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Research article

Rethinking the nexus between competition and efficiency in emerging economies: Evidence from Sri Lankan banking sector

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Abstract

This study provides new and rather scarce evidence of effects of bank competition on banking sector efficiency in an emerging economy during the period 1996-2010. Using bank level accounting data and applying Panzar-Rosse approach the study finds that Sri Lankan banking market is moderately competitive. Further, by using non parametric (DEA) approach study revealed a moderate level efficiency of Sri Lankan banking sector. The econometric analysis carried out in this paper provides evidence for a U shape relationship between bank competition and efficiency. The moderate level of efficiency of the banking sector is attributed to the moderate level of competition in Sri Lankan banking industry. Moreover, the results of the analysis confirm the long run positive effect of competition on efficiency in the banking sector.

Keywords: Bank competitioin; efficiency; data envelopement analysis; h-statistics; Sri Lankan banking scetor

JEL Code: G 21, L1, G14

Introduction

For many sectors competition is good, as it increases efficiency, lowers prices, and enhances choice and innovation. In other words, in a competitive market setting, there is allocative and productive efficiency as well as dynamic efficiency. As in other industries, competition in the banking industry is also needed for efficiency and

maximization of social welfare. Banks as a service industry contribute to economic development by providing financial means need to other industries to produce goods and services. Thus competition in the banking industry helps economic growth by promoting capital accumulation.

One of the most important economic dimensions for ensuring the success of a company or an industry is the efficiency with which it uses its resources. As the first order effect, competitiveness in the banking sector expects to improve the efficiency. However, substantial convergence of recent research interest witnesses an opening debate on the economic role of bank competition. It was common wisdom that increased competition in an industry improves the welfare of the economy for which banks were not exceptions. Therefore, traditionally we believe that banks with monopoly power charge higher interest rates on firms and individuals when providing loans while exercising their monopoly power to attract deposits by paying lower interest rates. The higher rates on one hand cause the banks to be less motivated to screening quality of lenders. On the other hand, the higher costs of finance restrain the businesses from new investment thus slowing down the firms' technological innovation and productivity growth (Cetorelli and Gambera, 2001). Ultimately this would further adversely affect the overall economic growth due to the lower rate of capital accumulation associated with higher interest rates. Therefore, whether the competitive forces should be restrained or not had been a debate in the bank competition literature. The theoretical background of the debate can be illustrated with most common arguments used to identify positive and negative economic effects of bank competition. There are two groups of baseline theories underpinning the effects of bank competition on economic activities; Industrial Organizational Theory and Asymmetric Information based Theories.

Industrial Organization theories holds the view that greater bank competition affects the equilibrium price and quantity of loans as the number of banks competing in a market increases. The second group of theories explicitly incorporates asymmetric information between borrowers and banks to discuss the effects of bank competition. These theories show that bank competition may reduce the supply of credit to opaque borrowers by worsening adverse selection, moral hazard, and holdup problems and thus affecting the efficiency of financial intermediation.

This paper aims to investigate the dynamics of both competition and efficiency in Sri Lankan banking markets during the period 1996-2010. Using bank level accounting data for commercial banking sector, this paper aims to shed some light on the recent developments in bank Competition by using a non structural, Panzar Rosse approach. The study also tests the bank specific efficiency levels by using non parametric (DEA) approach. Finally, the present paper tests econometrically, how the efficiency of the banking sector is affected by the level of competition in the banking sector in the context of Sri Lanka. To achieve this objective the study will investigate the effect of bank competition by regressing bank efficiency, the dependent variable, on the measure of bank market competition i.e. and a set of control variables

Commercial Banking in Sri Lanka

The banking sector in Sri Lanka, which comprises Licensed Commercial Banks (LCBs) and Licensed Specialized Banks (LSBs), dominates the financial system.[1] In terms of the asset base and the magnitude of services provided, the LCBs are the single most important category of financial institutions[2] within the banking sector. As at end September 2010, the LCBs dominated the financial system with a market share of 43.8% of the entire financial system's assets and 83.5% of the banking sector's assets. Therefore, the health of the financial system depends to a large extent on the soundness of the LCBs (Sri Lanka Financial System Stability Review, 2010). As at end-December 2010, the banking sector comprised 22 LCBs and 9 LSBs. As stated in Financial System Stability Review (FSSR) reports, even though a large number of licensed banks exist in the country, the stability of the financial

[1] The financial system of Sri Lanka consists of four main components. They are financial institutions, financial markets, financial infrastructure and the financial regulatory framework.

[2] The financial institutions includes the Central Bank of Sri Lanka (CBSL), Licensed Commercial Banks (LCBs), Licensed Specialised Banks (LSBs), Registered Finance Companies (RFCs), Specialized Leasing Companies (SLCs), Primary Dealers (PDs), pension and provident funds, insurance companies, rural banks, merchant banks, unit trusts and thrift and credit co-operative societies.

system is primarily dependent on the performance and financial strength of the six largest LCBs[3] of which two are state commercial banks. These six banks, which are generally, referred to as the Systemically Important Banks (SIBs), represented 78% of the LCB sector assets and 65% of the banking sector assets. In terms of deposits, the SIBs held a market share of 83% and 68% of LCB sector and banking sector deposits, respectively. (FSSR, 2008).

The financial sector in Sri Lanka, reflecting a broad range of reforms introduced since early 1990s, includes most of the institutional elements of a modern financial system. The banks are active in virtually all aspects of financial services, with most having subsidiaries or affiliates engaged in insurance and capital markets activities. The key to financial sector development in Sri Lanka is continuation of the broad thrust of reforms begun in the 1990s to strengthen the government infrastructure and institutional framework, while decreasing direct government intervention. Significant progress in the banking sector has been made, and considerable technical assistance[4] has been provided by the international community (Central Bank of Sri Lanka Annual Reports, various issues).

The financial services industry in Sri Lanka has been subjected to changes due to the reform measures introduced by the government including Central Bank and the industry. More recently, it seems that competition has also started to come from foreign sources. Changes in the national and international market environments, pressure applied by international organizations such as the International Monetary Fund (IMF) and the World Bank to relax controls and the introduction of new technologies, have made the financial sector more competitive and efficient.

Literature Review

As financial intermediaries, banks maximize allocative efficiency with both the quantity of credit supply as well as their efficient allocation. Traditional Industrial Organization theory depicts that a competitive industry is characterized by a large number of small banks and the potential benefits are similar to those of competition in other industries. Subsequent empirical studies after Klein (1971) confirm the positive effect of bank competition (Guzman 2000, Beck et al, 2003, Demetriades et al, 2008). Guzman (2000) compares two identical economies, one with a monopolistic bank and the other with a competitive banking sector. He shows that, a banking monopoly is more likely to result in credit rationing than a competitive banking market, hence leads to a lower capital accumulation rate. In particular, Beck et al (2003)`s study confirms that credit rationing occurs more often in concentrated banking systems. Using a large cross section of countries Claessens & Laeven, (2003) further confirm that they find no support for the view that market power is good for access to financing. The findings suggest that the degree of competition is an important aspect of financial sector development.

Some empirical evidence finds very strong effect of bank competition on real economic activities. Specially, Smith (1998) uses an equilibrium model to study the costs in terms of macroeconomic performance of imperfect competition in banking. His study reveals that increased bank competition raises the level of income and reduces the severity of business cycles. Moreover his conclusion is very strong and is worth quoting here. "…. the quantitative effect on macro-economic performance of less competition in banking can be large; for instance, an imperfectly competitive banking system can produce a worse macroeconomic outcome than if the economy had no banks." This also provides strong evidence of the allocative efficiency of bank comeptition.

In terms of productive efficiency (cost efficiency) in bank competition, traditional industrial organization approach posits that productive efficiency is obtained in perfect competition since outputs are produced at minimum cost. This will happen only if there are no economies of scale in the banking sector. Hannan (1991) argues that borrowers in markets with higher concentration ratios pay higher interest rates for loans. Moreover, borrowers may also experience more difficulty obtaining access to credit. Loan and deposit rates in a banking market are studied by

[3] The six SIBs are; Bank of Ceylon, Peoples' Bank (state banks) and Hatton National Bank, Sampath Bank, Seylan Bank and The Commercial bank.

[4] On the areas of tax administration and policy, banking and central bank legislation, banking supervision, monetary policy instruments, foreign exchange dealings etc.

Besanko and Thakor (1992) and found that loan rates decrease and deposit rates increase as more banks are added to the market. With respect to the level of bank interest rates, Maudos and Guevara (2004) show that an increase in banks' market power (i.e. a reduction in competitive pressure) results in higher net interest margins.

Leuvensteijn *et al* (2008) extends the existing empirical literature and analyze the effects of loan market competition on bank interest rates on loans and deposits, measuring competition by the Boone indicator. Their results show that, in the euro area countries, bank interest rate spreads on mortgage loans, consumer loans and short-term loans to enterprises are significantly lower in more competitive markets. This result implies that bank loan rates tend to be lower under heavier competition, thus improving social welfare. Further, banks compensate for stronger loan market competition by lowering their deposit rates. These results show that stronger loan market competition reduces bank loan rates while changes in market rates are transmitted more rapidly to bank rates.

Dynamic efficiency refers to efficiency over time. It is therefore necessary for firms to constantly introduce new technology, processes and products and reduce costs over time to be dynamically efficient. In this regard, Wonglimpiyarat (2005) study analyses the strategic move and the adoption of technology alongside the progress of the banking economy by focusing on the five major commercial banks in Thailand. The results show that the changes of technological innovation in the banking sector of Thailand is not revolutionary but evolutionary. This is the result of the rivalry between firms to increase market shares. Thus, competition may have the desirable effect of stimulating technological research and development in turn affecting dynamic efficiency.

All these findings underline the fact that competitiveness in the banking sector enhances social welfare through improved allocative, productive and dynamic efficiency. Some recent studies have identified that information asymmetries between borrowers and lenders play a crucial role in the banking sector. However, this effect has totally being neglected in traditional theories. Empirical literature on this strand is particularly scares. However, a few studies provide evidence for information based hypothesis on bank market competition and question about the positive implications of bank competition. Empirical research attempts to detect the effects of bank competition on lending to different groups of borrowers, and in particular, to privately held firms. Privately held firms are usually smaller than publicly held firms, and are characterized by larger informational asymmetries and greater dependence on bank financing for their investments. Allocative efficiency of bank competition can be reached when the supply of credit is provided to the most productive projects first. Supporting the Peterson and Rajan (1995) argument, Shaffer (1998), cited earlier, also finds evidence of higher loan charge-off rates in Metropolitan Statistical areas with a higher number of banks. He further shows that the average quality of a bank`s pool of borrowers declines as the number of competitors in the market increases. Zarutskie (2005) examines the impact of bank competition on the borrowing and investment of a large sample of privately held firms in the U.S. His findings reveal that newly formed firms, i.e., those likely characterized by the largest informational asymmetries, have significantly less outside debt on their balance sheets in the more competitive banking markets following deregulation. These firms substitute more contributed equity capital for outside debt, although they are not enough to invest as they would have in less competitive banking markets.

Certain studies have analyzed the adverse selection problem in credit market due to information asymmetries between the bank and the borrowers. Gehrig (1998) who argues that increased competition may make adverse selection problems more severe when customers that have been rejected at one bank can apply for loans at other banking institutions. This view is supported by Malkonen and Vesala (2006) who examine the adverse selection problem in an imperfectly competitive banking system and the relationship between the degree of bank competition and credit rationing. They show that the borrowers are heterogeneous in their preferences concerning the banks. Separation obtains in market segments where the 'high risk' borrowers receive credit from their preferred bank. The 'low risk' borrowers choose the ex-ante less-preferred bank that offers loan contracts with lower interest rates.

Few studies have analyzed the relationship between bank competition and lending relationships. Banks engage in both transactional and relationship lending. The banks with more market power are willing to engage in relationship lending. Degryse and Cayseele (2000) study a comprehensive sample of lending relationships of large Belgian banks and report not only that interest rate increases with the length of the relationships but that this effect depends on the

scope and intensity of the relationship. More recently, Degryse and Ongena (2008) survey empirical findings from different countries and report that both the magnitude and the direction of the effect of the number of banks on interest rates change across countries. Moreover, Bonfim et al (2009) provides new evidence on the effect of bank competition on the cost of lending, in an environment of reduced information asymmetries between firms and banks. Using a unique data set from Portugal, they find that when a firm borrows from one additional bank, the interest rate on bank loans for this firm becomes 9 to 20 basis points lower on average. In addition, we find that when local bank competition is more intense firms can benefit more from simultaneously engaging in several banking relationships. However their study does not find this relationship for the smallest and youngest firms again raising the question about the information asymmetries.

Data and the econometric model

This paper employs a new empirical industrial organization approach to assess whether any deviations in Sri Lankan banks' efficiency can be attributed to bank competition. Following Martinez-Miera and Repullo (2008), non linearity between competition and efficiency in banking is allowed in this study. Specifically, the Generalized Least Squares (GLS) model of the study is developed as follows:

$$Efficiency_{it} = f(Competition_t, Competition_t^{\,2}, Business Environment_{it}) \text{-------} Equation(1)$$

The major decision variable of the equation is H statistics and squared value of H statistics. Previous studies done in the context of developing countries have found that competition enhances efficiency in the banking sector (e.g. Buchs and Mathesen (2005) in Ghana, Poshakwale and Qan (2011) in Turkey, Mlambo and Ncube, (2011) in South Africa.) Since Sri Lanka also belongs to the group of under developed countries, and with quite similar economic background, it is possible to expect a positive relationship between bank competition and efficiency. However, Sri Lankan financial sector characterized by lack of financial infrastructure needed for a higher level competition, therefore the consequent net results of competition on efficiency would be mixed. Hence, the present study forecast competition increases efficiency at lower competition and decreases at higher level of competition. This particular relationship would be the shape of inverted U.

In selecting efficiency correlates, the present paper formed three groups of variables that are assumed to be associated with bank efficiency. They are; Individual bank level characteristics, variables explaining the industry level differences and macro level variables. Under individual bank characteristics the *size of the bank, relative market share of the bank and bank level operational risk ratio* were used.

The study expects that a bank's market share is positively related to efficiency, because banks with a larger market power relative to their relevant market can charge higher prices for their services (Berger and Mester, 1997). Following prior studies (Goldberg and Rai, 1996; Schaeck and Cihak, 2008) 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 profitability. In measuring the size, there are different variables such as the total loans held by the bank, total deposits held by the bank, which have been used in previous studies. This study prefers to use total assets as a proxy for the size of market in banking industry since the total assets represented the combined outcome of all banking activities. In addition to them, risk taking behaviour of efficiency seeking bank is also controlled in the GLS regression.

$$Eff_{it} = \alpha_{it} + \beta_1 H_t + \beta_2 H_t^{\,2} + \beta_3 MS_{it} + \beta_4 L/TA_{it} + \beta_5 Eff_{it} + \beta_6 BInter_t + \beta_7 CrPvt_t + \beta_8 TAgr_t + \beta_9 GDP_t + \beta_{10} Inf_t \text{ ----------} Equation(1a)$$

The study intended to incorporate the industry differences across time, as such variables are crucial in identifying efficiency differences in banks. The banks are said to be more efficient when more credit is allocated to the private sector. This happens as banking sector resources are allocated in various sectors in an economy. Thus, the amount of credit to private sector is also controlled in the regression. The intermediation ratio, defined as a loans-to-deposit

ratio, reveals the intermediation activity of banks and is therefore expected to be associated with the cost efficiency of the banking firm. The model further includes the assets growth of the banking sector as it is an informative indicator of overall banking sector development. Periods where larger growth rate should on average have higher efficiency of banking operations, and vice versa.

Among the macro economic variables studies usually use variables, that reflect the income differences and general characteristics such as stability of the economy. The most commonly used macroeconomic indicator is GDP growth rate or GDP per capita of the country. The expected outcome is a positive relationship of a country's general level of development with the level of bank efficiency. However the results of previous studies are mixed. The proxy used in the present study is GDP per capita to assess this expectation in the Sri Lankan context. In addition to asses any effect on macro level stability, the inflation rate was also used.

The equation was estimated as a panel data regression with bank specific fixed effects. Assuming the correlation of a time series with its own past and future values in bank revenues, following Ordinary Least Squares (OLS) to estimate the revenue model, seems to be problematic. Thus, in estimating the equation, the study followed an Estimated Generalized Least-Squares (EGLS) procedure instead of applying the method OLS because estimators of the former are more efficient with a large sample. In the EGLS procedure, the estimation was done with the cross section weights, which correct the presence of cross-section heteroskedasticity.

Since the purpose of the study is to investigate how efficient bank competition is both accounting data and macro level data were employed. In terms of bank types, the study considers only commercial banks and excluded saving banks from the sample. The study uses an extensive bank level set of panel data and macro data for the 15 years starting from1996. The sample covers 22 commercial banks.

Measuring bank competition

Panzar and Rosse (1987) define a measure of competition, the *H* as the sum of the elasticities of the reduced-form revenue function with respect to factor prices. According to them, this statistic can reflect both the structure and the conduct of the market to which the firm belongs; it represents the percentage variation of the equilibrium revenue derived from the unit percent increase in price of all factors used by the firm.

The Panzar-Rosse (P-R) revenue test is based on a reduced-form equation relating gross revenue to a vector of input prices and other control variables. The study estimates the PR model using the following, reduced form revenue equation. Assuming an *n*-input single-output production function, the empirical reduced-form equation of the P-R model is written as

$$\log TR = \alpha + \sum_{i=1}^{n} \beta_i \log W_i + \sum_{J} \lambda_J \log CF_j + e ------ Equation(2)$$

Where TR denotes total interest revenue, W_i the *i*-th input factor, and CF other firm-specific control factors. Panzar and Rosse (1987) show that the sum of input price elasticities, $H = \sum_{i=1}^{n} \beta_i$ reflects the competitive structure of the market. In this study, banks are considered as employing three factor inputs namely labour, funds, and capital.

The above econometric model also includes a set of exogenous and bank-specific variables that may shift the revenue schedule. Accordingly, the equation (1) can be rewritten as;

$$\log TR_{it} = \alpha + \beta_1 \log IPL_{it} + \beta_2 \log IPF_{it} + \beta_3 \log IPC_{it} + \lambda_1 \log TA_{it} + \lambda_2 \log NPL_{it} + \lambda_3 DV + \lambda_3 BR + e_{it} ---------- (Equation\ \ 2a)$$

Where *Rit* is the ratio of gross interest revenue to total assets (proxy for output price of loans), I*PLit* is the ratio of personnel expenses to total assets (proxy for input price of labor), I*PFit* is the ratio of interest expenses to total deposits (proxy for input price of deposits), and I*PC it* is the ratio of other operating and administrative expenses to

total assets (proxy for input price of equipment/fixed capital). Equation (2) also includes a set of exogenous and bank-specific variables that may shift the revenue schedule. Specifically, TA*it* (total assets) of the bank was incorporated to control for potential effects of size on interest revenue. Another control variable is NPL. If the non-performing loans are kept existing and continuously rolled over, the resources are locked up and banks' ability to earn interest would be low. Assuming this effect on interest revenue of the bank, NPL was incorporated in the model as a control variable. The definition of NPL*it* o of this study is, the ratio of non-performing loans to gross loans of the bank. The ratio of the number of branches of a bank to the total number of branches (*BR*) represents another useful proxy for evaluating the effect of bank size on revenues, thus identifying possible scale economies. Its sign will be positive or negative depending on whether differences between the banks, driven by their branch networks, lead to higher or lower revenues. This variable is particularly useful in the Sri Lankan context because banks, especially state-owned banks, have large branch networks. All of these variables are in logs, with the coefficients representing their respective elasticities. In addition, a dummy variables (DV) was included for foreign-owned banks.

Measuring efficiency

There are various approaches to measure bank efficiency. They include interest spread, minimum reserves held by the bank, productivity per employee or employee hour, monetary aggregates such as private credit to GDP and some accounting ratios such as return on assets or return on investment. All these approaches address only one aspect of efficiency. The problem associated with these traditional methods is that the relative comparison of banks with other banks and with other bank industries.

In analyzing banking firms, it is often important to measure their performance relative to other banks in the industry. With the rapid evolution of frontier efficiency methodologies, the conventional methods are rapidly becoming obsolete. Frontier methodologies measure firm performance relative to "best practice" frontiers consisting of other firms in the industry. They summarize firm performance in a single statistic (for a given type of efficiency) that controls for differences among firms in a sophisticated multidimensional framework that has its roots in economic theory (Cummins & Weiss, 1999).

Basically there are two types of frontier methodologies; parametric (econometric) methodology and non parametric (mathematical programming) methodology. Econometric methodologies include approaches such as Stochastic Frontier Approach (SFA) and Distribution Free Approach (DFA). These approaches require the specification of a production, cost, revenue, or profit function. The primary advantage of the econometric approach is that it allows firms to separate the error term in to random error as well as inefficiency. This will also creates problems in the specification of the functional form or error term(s). The non parametric approach avoids this type of specification error as it does not have any assumption on the error term and does not separate out the error term as random error or bad luck. Instead, any departure from the frontier is measured as inefficiency. The non-parametric approach does not require a production function to calculate the efficiency. It attempts to determine the efficiency of the firm against some imposed benchmark through mathematical programming. Data Envelopment Analysis (DEA) is the most popular non-parametric approach to determine the level of efficiency. Further, DEA allows performing analysis with small samples. Since the mid-1980s, DEA has been receiving importance as a technique for measuring efficiency of commercial banks in several countries. Due to these reasons, this paper uses DEA to derive efficiency scores for Sri Lankan commercial banks. It was developed by Charnes, Cooper and Rhodes (1978), in order to measure relative efficiency without knowing (a priori) what variables are more important, or what the relationship among them is. The fundamental concept of DEA is to compare each commercial bank with the best bank. The best commercial bank will be assigned the efficiency score of 1 while the others are in between 0 and 1.

There are two different DEA approaches in estimating efficiency in banks. They are; operating approach – a perspective of cost/revenue (labour, material and machinery to produce number of savings and loan accounts) management and intermediation approach taking banks as entities which use labour and capital to transform deposits in to loans and securities. This paper uses intermediation approach as it is more mechanical with respect to banks. Currently, there is no consensus about the input and output variables of DEA. From the available data the model

uses two inputs; interest expenses and non interest expenses and two outputs; interest income and non-interest income are used.

Charnes, Cooper and Rhodes (CCR, 1978) propose a DEA model that assigns an efficiency score to each unit by comparing the efficiency score of each unit with that of its peers. The formulation of the model is represented below.

Maximize $$E_{ks} = \frac{\sum_{y} O_{sy} V_{ky}}{\sum_{x} I_{sx} U_{kx}} ------ Equation(3)$$

Subject to $E_{ks} \leq \forall$ *firm s*

$$U_{kx}, V_{ky} \geq 0$$

where E_{ks} is the efficiency score of firm *s*, using the weights of test firm *k*, O_{sy} is the value of output *y* for firm *s*; V_{ky} is the weight assigned to firm *k* for output *y*; I_{sx} is the value for input x of firm s; and U_{kx} is the weight assigned to firm *k* for input *x*.

Empirical findings

The level of bank competition in Sri Lanka

As the results of the estimated reduced form revenue equation 2a, the estimated *H* statistic is 0.55 for the sample period. This value does not lend support for a perfectly competitive banking market in Sri Lanka, as the estimated *H* statistic significantly differs from 1. This value is also significantly non-negative (closer to zero), thus offers no evidence for a monopoly in the banking market. The results suggest that for the observed period, the Sri Lankan banking sector is characterized by monopolistic competition according to the PR classification. This indicates that an increase in input prices will lead to a less than proportional increase in revenues, as the demand for banking facing individual banks is inelastic. As this value is in the range between 0.5 and 1, the estimated *H* statistic supports evidence for a moderately competitive market in the Sri Lankan banking industry. The *H* statistic estimates over the stages move around 0.49 to 0.67 between 1996 and 2010 and do not have a persistent upward or downward trend. Rather it shows cyclical movements along the sample period. This particular pattern of competition in Sri Lankan banking industry can be further illustrated by using figure 1.

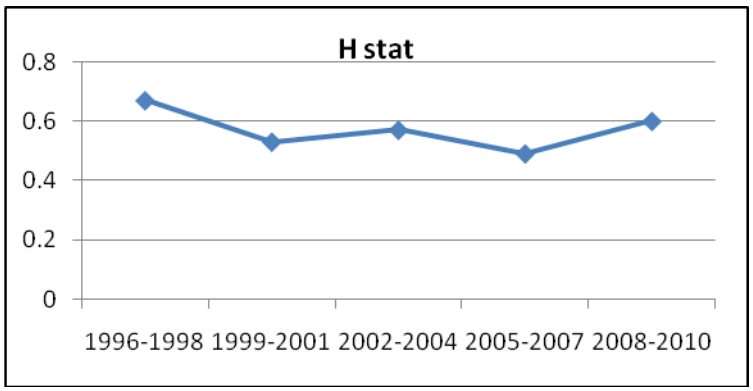

Figure 1. Trends in observed competition measure of Sri Lankan banks 1996-2010

The first stage exhibits the highest level (0.67), but declines during the second stage (0.53) and rises to an intermediate position during the third phase (0.57). The H statistic reaches its minimum in the fourth stage, noteworthinly, the H-statistic rises to an intermediate position (0.6) during the last stage. Several striking features of the estimation outcome should be highlighted. First, according to the estimated annual H statistics, the degree of

bank competition during the periods 1999 to 2001 and 2005 to 2007 had been low compared to the rest of the years, stating that the changes in bank input prices are not sufficient to explain the changes in bank revenue during the said periods. This indicates that changing input prices had minimal effect on bank revenue undermining competition during these two periods. Second, striking feature is that neither the size of the bank nor the credit risk are responsible for the changes in the degree of bank competition in the country during the sample period except in 2005-2007 period. The larger banks tend to earn more interest revenue restraining competition during the years 2005 to 2007. However, this effect is very small in statistical terms and explained only 8% of change in interest revenue. None of the other control variables included in the model, shows any kind of relation to bank revenue changes over time and thus to the competition of the banking sector. These findings suggest that the competitive condition in the banking sector is affected by some factors other than the elasticity of bank input prices. Thirdly, from among different stages of H statistics, price of loanable funds contribute significantly explaining degree of competition during sample horizon. Price of labour is the second most important factor while the contribution of price of capital is least significant.

The level of banking sector efficiency

The efficiency scores of the individual banks for the period were calculated by using DEA technique by using the variables discussed above. For that, Equation 3 was used. Accordingly, the average efficiency score for the Sri Lankan commercial banking sector is calculated as 0.51 for the sample period. This score is an indication of moderate level efficiency of Sri Lankan commercial banking sector.

In order to get a comparative picture about the efficiency scores of Sri Lankan commercial banking sector, the efficiency scores of other countries were also used subject to the availability. In most of the developed and developing countries the efficiency scores are higher than that of Sri Lankan banking sector. To state a few, it had been in the range of 0.91 and 0.97 for Thailand (sample size comprised 13 banks and sample period was 2003-2006) (Chansarn, 2008), and 0.63 for China (sample size comprised 16 banks and sample period was 2002)(Wang and Huang, 2004). According to the study done by Casu and Girardone (2008), the efficiency scores calculated for Germany was 0.88, for Italy 0.69 and for United Kingdom 0.75 (sample period 1997-2003 and sample size covers 14% of the population). Most of the studies have taken only a selected number of banks, perhaps only the systemically important banks, when calculating efficiency scores with DEA. The lower level of efficiency scores of Sri Lankan commercial banking sector could be justified with the data coverage of the present study. The present study covers all the commercial banks operating in the country irrespective of the level of their efficiency. Under DEA, efficiency scores are measured relative to "best practice" frontiers consisting of other firms in the industry. Thus, it is not a surprise to get lower efficiency scores for the Sri Lankan commercial banking sector as large deviations are obvious among individual banks.

Observations of the level of bank efficiency

The annual efficiency scores were also analysed to see any deviations over the sample period. The annual results for each DEA model are summarized in Table 1. The analysis of the annual averages of efficiency scores reveals dynamic over the sample period. The score lies in range of 0.32 and 1, indicating the lowest efficiency year of the commercial banking sector as year 2000. By looking at the column reporting the minimum values of efficiency scores shows some values with very low efficiency scores such as 0.04. This reveals that in certain years some banks had been highly inefficient.

Table 1. Efficiency Scores under DEA 1996-2010

	Mean	Maximum	Minimum	St Dev	No of obs
1996	0.52	1	0.12	0.26	21
1997	0.46	1	0.11	0.29	21
1998	0.5	1	0.16	0.25	21
1999	0.34	1	0.04	0.3	21
2000	0.32	1	0.08	0.26	21
2001	0.43	1	0.06	0.27	21
2002	0.49	1	0.16	0.24	21
2003	0.63	1	0.08	0.24	21
2004	0.57	1	0.26	0.21	21
2005	0.8	1	0.44	0.16	21
2006	0.73	1	0.34	0.17	21
2007	0.56	1	0.32	0.19	21
2008	0.41	1	0.15	0.26	21
2009	0.44	1	0.05	0.27	21
2010	0.47	1	0.18	0.24	21

Source: Calculations by the author

The average efficiency scores shows a declining trend in the first 5 years of the sample period and gradual increase thereafter, until it reaches its highest in year 2005 at a score of 0.8. However, this increasing efficiency again started to decline after year 2007. A careful analysis of the relationship between mean efficiency scores and their standard deviation reveals that in highly efficient years the standard deviations are lower and in lower efficiency years the standard deviations are higher. This suggests that higher efficiency scores reported above represents majority of individual banks, whereas the lower efficiency scored represent fewer individual banks.

Effect of bank competition on efficiency

The equation 1a is solved as non-linear regression analysis in order to assess the effect of bank competition on bank efficiency. Despite competition measure the regression model used a number of control variables. However, *MS*, *BInter* and *Ta gr* and *GDP* variables were excluded from the model as the multicolliniarity effect of those variables on the model is estimated as very high (VIF values of these variables are very high). The correlation between *H* and *H2* had been ignored, since this comes due to the nature of non-linearity of the model. The Equation was then estimated with fixed effect panel regression analysis. Because it is possible that unobservable bank characteristics are correlated with the bank efficiency levels; for example, the decision making capacity of bank managers and/or effects of advertising. In this case, an OLS estimation with a constant of the above equation would produce biased parameters. Therefore bank specific fixed effects were included in the model instead of constant. There is a significant degree of persistence in the efficiency variable, since the average value of the first-order autocorrelation is 0.96. Hence, the lagged dependent variable was included as an explanatory variable. Assuming the correlation of a time series with its own past and future values in bank revenues, following Ordinary Least Squires (OLS) to estimate the revenue model seems to be problematic. Thus, in estimating the equation, the study followed an Estimated Generalized Least-Squares (EGLS) procedure instead of applying the method of (OLS) because estimators of the former are more efficient with a large sample. In the EGLS procedure, the estimation was done with the cross section weights which correct for the presence of cross-section heteroskedasticity.

In the initial regression analysis coefficients of both *TA* and *L/TA* found as statistically insignificant. This says that the size of the bank and operational risk have no effect on the efficiency level of banks. This result suggests applying the general to specific approach in order to pick the best regression equation. Accordingly, the regression was re-estimated by excluding the non significant variables; *TA,* and *L/TA* respectively. Re-estimation improved the

explanatory power of the existing variables. The regression results, the coefficients for each variable, their *t* values and reflection point are given in the table 2 together with adjusted R- squared and DW stat values.

Table 2. Regression results – Equation 1a

Variable	Coefficient	
Constant	0.760***	(3.75)
H	-2.304**	(-2.37)
H^2	3.235***	(2.91)
Inflection point	*0.36*	
CrPvt	-0.334**	(-1.97)
$Eff_{(t-1)}$	0.837***	(15.98)
Adjusted R^2	0.72	
D-W stat	1.97	

According to the results of the regression analysis, competition measured with both H statistics and the square of H statistics are strong and statistically significant. Since the H statistics bears negative sign and H squared bears a positive value, the collective results provide evidence for a U shape relationship between bank competition and efficiency. Accordingly the level of bank efficiency falls with competition at initial stages and further increase in competition causes efficiency to rise with competition. As the calculated inflection point is given, this relationship can be more clearly explained. That is, the level of bank efficiency falls at an increasing rate with increased competition to its minimum until the degree of competition equals to 0.36. The decreasing trend of efficiency slows down thereafter and starts to raise with increased competition.Within this model, less competition among banks could result in higher interest rates charged on loans, and market power of few banks which might raise the efficiency of only such banks but undermining the efficiency of the banking sector as a whole. However, the competition among the individual banks increases when other banks also react to capture the market. At this initial stage of competition, banks try for a minimum, i.e. to survive in the market. In such scenario they need to squeeze down their interest margins and spend more on technology and new promotional campaigns to capture the market.

The information asymmetry between the banks and the borrowers is very high in imperfect competition. As a consequence, banks have to implement some mechanisms to solve the resulting problems such as adverse selection and moral hazard. This will in turn increase the monitoring cost of the banks. This channel of inefficiency is more validated for transition economies like Sri Lanka. If the market power of the few banks decreases and competition increases further, the efficiency levels of all the banks become closer to each other, denoting higher relative efficiency scores. This is because, a heightened competition encourages banks to reduce their costs, i.e. their cost inefficiencies. Hence, decreasing efficiency at initial stages and increasing efficiency at latter part of increased competition in the banking sector. The above model supports evidence for this particular trade-off between competition and efficiency in Sri Lankan banking sector.

The findings of the study do not directly support the theoretical predictions of industrial organization theory, which predicts a positive correlation between competition and efficiency. The findings do not even support a direct negative relationship as predicted in asymmetric information theories. Rather, findings of the study support the implications of both theories. According to the industrial organization theory, efficiency is obtained in perfect competition since outputs are produced at minimum cost. However this will happen when only some conditions exist, as the information asymmetry theories argue. Therefore perhaps the findings of the current study are more supportive of asymmetric information based theories. This can be explained with two unique characteristics of a banking sector in a developing country. First, in a less competitive banking market relationship lending is possible and a common scenario. Thus the monopoly bank has a pool of risky borrowers resulting in inefficiency in credit allocation. However as the theory of information sharing says, when the competition among banks increases, information sharing mechanisms reduce adverse selection by improving the pool of borrowers, the knowledge of applicants` characteristics and therefore improve bank efficiency in the allocation of credit. Second, the positive link

between competition and efficiency will happen only if there are no economies of scale in the banking sector. In a less competitive environment, only a few but larger Sri Lankan banks have the market power. Then there are economies of scale. If economies of scale exists then the efficiency gain will off-set the more traditional negative effect of market power on efficiency. When the other banks also enter the competition, the negative effect of market power on efficiency will be squeezed down. Therefore, the found U shape relationship between competition and efficiency in Sri Lankan banking sector is theoretically supportive as the problems of asymmetric information are very high in the country.

In addition to the competition measure, credit to private sector and inflation is statistically significant in explaining the level of efficiency of Sri Lankan banking sector. Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable. Thus, increase in credit to private sector is an indication of banking sector development as well as the allocative efficiency of financial resources. Surprisingly the found coefficient with respect to credit to private sector is negative, indicating higher private sector credit lowers bank efficiency and *vice versa*. The higher nonperforming loans in Sri Lankan banking sector may have off-set the positive effect of private sector credit on efficiency. However this needs further analysis to come to a conclusion, and therefore this aspect will be beyond the scope of the study.

Inflation is a sign of price instability in an economy. According to the results of the above regression analysis, efficiency is negatively affected by the level of inflation prevail in the country. A high rate of inflation makes it difficult for businesses to set prices. Normally when the inflation rate is climbing too quickly above an acceptable level or remaining consistently high, interest rates will be increased in an attempt to bring it under control and eventually reduce it. The business environment, repayment ability of borrowers are all affected by high inflation, in turn making it a hard time to the banking sector as the lenders. Therefore, inflation is one of the most powerful indicators of bank efficiency in Sri Lanka. In addition, lag efficiency variable is significantly correlated with dependent variable, indicating that efficiency is also positively affected by the efficiency level of the previous year.

Long-run effect of bank competition on efficiency

The effect of bank competition on efficiency, which was discussed above, are of short-run, as lag values of independent variables were not taken. Having found the short run effect, the purpose of the next section is to analyse the long-run effects of bank competition on efficiency, if any. When competition increases, efficiency of banks first decreases and starts to increase after a certain point. The findings of the above section revealed this particular U shape between competition and efficiency in the short-run. Whether bank competition promotes or hinders efficiency in the long-run is analysed in this section. In order to reveal the long-run effect, bank efficiency is regressed on lags of its own and on H statistics (by excluding other control variables of Equation 1a) as given in the Equation 1b.

$$Eff_{it} = \alpha_{it} + \beta_1 H_{t-1} + \beta_2 H_{t-2} + \gamma_1 Eff_{t-1} \quad ----------(Equation\ 1b)$$

Here, two years period of time assumed to be sufficient for competition factors to work themselves out towards efficiency. Therefore, long run in this equation reflects the two consecutive years after the year of observation. For analysis of Equation 5c, a panel data estimator was employed with bank-fixed effects. Only two annual lags of H statistics were used in the baseline setup of the model. This lag structure avoids dropping a vast amount of information by using deeper lags. Since the study is predominantly interested in the effect of competition on efficiency, no control variables were added to the model. The results support strong evidence for long run effect of bank competition on efficiency.

$$\begin{array}{lllll} Eff_{it} = & -0.14 + & 0.44H_{t-1} + & 0.095H_{t-2} + & 0.75Eff_{t-1} \quad ---(Equation\ 5c) \\ & (-1.86)^{**} & (4.77)^{***} & (0.75) & (27.78)^{***} \end{array}$$

The found H statistics in relation to both (t-1) is positive and highly significant. H statistics for (t-2) were also positive but insignificant. This result suggests that competitive climate of the banking sector in past years positively affects the current level of bank efficiency. Accordingly, 1 basis point increase in first lag year bank competition affects bank efficiency to increase by 44 basis points and second lag year competition affect bank efficiency to increase by 9 basis points. This can also be explained in another way. That is, the higher bank competition in a particular year enhances the following years' efficiency of the banking sector. Therefore the higher level of bank efficiency of a certain year is explained by bank competition in previous years. The pattern of relationship shows persistence over the lag years, confirming the long run relationship between competition and efficiency in the banking sector; competition enhances bank efficiency in the long run.

The findings of the present study in relation to effect of bank competition on efficiency are not contradictory with the findings of some previous studies. For instance, findings of Casu and Girardone (2004), revealed that increased competition has forced banks to become more efficient in the context of EU countries. Evidence in Egypt too shows that increased competition has forced banks to become more efficient (Poshakwale and Qian, 2011). However, due to the methodological difference a U shape relationship is not evident in these studies. The findings of the study is however inconsistent with the findings of Podpiera et al (2007) whose study focused on Czech Repulic. Their results indicate a negative relationship between competition and efficiency in banking. Though, much cannot say about this contradiction as their measurement of competition is Learner Index. This methodological difference might be one reason for this difference.

Conclusion

This study provides new and rather scarce evidence of effects of bank competition on banking sector efficiency in an emerging economy. By applying the new empirical industrial organization approach, the study finds that Sri Lankan banking market is moderately competitive. The moderate level of efficiency of the banking sector is attributed to the moderate level of competition in Sri Lankan banking industry. Hence, the findings of the study revealed that the degree of bank competition prevails at present is not the optimum, as far as efficiency of the banking sector is concerned. This is supportive of the applicability of theories based on asymmetric information in the short run. However, supporting the predictions of industrial organization theory, it was evident that bank competition affects the efficiency in the long run. Therefore the evidence suggests to enhance bank competition to attain its positive outcome at its maximum. Based on the econometric exercise carried out in this study, it is reasonable to use a combination of both, asymmetric information based theories and the industrial organization theory, in explaining the effects of bank competition in the Sri Lankan context.

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