Drivers of Technical Efficiency of Sri Lankan Commercial Banks

Senarath Lalithananda Seelanatha[1]

Victoria University, Australia

Abstract: This article examines the determinants of technical efficiency (TE) in the Sri Lankan banking industry's intermediation and asset transformation functions using an unbalanced panel dataset from 1989 through 2009. It estimates the banks' relative TE using input-oriented constant return to scale (CRS) data envelopment analysis (DEA) and input-oriented CRS super-efficiency DEA models. Such variables as operational risk, amount of purchased funds, gross interest margins, ownership, and the banks' relative ages affected their TE in intermediation positively and their market share affected it negatively. Such variables as operational risk, inflation, and market capitalization had a positive effect on TE in asset transformation, and market share, profitability, the quality of bank assets, the amount of purchased funds, and high liquidity had a negative effect on it.

Keywords: asset transformation, banking, intermediation, technical efficiency, Sri Lanka

JEL Classification: E44, G21, G28, N25

1. Introduction

Banking industries in developing countries serve as the major driving forces facilitating the transfer of funds from surplus holders, or savers, to deficit holders, or borrowers. This process, which includes intermediation and asset transformation, is vital for a country's economic development.

Sri Lanka has introduced various regulatory reforms to its financial-services sector since 1977 in order to enhance that industry's operational performance. A major expectation of these reforms has been to maximize the use of financial resources for economic development by improving the private sector's participation. These reforms have therefore had the objective of enhancing the productivity and efficiency of the sector's institutions by creating a competitive environment (1999).

This deregulation of the financial-services sector has transformed its operational environment by enabling structural changes to take place and by enhancing private-sector involvement in the industry. These financial reforms, together with other microeconomic and macroeconomic factors, have consequently influenced the improvement of Sri Lanka's banks' efficiency.

A large body of literature exists addressing the efficiency of banks in other countries (Berger & Humphrey, 1997). It varies widely, however, in regard to aims and findings, as the studies within it differ in regard to research techniques, definitions of outputs and inputs, whether the firms being analyzed include savings banks, commercial banks, or both, and the length of the sample periods. This means that these studies' findings cannot apply directly to banking environments in

other countries. This paper therefore aims to find the factors that drive the technical efficiency (TE) of Sri Lanka's banks.

This paper is structured as follows. Section 2 outlines the relevant literature, and section 3 introduces the methodology used to estimate TE(TE) and to investigate the determinants of TE in banks in Sri Lanka. Section 4 presents the details of the analysis and a discussion of the results, and section 5 summarises the main findings and draws conclusions regarding the banking industry in Sri Lanka.

2. Literature Review

Existing studies of banking efficiency have examined the factors that affect banks' TE using different approaches. Table 1 summarizes some of those determinants, categorizing them as microeconomic, macroeconomic, or other factors. The microeconomic ones include such factors that management actions can control as product lines, capital employed, input utilization, people, the organization and system, work methods, and management styles, and such factors that are less susceptible to control by managerial decisions as market share and market concentration. These factors' impact is limited to the firm level. The macroeconomic factors include those that may influence the productivity and efficiency of all industries in general, such as per capita income, inflation, gross national product, economic growth rates, and population. The third category includes all non-economic factors.

Researchers have selected these factors based on their analyses' objectives. They have, for example, tended to give greater precedence to such regulatory factors as capital adequacy, type of ownership, the nature of banking activities, and problem loans when addressing policy matters (Ali and Gstach 2000; Barr et al 1994; Dietsch and Lozano-Vivas 1996; Grifell-Tatje and Lovell 1996; Hermalin and Wallace 1994; (Delis & Papanikolaou, 2009; Pasiouras, 2008; Sufian & Habibullah, 2009). As mentioned before, however, researchers have selected TE's potential explanatory variables according to their studies' objectives. Leong and Dollery (2002), for instance, used such factors as agency problems[2], regulatory and organizational structure[3], risk management[4], and size and technology[5] in order to identify the properties of efficiency scores estimated by data envelopment analysis (DEA).

As noted earlier, previous studies have used different approaches to investigates the factors affecting to the TE and significance of their influence. Such studies as (Ali & Gstach, 2000; Darrat, Topuz, & Yousef, 2002; Delis & Papanikolaou, 2009; Favero & Papi, 1995; Grigorian & Manole, 2002; Miller & Noulas, 1998; Sufian, 2009; Sufian & Habibullah, 2009) have used such multivariate regression analysis techniques as generalized least squares methods and Tobit to investigate the factors that affect banks' TE, (Barr, Killgo, Siems, & Zimmel, 1999; Leong & Dollery, 2002) have used a longitudinal graphical approach to do so, and (Avkiran, 2009; Chaffai, Dietsch, & Lozano-Vivas, 2001; Pastor, 1999, 2002) have used DEA itself for this purpose.

Multivariate regression analysis involves a two-stage procedure in which it first uses DEA to estimate relative efficiency and then regresses the estimated efficiency scores. The longitudinal approach examines general trends of estimated productivity over an extended timeframe and uses graphic representation to show the relationship between estimated productivity and each factor.

Studies have also used DEA techniques, together with Malmquist-type indices, to find the aggregate effect of other, non-production, variables on estimated efficiency[6] (Pastor, 1999, 2002).

Neither DEA techniques nor the longitudinal approach provide sufficient information to test hypotheses, so studies have relied mainly on regression techniques, which do enable such testing. The empirical evidence in the literature, however, is inconsistent, apparently due to methodological differences as well as differences in regulatory and economic environments. Comparing the findings in the literature therefore requires care.

This means that the studies in the existing literature have investigated different combinations of factors and their proxy variables. They have, for example, used the same variable as a proxy for different factors, and different studies have used different proxy variables to account for the same factor. Both Favero and Papi (2002) and Isik and Hassan (2003), for example, categorized banks as being either big, medium, or small and used dummy variables to represent each category in the regression. Miller and Noulas (2000) used the value of total assets to represent the firms' size. The variable's definition therefore clearly influences the estimated coefficient considerably.

3. Methodology

This study used a two-stage procedure to investigate the factors that affect Sri Lankan banks' TE. At the first stage, TE of individual banks have been estimated using DEA, which is a non-parametric approach (Charnes(1978). In the second stage, the estimated efficiency scores are regressed against a range of explanatory variables.

3.1 Estimation of TE Scores

Being a non-parametric mathematical programming approach, DEA allows the construction of a production frontier using a relatively small sample of decision-making units (DMUs) to estimate TE. It has the capacity to incorporate multiple inputs and outputs in order to estimate the DMUs' relative efficiency in an industry without a pre-specified production function. This study employed the input-oriented[7] constant return to scale (CRS) DEA model[8] and the super efficiency input-oriented CRS model in order to estimate the TE of Sri Lankan banks (Barr et al., 1999; Delis & Papanikolaou, 2009; Denizer, Dinç, & Tarimcilar, 2000; Dietsch & Lozano-Vivas, 1996; Drake, 2001; Elyasiani & Mehdian, 1990; Sufian, 2009; Sufian & Habibullah, 2009). This study defined TE in this context as a bank's ability to produce a maximum combination of outputs using a minimal amount of inputs. TE-AT (TE in asset transformation) and TE-IM (TE in intimidation) represent the TE scores in assets transformation and intermediation which are estimated using CRS model. TES-AT (super-TE in asset transformation) and TES-IM(super-TE in intimidation) represent the estimated TE scores using the second model.

3.2 Input and Output Specifications

This study identified three commonly used input and output specification approaches after considering the literature addressing productivity and efficiency in the banking industry. These

are intermediation, production, and profit (Fethi & Pasiouras, 2010). Based on these approaches, this study identified two input and output specification. The first input and output specification which used for estimating TE-AT is included interest expenses, personnel costs, and premises and establishment expenses as inputs, and loans and advances, interest income, and other income as outputs. The second specification which is used for measuring TE-IM is included deposits, other loanable funds, and personnel costs as inputs and loans and advances and other earning assets as output. It is excluded all non-revenue-generating assets from the input and output specifications and employed corresponding monetary values in published financial statements as proxies for all output and input variables.

3.3 Determinants of Banks' Efficiency

Based on previous studies, 15 explanatory variables are identified as potential determinants of Sri Lankan banks' technical efficiency. Those are the seven firm-specific microeconomic variables of asset quality, capital strength, interest margins, profitability, operational risk, product quality, and liquidity, the six macroeconomic variables of stock market capitalization, inflation ratio, market power and concentration, per capita income, and GDP growth, and the two qualitative variables of the banks' ownership and age as the determinants of Sri Lankan banks' TE. Table 2 shows the predicted relationships with each variable's estimated efficiency scores and descriptive data.

The firm-specific variables took precedence over the others because they are specific to the individual banks. This study introduced the macroeconomic variables to control for environment-related influences that affected all banks equally and used a qualitative variable as a proxy in the regression analysis for the regulatory conditions in which the banks operated.

4. The Model

Based on the preceding theoretical explanation, this study specified the empirical model in equation (1) in order to study the impact of each determinant of TE it identified for Sri Lankan banks and that factor's significance.

$$\theta_{nj}^{*} = \sum_{i}^{n} z_{kj}\delta_{k} + u_{j} + \varepsilon, \qquad (1)$$

In this equation θ_i is the DEA-estimated TE scores, Z_{kj} is a vector of the variables observed as explaining the banks' efficiency, and n denotes the number of observations that the analysis used. Table 1 presents TE's possible explanatory factors, the proxy variables, and their expected relationships.

The literature has highlighted two problems in using DEA-estimated data in regression analysis. Xue and Harker (1999) found that DEA-estimated relative efficiency scores are interdependent and subject to heteroskedasticity. Least squares regressions may therefore produce biased estimations of the explanatory variables. Saxonhouse (1976) stressed that dependent variables are estimated parameters bounded by one and zero, or limited dependent variables.

Least squares regression analysis may therefore be inappropriate for regressions using DEA-estimated efficiency scores as dependent variables. Recent studies have, however, found that the

estimated coefficient using least squares and Tobit are indeed consistent ((Banker & Natarajan, 2008)). This study therefore used simple least squares regressions to identify TE's determinants.

5. Data and Sample

This study's sample includes all locally established commercial banks that operated in Sri Lanka from 1989 to 2009. This excludes all of such specialized financial institutions as development, investment, regional, and rural banks and branches of foreign banks, as they have different product lines. This study collected its bank-related data from published annual financial statements and its macroeconomic data from the Central Bank of Sri Lanka's various annual reports and publications.

Mester (1996) explained that DEA models need data that are free from measurement errors or noise to ensure accurate estimates. Since the data this study used were extracted directly from audited accounts and collected from audited financial statements it is reasonable to assume that they are free of noise from data collection.

6. Results and Discussion

Table 2 presents the means and standard deviations of the independent and dependent variables which are included into the regression models. The descriptive statistics reveal that banks have invested relatively lower amount in fixed assets with high collateral value and therefore kept a large amount of total assets as liquid assets.

A low standard deviation of liquidity ratio indicates all banks maintain a similar percentage of total assets as liquid assets. However, the high standard deviation of market power shows the high variation of market share held by individual banks. The information provided in the table shows that banks in Sri Lanka have a low average rate of return on assets.

Table 3 presents descriptive statistics of estimated efficiency scores. The study reports TE scores estimated by using CRS and supper efficiency models. Recorded efficiency scores showed that privately-owned banks are more efficient than the state-owned banks in Sri Lanka. It is also indicate that the Sri Lankan banks have maintained relatively higher level of efficiency. TE scores estimated using CRS DEA model recorded a lover level of dispersion. On the other hand, efficiency scores which estimated using supper efficiency DEA model showed a higher level of dispersion indicating that the DMUs which were regarded as efficient DMUs under the CCR model is not equally efficient.

Table 4 shows the estimated correlation coefficients between the explanatory variables. These show that little correlation was present, indicating a negligible risk of multicollinearity.

This study ran four least squares regressions. Estimated TE-AT, TE-IM, TES-AT and TES-IM have been used as the dependent variables. The estimated least squares regression coefficients are presented in Table 5. The recorded 'F' statistics and adjusted '$R^{2'}$ values indicate that these regression models have sufficient explanatory power to explain the projected relationships.

Recorded results shows that asset quality, market share, profitability, purchased funds, and liquidity have a significant negative influence on TE-AT, and market capitalization, operational risk, and inflation therefore have a significant positive relationship with TE-AT. The regression results on super-TE in asset transformation (TES-AT) show similar relationships. No statistically significant relationship was present between TE-AT and such variables as capital strength, market concentration, size, and GDP growth. Interest margins, operational risk, purchased funds, ownership, and the age of the bank had a statistically significant positive relationship with TE-IM estimated using the CRS DEA model. Market share had a negative relationship with both TE-IM and super-TE-IM (TES-IM).

Banks use investment in long-term assets to maintain their deposit holders' trust (Claeys & Vennet, 2003). Having a high ratio of long-term assets to total assets enhances a bank's ability to manage loan defaults. Investment in long-term assets is therefore an indicator of banks' creditworthiness, so this study used the fixed assets to total assets ratio to proxy their assets' quality. Asset quality represents a bank's ability to provide long-term collateral to its deposit-holders, so it is reasonable to assume that relatively high investment in long-term assets is an indication of having high asset quality and therefore high productive efficiency.

Relatively high investment in long-term assets, however, may limit banks' ability to use funds for more productive investments and therefore affect productive efficiency negatively. The regression for the asset quality variable revealed no statistically significant evidence associating it with productive efficiency, but both of the regressions showed a statistically significant negative correlation between the asset-quality variable and TE-AT and TES-AT, indicating that relatively low investment in long-term assets can improve banks' TE.

This study used the gross interest margin (GIM) and profitability to proxy the banks' earning potential and found statistically significant positive relationships between GIM and both TE-IM and TES-IM, which indicates that banks with higher GIMs tend to have more TE-IM than other banks. Efficient banks may therefore be able to invest their funds in assets that offer relatively higher returns than less efficient banks. Contrary to the hypothesized relationship, this study found that TE-AT and profitability have a statistically significant negative relationship, indicating that profitable firms tended to be less efficient. This indirectly supports Hicks's (1935) quiet life hypothesis.

This study assumed that managers' risk-taking and profit-seeking behaviors may have a direct influence on their banks' operational efficiency. Profit-seeking managers are likely to tend to allocate their banks' funds toward risky lending portfolios, thereby expecting to generate higher interest income resulting in high loan-to-assets ratios. This study therefore used the total loans to total assets ratio to proxy the risk-taking behavior of the banks' management and found that risk-taking banks tended to have comparatively higher TE than less aggressive ones, thereby supporting the findings of Darrat et al (2002) and Burki and Niazi (2003) and contradicting those of McKillop et al (2002) and Havrylchyk and Scharrnstrabe (2004).

Banks obtain the funds to make loans mainly from deposits. Their ability to collect loans with interest reflects the quality of those loans. This study therefore used the ratio of problem loans to total assets to proxy product quality. Berger and De Young (1997) found that the literature tends to explain the relationship between operational efficiency and problem loans with the bad luck,

bad management, and skimping hypotheses. Both the bad-luck and bad-management hypotheses predict a negative relationship between problem-loan provision and operational efficiency, and the skimping hypothesis, which relates the cost of managing loan assets with problematic loans, predicts a positive relationship. This study relied on the bad-management hypothesis and predicted that it would find a negative association between problem-loan provision and operational efficiency. The estimated coefficients for the product-quality variable in all the regressions were negative, but only the TE-AT showed a statistically significant relationship. Overall, these findings indicate that bad management results in low-quality banking products. Poorly managed banks should therefore have a relatively higher proportion of problem loans than well-managed ones.

Funds purchased from other financial institutions, funds from individuals, or both can be substitutes for funds generated from deposits (Heffernan, 1996). Purchasing and borrowing funds increases the amount of money banks have available to loan. This study therefore predicted that it would find a positive relationship between TE and the amount of funds purchased and found that the amount of funds purchased affected TE-AT and TE-IM differently. The coefficient for purchased funds to total assets had a statistically significant negative relationship with TE-AT. This indicates that purchasing funds is likely to increase the cost of asset transformation, as it costs more than paying interest on deposits, thereby reducing the banks' efficiency. Purchased funds are, however, an alternative method of intermediation in the capital market and help banks to obtain more loanable funds, and this study did find that the availability of such funds enhances the banks' capacity to intermediate in the financial market.

Although a bank's size and relative market share reflect its capacity to compete with other players in the banking market, this study found no evidence of a relationship between bank size and TE. Focarelli and Panetta (2003) found that large banks can reduce their average costs by having access to cost-saving technologies or by spreading their fixed costs over a larger base and exploiting advantages of economic scope, but Hick's (1935) quiet-life hypothesis notes that larger firms may tend to be less productive due to their management seeking a quiet life by pursuing other objectives or by maintaining the advantages their market power produces (Berger & Hannan, 1994).

Banks with a large market share may therefore tend to seek advantage by charging higher margins on their products without improving their TE and therefore be less competitive in their market (Berger & Hannan, 1994; Isik & Hassan, 2003). This study found that firms with lower market power significantly tended to allocate assets more efficiently than those with larger market shares, thereby supporting the quiet-life hypothesis. High market power, which leads to high market concentration, may therefore earn economic rent for firms with considerable market share without their minimizing costs fully. This finding has important policy implications in regard to regulatory changes that tend to encourage higher market concentration from mergers or similar organizational arrangements.

This study found that the banks' liquidity, which is the ratio of their total assets to total investment in cash and near-cash items, had a significant negative relationship with TE-AT. Asset transformation refers to banks' ability to use their funds to make productive investments.

This study therefore found that a large investment in cash and near-cash items reduces their ability to use such funds productively.
In order to control country-specific macroeconomic conditions, this study includes the change in stock market capitalisation (represent competitive threats made by other capital market participants), inflation (proxy for impact of changes in price level) and GDP growth rate (to capture the influence of general economic growth) in the regression model. However, only the growth in stock market capitalisation shows a statistically significant relationship with estimated efficiency scores.

The impact of changes in the stock market capitalization on banks' efficiency can be explained in three different ways. These are that (a) savers may withdraw their deposits and choose to invest their savings in the stock market, reducing the funds available to banks for investment, (b) investors in the stock market may tend to borrow from banks for their investments in the hope that they will make profits as the market improves, and (c) the banks themselves may capitalize on profit-making opportunities in the stock market by investing excess cash in active portfolios.

The evidence found in this study suggest that stock market development have expand the lending opportunities. Therefore, growth in capital markets help banks to smooth their intermediation function and to provide them with more opportunities to diversify their investments. The short-term investment opportunities arising in the stock market, furthermore, enable banks to keep temporary cash surpluses in active portfolios. The extra income such investments generate as well as the new lending opportunities may ultimately enhance the banks' efficiency. Overall, these findings challenge Grigorian and Manole's (2002) argument that developments in security markets and non-bank financial institutions reduce bank performance and support Fat and Hua's (1998) finding that stock market performance is closely related to bank efficiency. These findings indicate that the expansion of stock market activities widens rather than hinders banking firms' profit-making opportunities.

This study found that Sri Lanka's private banks are more efficient than its state owned banks in regard to their intermediation function. This supports Isik and Hassan's (2003) findings in regard to Turkey and Sathye's (2000) in regard to India.

This study predicted that banks with relatively greater market experience would also have superior TE and found that new banks are less efficient with intermediation. Isik and Hassan (2003) explained that older banks can manage their resources more effectively than newer ones due to the greater amount of knowledge about their markets that they have acquired over time. Mester (1996) noted, furthermore, that in order to build customer confidence new banks must incur relatively high start-up costs. Supporting Mester (1996) findings, this study found that older banks are more efficient in intermediation than the new banks.

7. Conclusion

This article's objective was to investigate the determinants of the TE of Sri Lanka's locally owned banks. Its study found these to differ from those of other countries' banks. The significantly determining variables were (a) asset quality, (b) degree of operational risk, (c) amount of purchased funds, (d) market share, (e) degree of liquidity, (f) changes in stock market

capitalization, and (g) ownership type. This study has also found that the overall determinants of efficiency and their influence vary with the functions of intermediation and asset transformation.

Endnotes

1. Lalith Seelanatha is a Lecturer in Accounting and Finance, School of Accounting and Finance and a research associate of Centre for Strategic Economic Studies (CSES) of Victoria University, Melbourne. Email: lalith.seelanatha@vu.edu.au; Tel 061-9919 5320.

2. Agency problems arise when ownership and management are separate.

3. Firm structure and organization depend on existing regulations.

4. A bank management's ability to foresee the future tends to lead to a reduction in unanticipated losses.

5. Bank size and technology indicate firms' overall ability to respond to environmental uncertainty (Leong and Dollery, 2002).

6. Two DEA models exist. One includes only input and output variables directly related to the production process in order to estimate true efficiency. The other includes both production factors and those non-production factors that affect the production process in order to estimate TE. A Malmquist-type index can find the difference between these two models' estimated efficiency scores and identify the aggregates affecting the other variables (Pastor, 1999, 2002).

7. The input-oriented model identifies TE as a proportional reduction in input usage for a given level of output (Coelli et al, 1998).

8. CRS-DEA formulation:

   $Min\ \theta$,

   Subject to

$$\sum_j x_{ij}\lambda_j - \theta x_{ij_{i\bar{i}}} \le 0 \quad for\ i = 1,2,...m$$

$$\sum_j y_{rj}\lambda_j \ge y_{rj_0} \quad for\ r = 1,2,...k$$

$$\lambda_j \ge 0$$

9. TE-AT and TE-IM have been estimated using CRS DEA model and TES-AT and TES-IM have been estimated using supper efficiency model.

10. This table presents Pearson correlation coefficients which are estimated using data analysis tools in Microsoft Excel.

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Table 1. Microeconomic, Macroeconomic and Other Factors Affecting Banks' Efficiency

Factor	Study
Microeconomic factors	
Size	Barr et al. (1999); Darrat, Topuz and Yousef (2002); Favero and Papi (1995); Leong and Dollery (2002); Leong, Dollery and Coelli (2002); McKillop (2002); Miller and Noulas (1996) Sufian (2009) Delis (2009) Pasiouras (2008)
Profitability	Casu and Molyneux (2004; 2003); Darrat, Topuz and Yousef (2002); Maghyereh (2004); Miller and Noulas (1996) Sufian & Habibullah (2009) Pasiouras (2008)
Capital ratio	Casu and Molyneux (2004; 2003); Darrat, Topuz and Yousef (2002); Leong and Dollery (2002); Maghyereh (2004) Sufian (2009) Sufian & Habibullah (2009) (Pasiouras, 2008)
Loan to total assets	Leong and Dollery (2002); McKillop (2002) Sufian (2009)
Fixed assets to total assets	Leong and Dollery (2002) Pasiouras (2008)
Problem loans	Barr et al. (1999); Maghyereh (2004); McKillop (2002), Pastor (2002) Sufian (2009) Sufian & Habibullah (2009)
Risk	Leong and Dollery,(2002)
Purchased funds	Barr et al., (1999)
Liquidity	McKillop,(2002)
Market power	Darrat, Topuz and Yousef (2002), Devaney and Weber (2000), Favero and Papi (1995), Maghyereh, (2004) Miller and Noulas (1996)
Non-interest income to total assets	Sufian (2009) Sufian & Habibullah (2009)
Deposit	Sufian & Habibullah,(2009)
Macroeconomic factors	
Gross domestic product	Pasiouras (2008) Sufian (2009) Sufian & Habibullah (2009) Delis (2009)
Per-capita income	Chaffai, Dietsch and Lozano-Vivas (2001) Grigorian and Manole (2002) Hasan, Lozano-Vivas and Pastor (2000)
Inflation ratio	Grigorian and Manole (2002) Pasiouras (2008)
Stock market-capitalization	Grigorian and Manole (2002) Sufian & Habibullah (2009)
Market concentration	Pasiouras (2008) Sufian & Habibullah (2009) Delis (2009)
Liberalisation	Maghyereh,(2004)
Other Factors	
Specialization	Favero and Papi (1995); Mukherjee, Ray and Miller (2001)
Location	Casu and Molyneux (2004; 2003); Devaney and Weber (2000), Favero and Papi (1995); Miller and Noulas (1996)
Ownership	Favero and Papi (1995), Maghyereh, (2004) Pasiouras (2008) Delis (2009)
Number of branches	Dietsch and Lozano-Vivas (1996); McKillop (2002)
Bank branch concentration	Chaffai, Dietsch and Lozano-Vivas (2001); Dietsch and Lozano-Vivas,(1996) Pasiouras (2008)
Population concentration	Dietsch and Lozano-Vivas (1996) Hasan, Lozano-Vivas and Pastor (2000)
Bank supervision/deposit insurance/operational restriction	Pasiouras (2008)

Table 2. Variables and Definitions

Characteristic	Proxy variable	Hypothesised relationship	Mean and standard deviations
Dependent variables			
TE-IM[9]	Technical efficiency in intermediation		0.838 (0.11)
TE-AT	TE in asset transformation		0.885 (0.09)
TES-IM	TE (supper) in intermediation		0.858 (0.18)
TES-AT	TE (supper) in asset transformation		0.903 (0.15)
Independent variables – Microeconomic			
Asset Quality	Fixed assets to total assets	Positive	0.025 (0.01)
Capital Strength	Equity capital to total assets	Positive	0.069 (0.05)
Gross Interest margin	Gross Interest margin to Total Assets	Negative	0.366 (0.10)
Profitability	Return on capital	Negative	0.009 (0.01)
Operational Risk	Loan to assets ratio	Negative	0.608 (0.09)
Product quality	Problem loan provision to total loan portfolio	Negative	0.057 (0.04)
Purchased funds	Purchased funds to total assets	Negative	0.137 (0.10)
Size	Natural logarithm of total assets	Positive	10.581 (1.43)
Market power	Market share of the firm	Positive	0.100 (0.10)
Liquidity	Liquid assets to total assets	Positive	0.149 (0.08)
Market concentration	Banking industry concentration		0.193 (0.04)
Independent variables – Macroeconomic			
Stock market capitalisation	% change in total market capitalisation compared to the previous year	Negative	0.307 (0.48)
Inflation ratio	% change in Consumer Price Index	Negative	0.110 (0.06)
GDP growth	GDP growth rate	Positive	0.050 (0.02)
Independent variables – Qualitative			
Commercial banks	Dummy; equal to 1 if the bank is a commercial bank, 0 otherwise	Positive	
Privately-owned banks	Dummy; equal to 1 if the bank is a privately owned bank, 0 otherwise	Positive	
Age (Old vs. new)	Dummy; equal to 1 if the bank is incorporated and commenced business before 1977, 0 otherwise	Positive	

Table 3. Descriptive Statistics of Estimated TE for 1989-2009

	TE-IM	TE-AT	TES-AT	TES-IM
State owned bank	0.813(0.165)	0.841(0.098)	0.845(0.104)	0.824(0.180)
Private owned bank	0.845(0.093)	0.899(0.077)	0.922(0.155)	0.869(0.185)
Old bank	0.835(0.133)	0.857(0.081)	0.859(0.086)	0.844(0.146)
Newly established bank	0.840(0.095)	0.912(0.081)	0.944(0.179)	0.871(0.213)

[Standard deviations are in parentheses]

Table 4. Correlation Coefficients of Variables Tested[10]

	TE-AT	TES-AT	TE-IM	TES-IM	Assets quality	Capital strength	GIM	Profitability	Operational Risk	Product quality	Purchased funds	Size - Total Assets	Market share	Liquidity	market concentration	Inflation	GDP
TES-AT	0.740																
TE-IM	0.082	0.090															
TES-IM	0.074	0.086	0.782														
Assets quality	-0.170	-0.111	-0.047	-0.078													
Capital strength	0.054	0.035	0.209	0.276	0.177												
GIM	-0.158	-0.168	0.178	0.233	0.019	0.299											
Profitability	-0.126	-0.075	0.136	0.150	0.039	0.410	0.308										
Operational Risk	0.400	0.264	0.154	-0.029	0.211	0.159	-0.011	0.079									
Product quality	-0.210	-0.135	-0.114	-0.177	-0.196	-0.463	0.053	-0.219	-0.275								
Purchased funds	-0.124	-0.013	0.288	0.156	-0.082	0.082	0.086	0.093	-0.146	0.080							
Size - Total Assets	-0.146	-0.158	0.139	-0.037	-0.239	-0.343	0.108	0.001	-0.140	0.519	0.217						
Market share	-0.360	-0.293	-0.218	-0.196	-0.244	-0.433	0.110	-0.047	-0.292	0.633	0.030	0.636					
Liquidity	-0.230	-0.203	-0.139	0.023	0.194	0.063	-0.010	0.061	-0.075	-0.363	-0.390	-0.519	-0.219				
Market concentration	-0.217	-0.178	-0.378	-0.168	0.167	-0.122	-0.042	0.110	-0.001	-0.122	-0.298	-0.431	0.235	0.562			
Inflation	0.050	0.033	0.080	0.065	-0.003	0.058	-0.197	0.073	0.126	-0.035	0.069	0.003	0.027	0.050	0.087		
GDP growth	0.064	-0.064	0.123	0.045	-0.101	0.120	0.247	0.185	0.019	0.015	0.088	0.097	-0.028	-0.005	-0.198	0.038	
Change in market capitalisation	0.068	0.085	0.002	-0.026	-0.046	-0.058	0.044	0.039	-0.164	0.087	-0.065	-0.052	-0.015	0.056	0.060	-0.413	-0.037

Table 5. Least Square Regression Results

	TE		TES	
	AT	IM	AT	IM
Constant	0.823***	0.524***	1.212***	0.681**
	(6.22)	(2.72)	(4.51)	(1.98)
Assets quality	-2.079***	-0.188	-2.235**	-1.583
	(-3.93)	(-0.24)	(-2.08)	(-1.15)
Capital strength	-0.095	0.039	-0.320	0.437
	(-0.62)	(0.17)	(-1.03)	(1.09)
Gross Interest margin	-0.030	0.171*	-0.094	0.426***
(GIM)	(-0.49)	(1.92)	(-0.75)	(2.68)
Profitability	-1.252*	0.673	-0.007	0.689
	(-1.88)	(0.69)	(-0.01)	(0.40)
Operational Risk	0.292***	0.182*	0.361**	-0.176
	(4.25)	(1.82)	(2.59)	(-0.98)
Product quality	-0.367*	-0.453	-0.326	-0.854
	(-1.78)	(-1.51)	(-0.78)	(-1.59)
Purchased funds	-0.189***	0.284***	-0.108	0.203
	(-3.23)	(3.34)	(-0.91)	(1.34)
Size - Total Assets	0.003	0.021	-0.021	0.021
	(0.33)	(1.60)	(-1.16)	(0.90)
Market Share	-0.342*	-1.052***	-0.278	-1.365***
	(-1.93)	(-4.06)	(-0.77)	(-2.95)
Liquidity	-0.443***	0.144	-0.562***	0.164
	(-4.33)	(0.97)	(-2.71)	(0.62)
Market concentration	0.202	-0.616	-0.370	-0.234
	(0.73)	(-1.53)	(-0.66)	(-0.33)
Change in market	0.032***	0.028	0.051**	0.009
capitalisation	(2.67)	(1.61)	(2.08)	(0.28)
Inflation	0.182*	0.280*	0.263	0.395
	(1.76)	(1.86)	(1.25)	(1.47)
GDP growth	0.401	-0.138	-0.397	-0.733
	(1.52)	(-0.36)	(-0.74)	(-1.07)
Ownership	0.021	0.159***	0.029	0.217***
	(0.69)	(3.53)	(0.47)	(2.69)
Age (Old vs. new)	-0.020	0.060**	-0.021	0.051
	(-1.21)	(2.43)	(-0.62)	(1.15)
F statistics	9.124	6.096	3.831	3.068
Adjusted R^2	0.428	0.319	0.207	0.160

['T' scores values are in the parenthesis, '***' indicates significant coefficients under 1% confidence leve
'**' indicates significant coefficients under 5% confidence level '*' indicates significant coefficients unde
10% confidence level]