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ABSTRACT

This paper examines for the first time the relationship between China banks' efficiency and its share price performance. Our analysis consists of three parts. First, we calculate the annual share price returns of the banks for each year between 1997 and 2006. Then we employ Data Envelopment Analysis (DEA) Window Analysis method, first proposed by Charnes et al. (1985) to estimate the efficiency of the banks. Finally, we estimate the annual share price returns over the change in efficiency, while controlling for other bank specific traits. The empirical findings suggest that large China banks have exhibited higher technical and pure technical efficiency levels compared to their small and medium sized bank counterparts, while the medium sized banks have exhibited higher scale efficiency. The relationship between China banks' efficiency and share price performance suggest that bank efficiency estimates derived from the DEA Window Analysis method contributes significant information towards share price returns beyond that provided by financial information.

JEL Classification: G21
Keywords: Bank Efficiency, Share Prices, DEA Window Analysis, China

1. INTRODUCTION

Studies on the stock market have found that stock prices do incorporate relevant publicly known information (Ball and Kothari, 1994). An efficient stock market should consider operating efficiency measures in the price formation process, as they represent all publicly available information. All else being equal, relatively more efficient banks should be able to raise capital at a lower cost. In a semi-strong, efficient market where most of the information is incorporated into prices, share price performance is the best measure whether firms are creating value for shareholders or not (Brealey and Myers, 1991). Thus, it may be expected that efficient firms perform better than inefficient firms and this will be reflected in market prices (directly through lower costs or higher output or indirectly through higher customer satisfaction and higher prices which in return may improve share price performance).

Although quite exhaustive surveys exist in the literature to examine the relationship between traditional accounting performance measures and share price changes[1], only a handful of studies have examined the relationship between bank efficiency and share price performance (Beccalli et al. 2006). These include Adenso-Diaz and Gascon (1997) in Spain, Chu and Lim (1998) in Singapore, Eisenbeis et al. (1999) in the U.S., Beccalli et al. (2006) in the principal EU banking sectors (i.e. France, Germany, Italy, Spain, and U.K), Sufian and Majid (2006) in Malaysia, Kirkwood Nahm (2006) in Australia, and Pasiouras et al. (2007) on Greece.

The present study contributes to the existing literature in at least three important ways. First, despite the importance of the China banking sector to the domestic, regional, and international economies, there are only a few microeconomic studies performed in this area of research. This study thus attempts to fill a demanding gap by providing the most recent evidence on the performance of the China banking sector. Second, unlike the previous studies on China banks' efficiency, the present study attempts to examine the efficiency of the China banking sector by using the Data Envelopment Analysis (DEA) Window Analysis method, first proposed by Charnes et al. (1985). Given the small sample size of the China listed banks, we believe that it is more appropriate to investigate the efficiency of the China banking sector by using the DEA Window Analysis method for at least two important reasons. Firstly, the method provides a greater degree of freedom to the sample (Reisman, 2003). Secondly, the greater degree of freedom could provide better explanatory power to the second stage regression analysis (Sufian, 2007). Nevertheless, this study will also be the first to investigate the efficiency of the China banking sector by using this relatively new DEA Window Analysis method. And finally, the study attempt to examine the

[1] See Kothari (2001) for a very comprehensive review of the literature.

relationship between China banks' efficiency and its share price performance in the marketplace. To the best of our knowledge, this type of analysis is completely missing in the literature in regard to the China banking sector.

This paper is set out as follows. The next section reviews related studies in the main literature with respect to the study on bank efficiency. Section 3 outlines the approach to the measurement and estimation of efficiency change and provides details on the construction of our data set. Section 4 discusses the results and finally, section 5 provides some concluding remarks.

2. SURVEY OF THE LITERATURE ON BANK EFFICIENCY

Studies on bank efficiency are fast growing, but the vast majority of studies cover the U.S. and other developed countries (Berger et al. 1993; Berger and Humphrey, 1997). Although there have been a number of studies examining the efficiency of the Chinese banking industry, these studies have been published in Chinese scholarly journals[2]. To date, only a few studies are available to non-Chinese readers. Among them are studies by Chen et al. (2005), Fu and Heffernan (2007), Ariff and Can (2007) and Yao et al (2007).

Chen et al (2005) examined the cost, technical and allocative efficiency of 43 Chinese banks over the period 1993 to 2000. The results show that the large state-owned banks and smaller banks are more efficient than the medium sized Chinese banks. In addition, technical efficiency consistently dominates the allocative efficiency of Chinese banks. The financial deregulation of 1995 was found to improve cost efficiency levels including both technical and allocative efficiency.

Fu and Heffernan (2007) employed the Stochastic Frontier Approach (SFA) to investigate China banking sector's cost X-efficiency over the period 1985 to 2002. A two-stage regression model is estimated to identify the significant variables influencing X-efficiency. Overall, the results show that banks are operating 40–60% below the X-efficiency frontier. On average, the joint-stock commercial banks are found to be more X-efficient than the state-owned commercial banks, but individual scores present a far more complex picture. It appears that X-efficiency was higher during the first phase of bank reform. Recent policies aimed at increased privatization, greater foreign bank participation, and liberalized interest rates should help to improve the cost X-efficiency of China banks.

2 For example Xue and Yang (1998), Zhao (2000), Wei and Wang (2000), Qing and Ou (2001), and Xu et al. (2001) have used the non-parametric techniques, while Qian (2003), Liu and Song (2004), and Zhang et al. (2005) have used the parametric methods.

Ariff and Can (2007) used the non-parametric Data Envelopment Analysis (DEA) technique to investigate the cost and profit efficiency of 28 Chinese commercial banks during the period 1995 to 2004. In the second stage regression, they examine the influence of ownership type, size, risk profile, profitability, and key environmental changes on bank efficiency by using the Tobit regression. They find that profit efficiency levels are lower than cost efficiency, suggesting that the most important inefficiencies are on the revenue side. They suggest that the joint-stock commercial banks (national and city based) have exhibited higher cost and profit efficiency relative to their state-owned bank counterparts. Likewise, they find that the medium sized banks are more efficient than their small and large peers.

By employing the stochastic frontier production function, Yao et al. (2007) used a panel data of 22 banks over the period 1995-2001 to investigate the effects of ownership structure and hard budget constraint on China banks' efficiency. Their empirical results suggest that the non-state banks were 8-18% more efficient than the state banks, and that banks facing a harder budget tend to perform better than those heavily capitalized by the state or regional governments. The results shed important light on banking sector reform in China facing up to the tough challenges after WTO accession.

2.1 Evidence on Bank Efficiency and Share Prices

Efficiency studies applied to banking sectors are abound in the literature. However, only a few studies have examined the relationship between bank efficiency and its share price performance in the marketplace (Beccalli et al. 2006). Using DEA with three inputs and two outputs, Chu and Lim (1998) evaluated the relative cost and profit efficiency of a panel of six Singapore listed banks during the period 1992-1996. They found that during the period the six Singapore listed banks have exhibited higher overall efficiency of 95.3% compared to profit efficiency of 82.6%. They also found that large Singapore banks have reported higher efficiency of 99.0% compared to 92.0% for the small banks. They also suggested that scale inefficiency dominates pure technical inefficiency during the period of study. They found that percentage change in the price of bank shares reflect percentage change in profit rather than cost efficiency.

By using the DEA and the parametric Stochastic Frontier Approach (SFA) method, Beccalli et al. (2006) estimated efficiency measures of the banking cost to a sample of European banks (France, Germany, Italy, Spain, and the UK) in 1999 and 2000. The definition of the parameters used in the model, focused on the intermediation using deposits, loans, and securities as outputs, and labour and capital as inputs. The authors made the regression of the annual scores of efficiency in relation to the respective performances in the stock market. The results suggest that changes in the prices of banks' stocks mirror changes in cost efficiency, especially the ones derived from the DEA. This trend is less clear when the SFA model is used.

Kirkwood and Nahm (2006) used Data Envelopment Analysis (DEA) to evaluate cost efficiency of Australian banks in producing banking services and profit between 1995 and 2002. The empirical findings indicate that the major banks have improved their efficiency in producing banking services and profit, while the regional banks have experienced little change in the efficiency of producing banking services, and a decline in the efficiency of producing profit. They further relate the changes in efficiency to stock returns and found that change in bank efficiency is reflected in stock returns.

Sufian and Majid (2006) empirically investigated the cost and profit efficiencies of Malaysian banks that are listed on the Kuala Lumpur Stock Exchange (KLSE) during 2002-2003 by applying the non-parametric DEA model. They found that the cost efficiency of Malaysian banks was on average significantly higher compared to profit efficiency. They also suggest that the large banking groups on average were more cost efficient, whereas the smaller banking groups were found to be more profit efficient. They suggest that the stock prices of Malaysian banks react more towards the improvements in profit efficiency rather than the improvements in cost efficiency.

Pasiouras et al. (2007) examined the association between the efficiency of Greek banks and their share price performance. Their sample of analysis comprised of the 10 Greece commercial banks, which are listed on the Athens stock exchange. They found that the average technical efficiency under the constant returns to scale is 93.1% and increases to 97.7% under variable returns to scale. The regression results indicate a positive and statistically significant relationship between annual changes in technical efficiency and share price returns. On the other hand, they found that changes in scale efficiency have no impact on share price returns.

2.2 Bank Efficiency Studies Utilizing DEA Window Analysis

Although studies investigating bank efficiency using DEA are voluminous, there are only a few papers, which have utilized the DEA Window Analysis method, first proposed by Charnes et al. (1985) to banking. Among the notable microeconomic research performed were those by Reisman et al. (2003), Webb (2003), Avkiran (2004), and Sufian (2007).

Reisman et al. (2003) investigated the impact of deregulation on the efficiency of eleven Tunisian commercial banks during 1990 to 2001. Applying three inputs namely fixed assets, number of employees, and deposits, loans and securities portfolios as outputs, they followed the intermediation approach to DEA with an extended window analysis. They found that deregulation had a positive impact on Tunisian commercial banks' technical efficiency. They suggest that public banks outperformed private banks in transforming deposits into loans. The decomposition of technical efficiency into its pure technical and scale efficiency components indicate that private banks experienced predominantly pure technical inefficiency during the period. The public banks on the other hand were pure technically inefficient during the early period, which was mostly, scale inefficient towards the end of the period of study. They also suggest that both public and private banks were inefficient in their investments.

Webb (2003) utilized DEA Window Analysis to investigate the relative efficiency levels of large UK retail banks during the period of 1982-1995. Following the intermediation approach, three inputs are considered namely deposits, interest expense, and operational expenses, while total income and total loans are outputs. He found that during the period the mean inefficiency levels of UK retail banks were low compared to past studies on UK banking industry. He suggested that the overall long run average efficiency level is falling and that all the six large UK banks shows declining levels of efficiency over the entire period. He concluded that scale inefficiency dominated pure technical inefficiency; less big banks are more likely to report technical inefficiency, and during the period of study banks with asset levels of over ₤105 billion suffered declining returns to scale (DRS).

Applying a three-year window to a sample of 10 Australian trading banks during the period 1986-1995, Avkiran (2004) found that Australian trading banks have exhibited deteriorating efficiency levels during the earlier part of the studies, before progressively trending upwards in the latter part. During the period of study, he found that interest expenses to be the main source of inefficiency of Australian trading banks. He suggest that most Australian banks have exhibited CRS during the early period, DRS and IRS in the early 1990s and turn to exhibit CRS during the latter part of the studies.

More recently, Sufian (2007) investigated the long-term trend in the efficiency of the Singapore banking groups over the period 1993-2003 by using the DEA Window Analysis approach. During the period of study, he found that the Singapore banking groups have exhibited mean technical efficiency of 88.4%. The findings suggest that the Singapore banking groups' technical efficiency was on a declining trend during the earlier part of the study, before increasing during the later period. Overall, the results suggest that scale inefficiency outweighs pure technical inefficiency in determining the Singapore banking groups' technical efficiency. The empirical findings also suggest that the small Singapore banking groups outperformed their large and very large counterparts for all efficiency measures.

3. METHODOLOGY AND DATA DEFINITIONS

A non-parametric Data Envelopment Analysis (DEA) is employed with variable return to scale assumption to measure input-oriented technical efficiency of China banking groups. DEA involves constructing a non-parametric production frontier based on the actual input-output observations in the sample relative to which efficiency of each firm in the sample is measured (Coelli, 1996). Let us give a short description of the Data Envelopment Analysis[3]. Assume that there is data on K inputs and M outputs for each N bank. For ith bank these are represented by the vectors x_i and y_i respectively. Let us call the K x N input matrix – X and the M x N output matrix – Y. To measure the efficiency for each bank we calculate a ratio of all inputs, such as $(u'y_i/v'x_i)$ where u is an M x 1 vector of output weights and v is a K x 1 vector of input weights. To select optimal weights we specify the following mathematical programming problem:

$$\min_{u,v} (u'y_i/v'x_i),$$
$$u'y_i/v'x_i \leq 1, \qquad j = 1, 2,\ldots, N,$$
$$u,v \geq 0 \qquad (1)$$

The above formulation has a problem of infinite solutions and therefore we impose the constraint $v'x_i = 1$, which leads to:

$$\min_{\mu,\varphi} (\mu' y_i),$$
$$\varphi' x_i = 1$$
$$\mu' y_i - \varphi' x_j \leq 0 \qquad j = 1, 2,\ldots, N,$$
$$\mu,\varphi \geq 0 \qquad (2)$$

where we change notation from u and v to μ and φ, respectively, in order to reflect transformations. Using the duality in linear programming, an equivalent envelopment form of this problem can be derived:

$$\min_{\theta, \lambda} \theta,$$

3 Good reference books on efficiency measures are Coelli et al. (1998), Cooper et al. (2000), and Thanassoulis (2001).

$$y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$\lambda \geq 0 \tag{3}$$

where θ is a scalar representing the value of the efficiency score for the *i*th decision-making unit which will range between 0 and 1. λ is a vector of N x 1 constants. The linear programming has to be solved N times, once for each decision-making unit in the sample. In order to calculate efficiency under the assumption of variable returns to scale, the convexity constraint ($N1'\lambda = 1$) will be added to ensure that an inefficient firm is only compared against firms of similar size, and therefore provides the basis for measuring economies of scale within the DEA concept. The convexity constraint determines how closely the production frontier envelops the observed input-output combinations and is not imposed in the constant returns to scale case.

3.1 Window Analysis

In order to capture the variations of efficiency over time, Charnes et al. (1985) proposed a technique called 'window analysis' in DEA. The window analysis assesses the performance of a DMU over time by treating it as a different entity in each time-period. This method allows for tracking the performance of a unit or DMU over time and provides a better degree of freedom (Avkiran, 2004; Reisman, 2003; Sufian, 2007). If a DMU is found to be efficient in one year despite the window in which it is placed, it is likely to be considered strongly efficient compared to its peers (Avkiran, 2004).

As there is no theory that underpins the definition of the window size (Tulkens and van den Eeckaut, 1995), this paper utilizes a three-year window, which is consistent with the original work by Charnes et al. (1985). Furthermore, Reisman (2003), Webb (2003), Avkiran (2004), and Sufian (2007) have also utilized a three-year window to investigate the Tunisian, UK, Australian, and Singapore banks' efficiency respectively.

To illustrate, from Table 1 below, the first window incorporate years 1997, 1998, and 1999. When a new period is introduced into the window, the earliest period is dropped i.e. in window 2, year 1997 is dropped, and year 2000 will be added to the new window. Subsequently in window 3, years 1999, 2000, and 2001 will be assessed. The analysis is performed until window 8 analyzes years 2004, 2005, and 2006. As DEA Window Analysis treats a DMU as different entity in each year, a three-year window with seven DMUs is equivalent to 21 DMUs. Subsequently, by applying an eight, three-year window, would considerably increase the number of observations of the sample to 168 (i.e. 7x3x8), thus providing a greater degree of freedom to the sample[4].

[Insert Table 1]

3.2 Linking Bank Efficiency to Share Price Returns

Given the unbalanced nature of the panel, several econometric issues arise. In order to examine the relationship between China bank efficiency and its share price performance, several specification tests are performed. First, although banks may be modelled as potentially heterogeneous cross-sectional units, estimations are conducted assuming homogeneity. This approach is justified on the assumption that parameters are homogeneous across banks. Furthermore, Baltagi et al. (2003) argues that when the sample is short, homogeneous panel estimation may be a more preferred approach to heterogeneous panel estimation.

Another issue concerns what estimation approach to use between pooled analysis, fixed effects and/or random effects. To determine the choice of the appropriate methodology, following the procedures set in Baltagi (2001), several specification tests are employed. To choose between fixed effects and pooled estimation, the likelihood ratio (LR) test was used and the Breush-Pagan Lagrange Multiplier (LM) test was conducted to assess whether the model must be estimated by random effects or pooled estimation analysis, while the Hausman test was used to choose between fixed and random effects. In all the specifications, pooled analysis was rejected at conventional significance level. In a majority of specifications, the Hausman test urges the use of fixed effects estimation. Accordingly, in order to account for unobserved factors, the empirical evidence presented in the paper is based on the fixed effects estimation.

The relationship between bank efficiency and share price performance is examined by regressing bank share returns against bank efficiency estimates derived from the DEA Window Analysis method. In addition to the basic pooled OLS model, this paper estimates panel regression method by combining cross section and time series data with the fixed effect estimators to control for the heterogeneity among bank specific factors, which are not considered in the basic regression model that may affect share price return, knowingly or not. White's (1980) heteroscedasticity consistent statistics is used. Accordingly, the following model is estimated:

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4 Due to entry and exit, the total number of bank year observations total 127.

$$SHR\_RET_{jt} = \alpha_0 + \beta EFF_{jt} + \beta \Sigma BSF_{jt} + \in_j \quad (4)$$

$$\varepsilon_{jt} = \mu_j + \nu_{jt}$$

where SHR_RET_{jt} is the moving average of bank j's *daily* share returns in window t; α_0 are bank j's fixed effects, EFF_{jt} is bank j's mean annual percentage change in bank efficiency in window t; β are the parameters to be estimated excluding the constant; and $\in_j$ is a normally distributed error term. The error term is assumed to be free from autocorrelation. Heteroskedasticity is corrected in the estimations by using the robust variance covariance matrix.

EFF_{jt} include the technical, pure technical, and scale efficiency scores derived from the DEA Window Analysis method. BSF_{jt} is an array of bank specific factors that are relevant to the modern banking business. These include *LNDEPO* as a proxy of bank's market power calculated as a natural logarithm of total bank deposits. *LOANTA* is a measure of bank's loans intensity calculated as the ratio of total loans to bank total assets. *LNTA* is the size of the bank's total asset measured as the natural logarithm of banks' total assets. *NIE/TA* is a measure of bank management quality calculated as total non-interest expenses divided by total assets. *NII/TA* is a measure of bank's diversification towards non-interest income, calculated as total non-interest income divided by total assets. *EQUITY/TA* is a measure of banks' leverage intensity measured by banks' total shareholders equity divided by total assets. *ROA* is a proxy measure for bank profitability calculated as bank profit after tax divided by total assets. Finally, *INV/TA* is a proxy measure for investment capacity calculated as investment divided by total assets.

3.3 Variables Definition

In the banking theory literature, there are two main approaches competing with each other in this regard; the production and intermediation approaches (Sealey and Lindley, 1977). Under the production approach pioneered by Benston (1965), a financial institution is defined as a producer of services for account holders, that is, they perform transactions on deposit accounts and process documents such as loans. The intermediation approach on the other hand assumes that financial firms act as an intermediary between savers and borrowers and posits total loans and securities as outputs, whereas deposits along with labour and physical capital are defined as inputs.

For the purpose of this study, a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) is adopted in the definition of inputs and outputs used. According to Berger and Humphrey (1997), the production approach might be more suitable for branch efficiency studies as at most times bank branches process customer documents and bank funding, while investment decisions are mostly not under the control of branches. Accordingly, we model China commercial banking groups as multi-product firms, producing two outputs by employing two inputs. All variables are measured in million of China Renminbi (RMB). This study employs annual data from 1997 to 2006 for each of the state-owned and joint stock commercial banks listed on the Shanghai Stock Exchange. All of the data come from of *the Almanac of China's Finance and Banking* (various editions).

The input vectors include (*x1*) *Total Deposits*, which includes deposits from customers and other banks and (*x2*) *Fixed Assets* while (*y1*) *Total Loans*, which includes loans to customers and other banks and (*y2*) *Investments* are the output vectors. Table 2 presents the descriptive statistics for the selected variables that are categorized under the intermediation approach of modelling bank behaviour.

[Insert Table 2]

For the panel regression analysis, individual banks' annual share returns are obtained from *Bloomberg*. The annual share returns are calculated as the sum of daily share returns for all listed China banks namely, China Merchants Bank Co Ltd (CMB), China Minsheng Banking Corporation (CHMB), Hua Xia Bank (HXB), Industrial and Commercial Bank of China (ICBC), Industrial Bank Co Ltd (IBC), Shanghai Pudong Development Bank (SPDB), and Shenzhen Development Bank Co. Ltd (SDB). This measure is believed to be a better measure than calculating a point increase with data from the first and the last day of the period under investigation. Daily returns have smaller standard deviations than do annual and monthly returns[5].

4. EMPIRICAL RESULTS

As mentioned earlier, this study will be the first to examine the efficiency of the China banking sector by utilizing the DEA Window Analysis method. To recap, the DEA model is applied to eight, three-year windows, and the results are reported for the general trends in technical efficiency for each window before we embark to briefly discuss the decomposition of technical efficiency into its mutually exhaustive pure technical and scale efficiency components. Changes over time for the sequence of the windows are then considered.

5 The mean standard deviation of monthly returns for randomly selected securities is about 7.8%, while the corresponding mean standard deviation of daily returns will be approximately 1.8% if daily returns are serially independent (Fama, 1976, pp.123).

The average of all scores for each bank is given in the column denoted 'Mean'. The column labeled 'SD' indicates the standard deviation for the score of each bank during the entire period. The column labeled 'LDY' indicates the largest difference in a bank's scores in the same year but in different windows. The column labeled 'LDP' indicates the largest difference in a bank's scores for the entire period. A bank can have different efficiency scores in different windows. A bank that is efficient in one year regardless of the window is said to be stable in its efficiency rating (Cooper et al. 2000).

4.1 Efficiency of the China Banking Sector

Table 3 presents the decomposition of the technical efficiency scores for each bank, with each bank represented as if it is a different DMU at each of the three successive dates noted at the top of each column. Eight separate windows are presented as separate rows in Table 3. Taking CHMB for example, in Table 3, the technical efficiency of CHMB in the first window is 81.9%, 100.0%, and 98.3%. These figures correspond to the estimated relative efficiency of CHMB for years 1997, 1998, and 1999 respectively. In the second window, the relative efficiency estimates of 100.0%, 95.2%, and 100.0% correspond to years 1998, 1999, and 2000 respectively.

The approach used in formulating Table 3 lends itself to a study of 'trends' and the examination of the 'stability' of efficiency scores, as well as within windows by the adoption of 'row views' and 'column views' respectively. For instance, taking CHMB again for example, the bank's efficiency varies from 85.6% to 100.0% in years 2000 through to 2002 (window 4) by adopting a 'row view' perspective. At the same time, the efficiency of a DMU within different windows can also vary substantially by adopting a 'column view' perspective. This variation reflects simultaneously both the absolute performance of a bank over time and the relative performance of that bank in comparison to its peers in the sample.

[Insert Table 3]

It is observed from Table 3 that SDB is the most efficient bank during the period, maintaining its position with mean technical efficiency of 96.5% and accompanied by a relatively low standard deviations of 0.052, which is consistent with Charnes et al. (1985). To recap, Charnes et al. (1985) suggested that DMUs with high efficiency levels tend to demonstrate lower standard deviations compared to its peers with lower efficiency levels. While SDB is the most efficient bank in terms of minimizing costs to produce the same level of outputs, on the other hand the findings seem to suggest that HXB is the least efficient bank with a mean technical efficiency level of 81.6% and standard deviation of 0.087 during the period of study.

Table 4 presents the results for the pure technical efficiency of the China banks. In general, it has been concluded by Berger et al. (1993) that large banks tend to report higher levels of pure technical efficiency than do their smaller counterparts. Supporting the findings of Berger et al. (1993), we find that the large banks namely, HXB, ICBC, and IBC have reported the highest mean pure technical efficiency of 98.2%, followed by the small banks, CHMB and SDB, with a mean pure technical efficiency of 94.0%, while the medium banking groups, SPDB and CMB, with total assets ranging from RMB50 billion to RMB100 billion, have reported the lowest mean pure technical efficiency of 93.9%.

[Insert Table 4]

It could be argued that the large banks may have the advantage over its smaller counterparts as the large banks may attract more deposits and loan transactions and in the process, command larger interest rate spreads. Furthermore, large banks may offer more services and in the process derive substantial non-interest income from commissions, fees and other treasury activities. Randhawa and Lim (2005) find that the large banks' extensive branch networks and large depositor base have attracted cheaper source of funds. On the other hand, the smaller banking groups with smaller depositor base might have to resort to purchasing funds in the inter-bank market, which is costlier.

It is worth mentioning that earlier bank efficiency studies have generally found large banks tend to report lower level of scale efficiency (Miller and Noulas, 1996; Drake and Hall, 2003; Webb, 2003). Similar to the pure technical efficiency results, it is clear from Table 5 that the small China banks have exhibited the lowest mean scale efficiency compared to its medium and large counterparts. The findings seem to suggest that the small banks namely, CHMB and SDB have reported the lowest mean scale efficiency of 95.6% compared to their large bank counterparts namely, HXB, ICBC, and IBC, with total assets of over RMB100 billion, which have exhibited mean scale efficiency of 95.9%. On the other hand, the results seem to suggest that the medium sized banks have exhibited the highest mean scale efficiency of 97.9% during the period of study.

[Insert Table 5]

4.2 Efficiency and China Banks' Share Price Returns

Share price performance could be argued to be the ultimate measure of efficiency. If bank share prices reflect almost all the information about the past, present, and expected future performance of firms, then this measure would be the more reliable indicator of bank efficiency. However, even if the choice of measures is correct, the previously described measures of efficiency may only be related to share price performance in the long-term. Short-term variations may not be explained by efficiency measures. In this case, individual bank effects may explain the majority of total variations in share price performance. In term of average share price performance over the years, CHMB has exhibited the highest annual share return of 37.86%, while SDB exhibited the lowest average annual share return of 1.47% over the sample period. In terms of share returns volatility, CHMB share price was the most volatile, while HXB was the most stable[6].

To examine whether statistical relationship exists between bank efficiency scores derived from the DEA Window Analysis method and China banks' share price performance, Equation (4) is estimated by using bank efficiency scores as the independent variable against share price return as the dependent variable. It is expected that the efficiency scores to be positively correlated with share prices. Tables 6-8 present the results derived from estimating Equation (4) by panel regression model with fixed-effects. It is interesting to note that the results from the fixed-effect model continued to remain robust across various regressions models with the inclusion of other bank specific trait variables. This gives us comfort into that accurate inferences are made regarding the test results.

Regression results focusing on the relationship between bank efficiency and share prices and other explanatory variables are presented in Tables 6-8. It is observed that both TE and PTE entered the regression models positively and significantly as expected. However, the coefficient of SE is insignificant in any of the regression models. These findings suggest that share prices of the relatively more managerially efficient banks tend to outperform their inefficient counterparts, which is consistent with earlier studies by among others Chu and Lim (1998), Beccalli et al. (2006), and Sufian and Majid (2006). On the other hand, the empirical findings seem to suggest that scale efficiency does not explain the variations in share prices in the marketplace. It is observed from Tables 6-8, the inclusion of other explanatory variables in Models 2-8 increase the explanatory power of the regression models with the variation in share price return ranges between 25% – 65% (adjusted variation is between 15% – 43%).

6 For brevity purposes, the table has been excluded from the text but is available from the authors upon request.

This indicates that the inclusion of other bank specific traits in the regression models to contribute to a better goodness of fit in explaining the variation in share price performance.

[Insert Table 6-8]

To further analyze this relationship, the reaction of changes in different bank efficiency estimates on share price returns is further examined by the magnitudes of the coefficient derived from the panel regression model. The magnitude of the coefficient of technical efficiency scores are positive ranging between 2.21 – 5.39, implying that a one percent improvement in efficiency would lead to the improvement in China banks' share prices between 2.21% – 5.39%. Likewise, the magnitude of the coefficient of pure technical efficiency scores is also positive, albeit higher, ranging between 5.12 – 7.55. On the other hand, China banks' share price returns seem not to react to changes in scale efficiency. The empirical findings seem to suggest that share price returns respond positively towards improvement in managerial efficiency but do not react towards changes in scale efficiency. The empirical results presented in this paper also concur with the earlier findings by Pasiouras et al. (2008) on the Greece banking sector, who suggest that changes in scale efficiency have no impact on share price performance.

Another important result of the regression models is the significance of the relationship between banks' share price returns and TE, PTE, and other bank specific trait variables namely, *NII/TA*, *LOAN/TA*, and *INV/TA* across all regression models. Nevertheless, the relationship between share price returns, SE, and other bank trait variables namely, *NII/TA*, *NIE/TA*, *LOAN/TA, LNDEPO*, and *LNTA* also contribute to better understanding on the variation of China banks' share price behaviour. The coefficient of *NII/TA* entered the regression models positively, suggesting that higher income from non-interest based product enhances share price performance. The coefficient of the variable *LOAN/TA* has a negative effect on share price returns, suggesting that banks with a higher level of loans-to-asset ratio could have a riskier loan portfolio and therefore, negatively affecting banks' income.

The coefficient of the *INV/TA* variable is negative and is statistically significant, indicating that banks, which do not maximize its investment capacity, will not improve their share price performance. The coefficient of *LNTA* exhibits a positive sign, implying that larger banks are more efficient in minimizing their operating costs. On the other hand, *LNDEPO* entered the regression models negatively. Finally, *NIE/TA* exhibits a positive sign implying that better management's technical ability in managing their operating costs would lead to higher earnings, which would translate into higher share price returns.

5. CONCLUSIONS

The paper attempts to investigate the efficiency of listed China commercial banks during the period of 1997-2006. The preferred non-parametric DEA Window Analysis methodology allows us to distinguish between three different types of efficiency, namely the technical, pure technical, and scale efficiency. In addition, the method also provides greater degree of freedom to the sample.

Our findings are consistent with prior evidence in the existing literature on bank efficiency (Berger et al. 1993) that large banks tend to report higher levels of pure technical efficiency, than do their smaller counterparts. The empirical findings suggest that large China banks have exhibited higher technical and pure technical efficiency levels compared to their small and medium sized bank counterparts. On the other hand, the medium sized banks have exhibited a higher scale efficiency compared to their small and large bank peers.

The explanation of the efficiency scores using panel regressions offers useful economic insights. Bank efficiency is found to be related to bank characteristics. Bank efficiency is found to decline with investment capacity, loans intensity, and market power, while it is found to increase with bank management quality, size, and bank's diversification towards non-interest income. Furthermore, the results suggest that changes in technical efficiency are statistically significant in determining banks' share price returns, whereas scale efficiency does not explain the variation in share price returns. The most important finding here would be that the efficiency of a bank's operation has significant information about its share price performance, which is not explained by market movements.

One implication of the findings is that managerially efficient banks, *ceteris paribus*, should be more profitable and therefore generates greater shareholder returns[7]. This is in line with the efficient market theory that in an efficient market a change in cost efficiency should be incorporated in the price formation process. Nevertheless, generalization of this conclusion would require more studies involving the whole range of industries and the banking sector.

7 As pointed out by Eisenbeis et al. (1999) the *ceteris paribus* condition is important since cost is only one half of the profit equation and therefore does not tell the full story. For example, a bank may offer greater customer services, which while more costly, also increases revenues.

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Table 1. **Windows Breakdown**

Window 1	1997	1998	1999						
Window 2		1998	1999	2000					
Window 3			1999	2000	2001				
Window 4				2000	2001	2002			
Window 5					2001	2002	2003		
Window 6						2002	2003	2004	
Window 7							2003	2004	2005	
Window 8								2004	2005	2006

Table 2. **Descriptive Statistics for Inputs and Outputs**

	Window 1 (RMBm)	Window 2 (RMBm)	Window 3 (RMBm)	Window 4 (RMBm)	Window 5 (RMBm)	Window 6 (RMBm)	Window 7 (RMBm)	Window 8 (RMBm)
Outputs								
Total Loans (y1)								
Minimum	5,137.39	10,996.48	17,178.66	39,138.02	66,422.45	88,310.98	126,195.50	126,195.50
Maximum	82,835.04	109,742.90	140,185.50	206,931.30	3,402,277.00	3,707,748.00	3,707,748.00	3,707,748.00
Mean	31,641.27	48,105.38	67,676.99	98,897.95	339,874.84	554,139.80	712,888.63	795,248.32
Standard Deviation	25,123.84	29,003.81	33,379.44	48,394.28	791,937.78	1,061,533.24	1,157,741.45	1,192,193.03
Investments (y2)								
Minimum	745.30	3,368.03	4,520.22	7,740.88	100.00	100.00	100.00	100.00
Maximum	20,071.77	36,640.84	61,910.42	87,734.48	761,923.00	826,325.00	1,957,265.00	1,957,265.00
Mean	6,937.24	11,386.82	18,413.93	26,641.53	73,415.65	109,474.72	188,078.14	221,594.92
Standard Deviation	5,946.46	9,310.49	15,222.59	22,234.20	179,170.81	242,939.96	467,564.14	516,228.96
Inputs								
Total Deposits (x1)								
Minimum	13,345.41	17,733.29	29,252.76	51,863.23	86,463.77	113,219.00	141,030.70	165,703.00
Maximum	121,647.10	163,881.20	212,827.10	300,182.60	4,706,861.00	5,176,282.00	5,736,866.00	6,351,423.00
Mean	46,567.86	69,599.09	98,577.27	140,203.12	465,712.31	756,453.02	1,025,197.94	1,208,442.72
Standard Deviation	36,257.10	43,541.13	51,527.71	70,812.56	1,096,398.05	1,480,257.49	1,760,882.84	1,974,837.19
Fixed Assets (x2)								
Minimum	410.29	691.72	909.62	989.79	1,958.83	1,945.93	1,793.76	1,730.03
Maximum	4,079.41	4,680.40	5,508.91	5,508.91	77,767.00	77,767.00	112,641.00	112,641.00
Mean	1,689.35	2,211.38	2,849.57	3,129.68	7,826.77	11,411.50	16,139.17	18,534.05
Standard Deviation	1,226.87	1,386.38	1,415.48	1,381.63	18,062.01	23,033.41	31,073.43	35,030.97

Table 3. **Window Analysis of Technical Efficiency Scores**

Bank	Window	Mean/Window	Mean	SD	LDY	LDP
CMB	1	0.985	0.960	0.048	0.120	0.120
	2	0.964				
	3	0.938				
	4	0.958				
	5	0.999				
	6	0.983				
	7	0.960				
	8	0.892				
	Mean Windows 1-4	0.962				
	Mean Windows 5-8	0.958				
CHMB	1	0.934	0.941	0.059	0.144	0.181
	2	0.984				
	3	0.952				
	4	0.913				
	5	0.930				
	6	0.954				
	7	0.946				
	8	0.915				
	Mean Windows 1-4	0.957				
	Mean Windows 5-8	0.932				
HXB	2	0.952	0.816	0.087	0.205	0.299
	3	0.829				
	4	0.766				
	5	0.762				
	6	0.771				
	7	0.779				
	8	0.853				
	Mean Windows 1-4	0.891				
	Mean Windows 5-8	0.786				
ICBC	5	0.836	0.871	0.072	0.045	0.199
	6	0.846				
	7	0.901				
	8	0.900				
	Mean Windows 5-8	0.871				
IBC	5	0.863	0.882	0.060	0.147	0.173
	6	0.924				
	7	0.888				
	8	0.851				
	Mean Windows 5-8	0.882				
SPDB	1	0.976	0.906	0.081	0.128	0.232
	2	0.934				
	3	0.862				
	4	0.801				
	5	0.839				
	6	0.900				
	7	0.964				
	8	0.975				
	Mean Windows 1-4	0.924				
	Mean Windows 5-8	0.896				
SDB	1	0.997	0.964	0.052	0.163	0.163
	2	0.995				
	3	0.954				
	4	0.909				
	5	0.963				
	6	0.989				
	7	0.965				
	8	0.942				
	Mean Windows 1-4	0.982				
	Mean Windows 5-8	0.954				

Mean is the average score for the ten year period; SD is the standard deviation for the period; LDY is the largest difference between scores in the same year; LDP is the largest difference between scores across the entire period. CMB is stand for China Merchants Bank Co Ltd; CHMB is stand for China Minsheng Banking Corporation; HXB is stand for Hua Xia Bank; ICBC is stand for Industrial and Commercial Bank of China; IBC is stand for Industrial Bank Co Ltd; SPDB is stand for Shanghai Pudong Development Bank; SDB is stand for Shenzhen Development Bank Co. Ltd.

Table 4. **Window Analysis of Pure Technical Efficiency Scores**

Bank	Window	Mean/Window	Mean	SD	LDY	LDP
	1	1.000				
	2	0.997				
	3	0.955				
	4	0.968				
CMB	5	1.000	0.984	0.032	0.100	0.100
	6	0.998				
	7	0.980				
	8	0.976				
	Mean Windows 1-4	0.980				
	Mean Windows 5-8	0.989				
	1	1.000				
	2	0.985				
	3	1.000				
	4	0.976				
CHMB	5	0.977	0.978	0.034	0.099	0.099
	6	0.966				
	7	0.948				
	8	0.974				
	Mean Windows 1-4	0.990				
	Mean Windows 5-8	0.966				
	2	1.000				
	3	0.839				
	4	0.837				
HXB	5	0.877	0.870	0.096	0.158	0.272
	6	0.871				
	7	0.782				
	8	0.884				
	Mean Windows 1-4	0.892				
	Mean Windows 5-8	0.854				
	5	1.000				
ICBC	6	1.000	1.000	0.000	0.000	0.000
	7	1.000				
	8	1.000				
	Mean Windows 5-8	1.000				
	5	0.876				
IBC	6	0.926	0.896	0.064	0.137	0.167
	7	0.909				
	8	0.875				
	Mean Windows 5-8	0.896				
	1	0.984				
	2	0.966				
	3	0.883				
	4	0.881				
SPDB	5	0.897	0.936	0.071	0.189	0.196
	6	0.909				
	7	0.970				
	8	1.000				
	Mean Windows 1-4	0.929				
	Mean Windows 5-8	0.944				
	1	1.000				
	2	0.995				
	3	0.994				
	4	0.982				
SDB	5	1.000	0.996	0.012	0.055	0.055
	6	1.000				
	7	1.000				
	8	1.000				
	Mean Windows 1-4	0.993				
	Mean Windows 5-8	1.000				

Mean is the average score for the ten year period; SD is the standard deviation for the period; LDY is the largest difference between scores in the same year; LDP is the largest difference between scores across the entire period. CMB is stand for China Merchants Bank Co Ltd; CHMB is stand for China Minsheng Banking Corporation; HXB is stand for Hua Xia Bank; ICBC is stand for Industrial and Commercial Bank of China; IBC is stand for Industrial Bank Co Ltd; SPDB is stand for Shanghai Pudong Development Bank; SDB is stand for Shenzhen Development Bank Co. Ltd.

Table 5. **Window Analysis of Scale Efficiency Scores**

Bank	Window	Mean/Window	Mean	SD	LDY	LDP
	1	0.985				
	2	0.967				
	3	0.983				
	4	0.990				
CMB	5	0.999	0.975	0.033	0.061	0.117
	6	0.985				
	7	0.980				
	8	0.915				
	Mean Windows 1-4	0.981				
	Mean Windows 5-8	0.970				
	1	0.934				
	2	0.999				
	3	0.952				
	4	0.936				
CHMB	5	0.952	0.962	0.055	0.144	0.181
	6	0.987				
	7	0.998				
	8	0.941				
	Mean Windows 1-4	0.955				
	Mean Windows 5-8	0.970				
	2	0.952				
	3	0.988				
	4	0.915				
HXB	5	0.871	0.947	0.057	0.153	0.161
	6	0.945				
	7	0.996				
	8	0.962				
	Mean Windows 1-4	0.952				
	Mean Windows 5-8	0.943				
	5	0.836				
ICBC	6	0.846	0.871	0.072	0.045	0.199
	7	0.901				
	8	0.900				
	Mean Windows 5-8	0.871				
	5	0.985				
IBC	6	0.997	0.978	0.027	0.078	0.078
	7	0.955				
	8	0.974				
	Mean Windows 5-8	0.978				
	1	0.992				
	2	0.966				
	3	0.978				
	4	0.914				
SPDB	5	0.937	0.968	0.040	0.147	0.170
	6	0.989				
	7	0.994				
	8	0.975				
	Mean Windows 1-4	0.962				
	Mean Windows 5-8	0.974				
	1	0.997				
	2	0.999				
	3	0.960				
	4	0.926				
SDB	5	0.963	0.968	0.049	0.163	0.163
	6	0.989				
	7	0.965				
	8	0.942				
	Mean Windows 1-4	0.971				
	Mean Windows 5-8	0.965				

Mean is the average score for the ten year period; SD is the standard deviation for the period; LDY is the largest difference between scores in the same year; LDP is the largest difference between scores across the entire period. CMB is stand for China Merchants Bank Co Ltd; CHMB is stand for China Minsheng Banking Corporation; HXB is stand for Hua Xia Bank; ICBC is stand for Industrial and Commercial Bank of China; IBC is stand for Industrial Bank Co Ltd; SPDB is stand for Shanghai Pudong Development Bank; SDB is stand for Shenzhen Development Bank Co. Ltd.

Table 6. **Technical Efficiency and Share Return**

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Technical Efficiency	2.207	4.353***	5.380***	5.192***	4.713***	4.025***	4.018**	5.390**
	(1.57)	(1.12)	(1.35)	(1.28)	(1.36)	(1.46)	(1.54)	(2.33)
Bank Characteristics								
ROA	-0.906	-0.555	-0.019	-0.091	-0.700	-0.800	-0.803	-0.735
	(5.98)	(0.39)	(0.73)	(0.66)	(0.90)	(0.98)	(1.08)	(1.14)
NII/TA	-	1.655***	1.756***	1.736***	1.514***	1.470***	1.479***	0.994*
		(0.32)	(0.30)	(0.32)	(0.24)	(0.23)	(0.54)	(0.55)
NIE/TA	-	-	0.832*	0.723*	0.510	1.088	1.087	0.589
			(0.43)	(0.39)	(1.06)	(1.41)	(1.41)	(1.63)
LOAN/TA	-	-	-	-3.724**	-5.173***	-5.279***	-5.327**	-6.484**
				(1.44)	(1.81)	(1.54)	(2.29)	(2.34)
LNDEPO	-	-	-	-	0.251	-1.134	-1.111	0.317
					(0.18)	(1.28)	(1.23)	(2.03)
LNTA	-	-	-	-	-	19.119	18.807	10.579
						(18.83)	(16.67)	(27.77)
EQUITY/TA	-	-	-	-	-	-	-0.012	0.316
							(0.63)	(0.60)
INV/TA	-	-	-	-	-	-	-	-3.455**
								(1.67)
Constant	0.802	2.505***	5.732	8.567*	11.021**	-17.200	-16.658	10.289
	(1.51)	(3.95)	(4.53)	(4.38)	(4.93)	(27.44)	(26.26)	(40.75)
R^2	0.26	0.50	0.55	0.59	0.61	0.62	0.62	0.63
Adjusted R^2	0.18	0.36	0.40	0.43	0.43	0.42	0.39	0.39
F**-Stat.**	1.472	3.503	3.611	3.714	3.469	3.160	2.790	2.656
Log-Likelihood	-31.13	-23.95	-22.17	-20.38	-19.64	-19.23	-19.23	-18.42

Note: *t*-statistics are in parenthesis. *, ** and *** indicates significance at 10%, 5%, and 1% confidence levels respectively. The models are estimated with fixed effects panel regressions (including bank and period fixed effects) with White's transformation to control for cross-section heteroscedasticity (d.f. corrected). *LNDEPO* is the natural logarithm of total bank deposits; *LOANTA* is the ratio of total loans to bank total assets; *LNTA* is the natural logarithm of banks' total assets; *NIE/TA* is the total non-interest expenses divided by total assets; *NII/TA* is the total non-interest income divided by total assets; *EQUITY/TA* is the banks' total shareholders equity divided by total assets; *ROA* is the bank profit after tax divided by total assets; *INV/TA* is the investment divided by total assets.

Table 7. **Pure Technical Efficiency and Share Return**

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pure Technical Efficiency	6.731***	6.614***	6.821***	6.537***	6.065***	5.155**	5.128**	7.549*
	(1.42)	(1.43)	(1.34)	(1.19)	(1.94)	(2.27)	(2.26)	(4.11)
Bank Characteristics								
ROA	0.826	-0.190	0.131	0.056	-0.239	-0.434	-0.483	-0.232
	(4.37)	(0.24)	(0.48)	(0.38)	(0.85)	(1.02)	(1.16)	(1.19)
NII/TA	-	1.197***	1.196***	1.195***	1.115***	1.151***	1.286**	0.570
		(0.25)	(0.25)	(0.27)	(0.26)	(0.22)	(0.59)	(0.66)
NIE/TA	-	-	0.416	0.323	0.247	1.070	1.015	0.287
			(0.25)	(0.22)	(1.25)	(1.68)	(1.61)	(2.00)
LOAN/TA	-	-	-	-3.597**	-4.306*	-4.486**	-5.169*	-6.551**
				(1.74)	(2.34)	(1.71)	(2.76)	(2.68)
LNDEPO	-	-	-	-	0.118	-2.002	-1.622	0.033
					(0.25)	(1.66)	(1.51)	(2.48)
LNTA	-	-	-	-	-	29.350	24.245	10.006
						(24.74)	(21.16)	(35.44)
EQUITY/TA	-	-	-	-	-	-	-0.184	0.169
							(0.668)	(0.70)
INV/TA	-	-	-	-	-	-	-	-4.506*
								(2.34)
Constant	-3.602**	4.530***	2.369	5.279**	6.802	-6.293	-2.622	2.984
	(1.34)	(1.59)	(2.85)	(2.40)	(4.86)	(3.60)	(3.89)	(4.51)
R^2	0.40	0.54	0.55	0.59	0.60	0.62	0.62	0.65
Adjusted R^2	0.25	0.41	0.40	0.43	0.41	0.43	0.40	0.42
***F*-Stat.**	2.690	4.066	3.671	3.731	3.299	3.204	2.846	2.820
Log-Likelihood	-27.51	-22.53	-22.00	-20.33	-20.19	-19.08	-19.01	-17.73

Note: *t*-statistics are in parenthesis. *, ** and *** indicates significance at 10%, 5%, and 1% confidence levels respectively. The models are estimated with fixed effects panel regressions (including bank and period fixed effects) with White's transformation to control for cross-section heteroscedasticity (d.f. corrected). *LNDEPO* is the natural logarithm of total bank deposits; *LOANTA* is the ratio of total loans to bank total assets; *LNTA* is the natural logarithm of banks' total assets; *NIE/TA* is the total non-interest expenses divided by total assets; *NII/TA* is the total non-interest income divided by total assets; *EQUITY/TA* is the banks' total shareholders equity divided by total assets; *ROA* is the bank profit after tax divided by total assets; *INV/TA* is the investment divided by total assets.

Table 8. **Scale Efficiency and Share Return**

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Scale Efficiency	-1.781	1.471	2.338	2.325	2.900	1.383	1.245	1.191
	(2.95)	(2.53)	(2.85)	(2.34)	(2.15)	(2.26)	(2.65)	(2.81)
Bank Characteristics								
ROA	0.971	-0.214	0.053	-0.032	-1.223	-1.234	-1.271	-1.254
	(5.37)	(0.45)	(0.65)	(0.55)	(0.68)	(0.86)	(1.00)	(1.03)
NII/TA	-	1.373***	1.462***	1.459***	1.190***	1.137***	1.254*	1.367***
		(0.29)	(0.31)	(0.34)	(0.30)	(0.30)	(0.66)	(0.65)
NIE/TA	-	-	0.446	0.344	1.838	2.658	2.610	2.603
			(0.41)	(0.35)	(0.88)	(1.33)	(1.16)	(1.16)
LOAN/TA	-	-	-	-4.219***	-6.869***	-6.531***	-7.163***	-6.808***
				(0.95)	(1.66)	(0.96)	(2.57)	2.55
LNDEPO	-	-	-	-	0.474**	-2.496***	-2.165*	-2.371*
					0.18	1.29	1.17	(1.33)
LNTA	-	-	-	-	-	39.939**	35.452**	38.096**
						(19.26)	(15.06)	(17.18)
EQUITY/TA	-	-	-	-	-	-	-0.176	-0.229
							(0.80)	(0.81)
INV/TA	-	-	-	-	-	-	-	0.682
								(0.98)
Constant	4.563	10.624***	8.288*	11.346**	14.842***	-44.915	-37.184	-41.051
	(2.90)	(2.62)	(4.63)	(4.18)	(3.83)	(28.30)	(27.03)	(29.93)
R^2	0.24	0.38	0.40	0.45	0.51	0.55	0.56	0.56
Adjusted R^2	0.15	0.20	0.19	0.23	0.29	0.33	0.30	0.27
F**-Stat.**	1.299	2.146	1.938	2.094	2.340	2.437	2.163	1.924
Log-Likelihood	-31.70	-27.91	-27.53	-25.81	-23.65	-22.00	-21.94	-21.91

Note: *t*-statistics are in parenthesis. *, ** and *** indicates significance at 10%, 5%, and 1% confidence levels respectively. The models are estimated with fixed effects panel regressions (including bank and period fixed effects) with White's transformation to control for cross-section heteroscedasticity (d.f. corrected). *LNDEPO* is the natural logarithm of total bank deposits; *LOANTA* is the ratio of total loans to bank total assets; *LNTA* is the natural logarithm of banks' total assets; *NIE/TA* is the total non-interest expenses divided by total assets; *NII/TA* is the total non-interest income divided by total assets; *EQUITY/TA* is the banks' total shareholders equity divided by total assets; *ROA* is the bank profit after tax divided by total assets; *INV/TA* is the investment divided by total assets.