) to estimate efficiency in Sri Lankan banks[1]. Both the CCR model formulated by Charnes, Cooper and Rhodes (1978) and the BCC model formulated by Banker, Charnes and Cooper (1984) are used to estimate technical and scale efficiency of banks in Sri Lanka. The CCR model assumes constant return to scale and BCC relaxes this assumption by being based on the variables' returns to scale.

Basic CCR formulation (dual problem/envelopment form)

$$Min\ \theta$$

Subject to

$$\begin{aligned} \sum_j x_{ij}\lambda_j - \theta x_{ij_{i\tilde{i}}} &\le 0 \quad for\ i = 1,2,...m \\ \sum_j y_{rj}\lambda_j &\ge y_{rj_0}\ for\ r = 1,2,...k \\ \lambda_j &\ge 0, \end{aligned} \tag{1}$$

where, y_{rj} is the amount of r^{th} output produced by DMU 'j' using x_{ij} amount of I input. 'θ' denotes the CCR efficiency of DMU 'j'. Both y_{rj} and x_{ij} are exogenous variables and λ_j represents the intensity variables assigned to each DMU under observation. The solution to the above minimization problem determines the values of intensity of the variables. The first constraint of the above linear problem implies that the combination of the inputs of firms, such as banks, on the frontier must be less than or equal to the input of the firm 'j'. The second constraint restricts the observed output of firm 'j' is less than or equal to the linear combination of the output of firms in the frontier.

The original CCR model assumed that all DMUs under consideration were operating in an optimum scale. The BCC-DEA formulation relaxed the assumption of optimum scale. The CCR model estimated TE. BCC accommodates the scale effect by relaxing the constant return to scale in CCR by incorporating a third constraint to the efficiency evaluation model. Generally, it relies on the convex combination of the efficient units instead of the linear combination, as in the case of the CCR. The efficiency estimation of these two models can be used to identify the three components of efficiency: technical, pure technical (PTE) and scale efficiency. The BCC-DEA formulation is given below.

Basic BCC formulation (dual problem/envelopment form)

$$Min\ z_0 = \quad \theta_{PTE}$$

Subject to

$$\begin{aligned} \sum_j x_{ij}\lambda_j - \theta x_{ij_{i\tilde{i}}} &\le 0 \quad for\ i = 1,2,...m \\ \sum_j y_{rj}\lambda_j &\ge y_{rj_0}\ for\ r = 1,2,...k \\ \sum \lambda_j &= 1 \\ \lambda_j &\ge 0. \end{aligned} \tag{4.1.5}$$

The DEAs' power of discriminating inefficient units from efficient units depends on number of units under observation and the number of inputs and outputs of the model. Since this study is based on a relatively small sample, viz., three year moving windows (Charnes, Abraham, Williem W. Cooper, Arie Lewin, and Lawrence M. Seiford, 1994) are used to construct production frontiers for measuring efficiency, following the previous similar studies (Asmild, Mette, Joseph C. Paradi, Vanita Aggarwall, and Claire Schaffnit, 2004).

CCR and BCC DEA formulations are applied to estimate TE and PTE, respectively. Previous studies have employed an MPI like index to decompose scale effect on a DMU's inefficiency. A firm's TE is a function of PTE and SE. Therefore, PTE should be separated from TE to identify SE (Coelli, Tim, D.S. Prasada Rao, and George E. Battese, 1998).

$$TE_{CCR} = PTE_{BCC} \times SE, \tag{4.2.1}$$

$$SE = TE_{CCR} \div PTE_{BCC}, \tag{4.2.2}$$

[1] Few reasons influenced on selecting DEA as the preferred method for estimating efficiency in banks in Sri Lanka. They are (1) non requirement of pre-specified functional form, (2) ability to incorporate a combination of input and output variables, and (3) its ability to measure the efficiency even using a small number of observations.

where TE_{CCR} = technical efficiency; PTE_{BCC} = pure technical efficiency; SE = scale efficiency.

This study estimated SE for each DMU based on the estimated efficiency in the BCC and CCR models. This helped to identify effectiveness of existing scales of operation in the Sri Lankan banks.