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Antecedents of Total Factor Productivity of Malaysian Banks: Evidence from Semi-Parametric Malmquist Productivity Index Method

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Abstract

The paper employs the semi-parametric Malmquist Productivity Index (MPI) method to assess the impact of technological change on the obtained total factor productivity of Malaysian banks during the period 1998 – 2008. The preferred methodology provides bias-corrected estimates of total factor productivity change along with the information on efforts to catch up to the frontier (efficiency change) from shifts in the frontier (technological change). During the period under study, the empirical findings indicate that the Malaysian banking sector has exhibited productivity progress mainly attributed to technological progress. We also find that shift in the frontier (technological change) positively influence both domestic and foreign banks total factor productivity change.

Keywords: Banks; total factor productivity; technological change; efficiency change; bootstrap malmquist productivity index

Abstrak

Kajian ini menggunakan kaedah Indeks Productiviti Malmquist semi-parametrik untuk menilai kesan perubahan teknologi keatas jumlah faktor produktiviti bank-bank di Malaysia dalam tempoh 1998 - 2008. Kaedah ini mampu menyediakan pembaikpulih kepincangan anggaran jumlah perubahan faktor produktiviti berserta maklumat bagi mendapatkan garis sempadan (kecekapan perubahan) daripada peralihan dalam garis sempadan (perubahan teknologi). Dalam tempoh kajian ini, penemuan empirikal menyatakan bahawa sektor perbankan di Malaysia telah menunjukkan peningkatan produktiviti disebabkan oleh kemajuan teknologi. Kajian ini juga mendapati bahawa peralihan dalam sempadan (perubahan teknologi) mempengaruhi secara positif keatas jumlah perubahan faktor produktiviti bagi kedua-dua bank domestik dan asing.

Kata kunci: Bank, faktor produktiviti, perubahan teknologi, perubahan kecekapan, indeks produktiviti Malmquist bootstrap

■1.0 INTRODUCTION

The importance of the banking sector is premised on the grounds that banks perform important financial intermediary role in the economy (Dell' Ariccia and Marquez 2004; Levine 1997) and provides important financial intermediation function by converting deposits into productive investments (King and Levine 1993a, b). Unlike in developed countries where financial markets and the banking sector work in unison to channel funds, financial markets are often undersized and sometimes completely absent in developing countries (Arun and Turner 2004). Therefore, it falls on the banking sector to bridge the gap between savers and borrowers and to perform all tasks associated with the profitable and secure channeling of funds.

As in other developing economies, the banking system plays an important intermediary role in the Malaysian economy (Sufian, 2010b). The banking sector controls most of the financial flows and accounts for more than 70% of the financial system's total assets. Therefore, knowledge of factors influencing the performance of the banking sector is essential for bank managements, the central bank, bankers association, and other financial authorities to help them formulate policies to improve the performance of the banking sector.

The present study deviates from the earlier studies microeconomic studies focusing on the performance of the Malaysian banking sector and contributes to the literature on several important aspects. First, the present study attempts to build on the earlier studies by Krishnasamy *et al*. (2004), Sufian (2008), and Sufian (2010a) among others and closely examine the influence of efficiency and technological changes on the total factor productivity of Malaysian banks. Second, unlike the earlier studies which employ the traditional Malmquist Productivity Index (MPI) method, which could arguably lead to bias conclusions, the present paper employs the semi-parametric MPI method to estimate the bias-corrected Total Factor Productivity Change (TFPCH) index. Furthermore, the preferred methodology enables us to isolate bias-corrected efforts to catch up to the frontier (Efficiency Change (EFFCH)) from shifts in the frontier (Technological Change (TECHCH)).

In essence, the present paper raises several important fundamental questions. First, has the Malaysian banking sector exhibit productivity progress (regress) or efficiency increase (decline) during the past decade? Second, do the foreign owned banks outperform their domestic bank peers in terms of efficiency change and productivity progress? Third, which factor is more prevalent in determining the productivity progress or regress in Malaysian banking sector: technological progress (regress) or efficiency increase (decline)?

The paper is structured as follows: the next section reviews the main literature. Section 3 outlines the approaches to the measurement of total factor productivity change. Section 4 discusses the results, and finally, Section 5 provides some concluding remarks.

2.0 REVIEW OF RELATED LITERATURE

The performance of the banking sector is a subject that has received enormous attention in recent years. It is generally agreed that better quality management of resources is the main factor contributing to bank performance as evidenced by the numerous studies focusing on the U.S. banking sector (e.g. Harris *et al*. 2013; Cornett *et al*. 2013; Goetz *et al*. 2013; Berger and Bouwman, 2013; De Young and Torna, 2013) and the banking sectors of the western and developed countries (e.g. Mamatzakis *et al*. 2013; Goddard *et al*. 2013; Delpachitra and Lester, 2013; Williams and Rajaguru, 2013; Lee and Kim, 2013; Sufian, 2011; Sufian and Habibullah, 2009).

Despite substantial studies performed in regard to the efficiency and productivity of financial institutions in the U.S., Europe, and other developed countries banking sectors, empirical evidence on the Malaysian banking sector are relatively scarce. To date, studies by Krishnasamy *et al.* (2004), Sufian and Ibrahim (2005), and Sufian (2010a) are the most notable empirical research performed to examine the productivity of the Malaysian banking sector. The earlier study by Krishnasamy *et al.* (2004) examines the total factor productivity of the Malaysian banking sector during the period of 2001 to 2004. The findings suggest that eight banks have exhibited progress in their total productivity levels, a bank has exhibited total factor productivity regress, and a bank's total factor productivity was stagnant. Sufian and Ibrahim (2005) employ the MPI method to investigate the relevance of non-traditional activities items in explaining Malaysian banks' total factor productivity changes. The results indicate that the inclusion of non-traditional activities items has resulted in a higher total factor productivity level for all banks. They suggest that the impact of the inclusion of non-traditional activities items have been more pronounced on Malaysian banks' technological change rather than efficiency change.

More recently, Sufian (2010a) examines the productivity of the Malaysian banking sector during the period 1995–2004. The empirical findings from the MPI method indicate that the Malaysian banking sector has exhibited productivity regress due to technological regress rather than efficiency decline. He finds evidence of productivity regress among the foreign owned banks, while the domestic banks have exhibited a marginal productivity increase. During the period under study, productivity levels seem to be positively associated with stock exchange listings, but negatively related to foreign ownership.

The above literature reveals the following research gaps. First, empirical evidence on the performance of the Malaysian banking sector is relatively scarce. Second, virtually nothing has been published to critically examine the impact of technological change in determining bank total factor productivity in Malaysia. Finally, to the best of our knowledge, within the context of the Malaysian banking sector, empirical evidence which employ the bias-corrected MPI method is completely missing from the literature. In the light of these knowledge gaps, this paper seeks to provide new empirical evidence on the influence of technological progress and efficiency change on the total factor productivity of Malaysian banks.

3.0 METHODOLOGY AND DATA

To assess productivity change in economic units, researchers typically employ two different indices namely the parametric Tornqvist (1936) or the non-parametric Malmquist (1953) productivity index. The Tornqvist index attributes deviations from the frontier to both purely random shocks and inefficiency. On the other hand, the Malmquist Productivity Index (MPI) attributes all deviations from the frontier to inefficiency. The present paper adopts the non-parametric MPI method to examine the sources of productivity and efficiency of the Malaysian banking sector. The MPI method uses exclusively quantity information and thus requires neither problematic price information nor a restrictive behavioral assumption in its calculation.

Because we do not know the production technology of a fully efficient firm in a banking industry, we should estimate from the observations in practice. To this end, we first map firms in an input-output space to detect the best practice firm or the production frontier (i.e. technology). Then, we construct existing firms to this frontier because it represents the set of efficient observations for which no other production unit employs as little or less of every input without changing the output quantities generated, or produces as much or more of every output without altering the input quantities used. However, production technology may change over time, resulting in shifts in the best practice technical frontier, because of experience, increased knowledge, better production techniques, etc.

The MPI method allows us to distinguish between shifts in the production frontier (technological change (TECHCH)) and movements of firms towards the frontier (efficiency change (EFFCH)). Thus, the MPI is simply the product of EFFCH and TECHCH. We may obtain the TECHCH and EFFCH indices under the assumption of constant returns to scale (CRS) i.e. assuming that banks operate at an optimum scale for cost minimization. However, in reality, banks could face scale inefficiencies due to decreasing returns to scale (DRS) or increasing returns to scale (IRS) in their operations.

To address this concern, we relax the CRS assumption and adopt the more realistic variable returns to scale (VRS) assumption. By doing so, we are able to decompose the EFFCH index into pure technical efficiency (PEFFCH) and scale efficiency (SECH) indices. The PEFFCH index measures changes in the proximity of firms to the frontier, devoid the scale effects. On the other hand, the SECH index shows whether the movements inside the frontier are in the right direction to attain CRS point, where changes in output levels result in proportional changes in costs. The PEFFCH index is entirely under the control of and therefore is a direct cause of management errors. Therefore, it is also termed as managerial efficiency in the literature. It occurs when more of each input is used than required to produce a given level of output. On the other hand, a scale efficient firm produces where there is CRS. Essentially, total inefficiency could be due to pure technical or scale inefficiency, or both.

For the purpose of this study, we follow the approach by Fare *et al.* (1994) among others to adopt the output oriented MPI first proposed by Shephard (1970). As far as banking firms are concerned, output orientation seems to be the natural choice, attributed to their competitive position in the market (Khumbhakar, 1987; Zelllner *et al*. 1966). Furthermore, Jaffy *et al*. (2007) suggests that the output orientation is more appropriate given the objectives of the developing countries banking sectors. We delineate the structure of production technology with the output distance function as follows:

$$D^t(x_j^t, y_j^t) = \min\left\{ \phi | \ (x_j^t, y_j^t/\phi) \in P^t \right\}, \tag{1}$$

which measures the output technical efficiency of bank *j* at time *t* relative to the technology at time *t* (Shephard, 1970). Since technical efficiency is measured relative to the contemporaneous technology, we have $D^t(X_j^t, Y_j^t) \leq 1$, with $D^t(X_j^t, Y_j^t) = 1$ signifying that bank *j* is on the production frontier and is technically efficient, while $D^t(X_j^t, Y_j^t) < 1$ indicating that the bank is below the frontier and is technically inefficient. Before describing the MPI method, we need to define distance functions with respect to two different time periods. The efficiency of bank *j* at time *t* relative to the technology at time *t+1* is represented by

$$D^{t+1}(x_j^t, \ y_j^t) = \min\left\{ \phi \ | \ (x_j^t, \ y_j^t/\phi) \in P^{t+1} \right\}. \tag{2}$$

Similarly, the efficiency of bank *j* at time *t+1* relative to the technology at time *t* is defined by the distance function

$$D^t(x_j^{t+1}, y_j^{t+1}) = \min\left\{ \phi \ | \ (x_j^{t+1}, \ y_j^{t+1}/\phi) \in P^t \right\}. \tag{3}$$

Caves *et al*. (1982) define the MPI as

$$M^t(x_j^{t+1}, y_j^{t+1}, x_j^t, y_j^t) = \frac{D^t(x_j^{t+1}, y_j^{t+1})}{D^t(x_j^t, y_j^t)}$$

or

$$M^{t+1}(x_j^{t+1}, y_j^{t+1}, x_j^t, y_j^t) = \frac{D^{t+1}(x_j^{t+1}, y_j^{t+1})}{D^{t+1}(x_j^t, y_j^t)}. \tag{4}$$

The indices in Equation (4) provide measures of productivity changes. To avoid choosing an arbitrary benchmark, two continuous MPI are combined into a single index by computing the geometric mean and then multiplicatively decomposed this index into two sub-indices measuring changes in technical efficiency and technology as follows (Fare *et al*. 1989; Fare *et al*. 1992).

$$\Delta Eff^{t,t+1} = \frac{D_c^{t+1}(x_j^{t+1}, y_j^{t+1})}{D_c^t(x_j^t, y_j^t)}, \tag{5}$$

and

$$\Delta Tech^{t,t+1} = \left[\frac{D_c^t(x_j^{t+1}, y_j^{t+1})}{D_c^{t+1}(x_j^{t+1}, y_j^{t+1})} \times \frac{D_c^t(x_j^t, y_j^t)}{D_c^{t+1}(x_j^t, y_j^t)} \right]^{1/2}. \tag{6}$$

The ratio in Equation (5) is an index of technical efficiency change between period *t* and *t+1*, measuring whether bank *j* moves closer to or farther away from best practices during the time period. The value of $\Delta Eff^{t,t+1}$ is greater than, equal to, or less than unity depending on whether the relative efficiency of bank *j* improved, unchanged, or declined during the period. The term $\Delta Tech^{t,t+1}$ in Equation (6) is an index of technology change, which gives the geometric mean of two ratios. A value of $\Delta Tech^{t,t+1}$ greater than, equal to, or less than unity indicates progress, no change, or regress in technology, respectively between periods *t* and *t+1*.

From Equations (5) and (6), the relationship between the MPI and its two sub-indices is

$$M^{t,t+1} = \Delta Eff^{t,t+1} \times \Delta Tech^{t,t+1}. \tag{7}$$

Clearly, productivity change is the decomposition of changes in both efficiency and technology with $M^{t,t+1}$ greater than, equal to, or less than unity representing progress, stagnation, or regress in total factor productivity, respectively between periods *t* and *t+1*. In principle, one may calculate the MPI in (7) relative to any technology pattern. The CRS technology is adopted to compute the MPI and its two sub-indices in the preceding analysis.

The $\Delta Eff^{t,t+1}$ index can be further disaggregated into its mutually exhaustive components of pure technical efficiency change $\Delta PureEff^{t,t+1}$ calculated relative to the variable returns to scale (VRS) technology and a component of scale efficiency change $\Delta Scale^{t,t+1}$ capturing changes in the deviation between the VRS and CRS technologies. That is,

$$\Delta Eff^{t,t+1} = \Delta PureEff^{t,t+1} \times \Delta Scale^{t,t+1}, \tag{8}$$

where

$$\Delta PureEff^{t,t+1} = \frac{D_v^{t+1}(x_j^{t+1},\ y_j^{t+1})}{D_v^{t}(x_j^{t},\ y_j^{t})}, \tag{9}$$

$$\Delta Scale^{t,t+1} = \frac{D_c^{t+1}(x_j^{t+1},\ y_j^{t+1}) / D_v^{t+1}(x_j^{t+1},\ y_j^{t+1})}{D_c^{t}(x_j^{t},\ y_j^{t}) / D_v^{t}(x_j^{t},\ y_j^{t})}, \tag{10}$$

and the subscripts "*v*" and "*c*" denote VRS and CRS technologies, respectively. $\Delta PureEff^{t,t+1} > 1$ indicates an increase in pure technical efficiency, while $\Delta PureEff^{t,t+1} < 1$ indicates a decrease and $\Delta PureEff^{t,t+1} = 1$ indicates no change in pure technical efficiency. Similarly, $\Delta Scale^{t,t+1} > 1$ implies that the most efficient scale is increasing over time, so the scale efficiency is improving, while $\Delta Scale^{t,t+1} < 1$ implies the opposite, and $\Delta Scale^{t,t+1} = 1$ indicates that there is no change in scale efficiency.

Bootstrapping the Malmquist Productivity Index

Simar (1992) and Simar and Wilson (1998) are pioneers in using the bootstrap in frontier models to obtain non-parametric envelopment estimators. The idea behind bootstrapping is to approximate a true sampling distribution by mimicking the data generating process (DGP). The procedure is based on constructing a pseudo sample and re-solving the DEA model for each DMU with the new data. Repeating this process many times enables us to build a good approximation of the true distribution. Simar and Wilson (1998) show that the statistically consistent estimation of such confidence intervals very much depends on the consistent replication of a DGP. In other words, the most important problem of bootstrapping in frontier models relates to the consistent mimicking of the DGP. They argued that this problem refers to the bounded nature of the distance functions. Since the distance estimation values are close to unity, re-sampling directly from the set of original data (the so-called naive bootstrap) to construct pseudo-samples will provide an inconsistent bootstrap estimation of the confidence intervals.

Hence, to overcome this problem, they propose a smoothed bootstrap procedure. They use a univariate kernel estimator of density of the original distance function estimates (for efficiency scores in that case), and then construct the pseudo data from this estimated density. However, to estimate the Malmquist indices, we have panel data instead of a single cross-section of data with the possibility of temporal correlation. Thus, Simar and Wilson (1999), in adapting the bootstrapping procedure for Malmquist indices, propose a consistent method using a bivariate kernel density estimate via the covariance matrix of data from adjacent years. However, the estimated distance functions $\hat{D}_{it_1|t_1}$ and $\hat{D}_{it_2|t_2}$ using a kernel estimator are bounded from above unity and it is noted by Simar and Wilson (1999) that a bivariate kernel estimator value under this condition is biased and asymptotically inconsistent. To account for this issue, Simar and Wilson (1998, 1999) adapt a univariate reflection method proposed by Silverman (1986). Therefore, to achieve consistent replication of the DGP taking all of these features into account, one must use the smoothed bootstrap. Repeatedly re-sampling from the Malmquist indices via the smoothed bootstrap results in a mimic of the sampling distribution of the original distance functions (a set of bootstrap Malmquist indices), from which confidence intervals can be constructed. The process can be summarized as follows:

1. Calculation of the Malmquist index $\hat{M}_i^o$ (t_1,t_2) for each bank ($i = 1,\ldots,N$) in each time (t_1 and t_2) by solving the linear programming models (8) and (9) and their reversals.
2. Construction of the pseudo data set $\{(x_{it}^*, y_{it}^*); i = 1,\ldots,N; t = 1,2\}$ to create the reference bootstrap technology using the bivariate kernel density estimation and adoption of the reflection method proposed by Silverman (1986).
3. Calculation of the bootstrap estimate of the Malmquist index ${}^*\hat{M}_i^o(t_1,t_2)$ for each bank ($i = 1,\ldots,N$) by applying the original estimators to the pseudo sample attained in step 2.
4. Repeating steps 2 to 3 for a large number of *B* times (in this study B = 2000) to facilitate B sets of estimates for each bank.
5. Construct the confidence intervals for the Malmquist indices.

The basic idea designed for construction of the confidence intervals of the Malmquist indices is that the distribution of $\hat{M}_i^o(t_1,t_2) - M_i^o(t_1,t_2)$ is unknown and can be approximated by the distribution of ${}^*\hat{M}_i^o(t_1,t_2) - \hat{M}_i^o(t_1,t_2)$, where $M_i^o(t_1,t_2)$ is the *true* unknown index, $\hat{M}_i^o(t_1,t_2)$ is the estimate of the Malmquist index, and ${}^*\hat{M}_i^o(t_1,t_2)$ is the bootstrap estimate of the index. Hence, a_α and b_α defining the $(1-\alpha)$ confidence interval:

$$\Pr\left(b_\alpha \le \hat{M}_i^o(t_1,t_2) - M_i^o(t_1,t_2) \le a_\alpha\right) = 1-\alpha \tag{11}$$

can be approximated by estimating the values a_α^* and b_α^* given by:

$$\Pr\left(b_\alpha^* \leq {}^*\hat{M}_i^o(t_1,t_2) - \hat{M}_i^o(t_1,t_2) \leq a_\alpha^*\right) = 1-\alpha \tag{12}$$

Thus, an estimated $(1-\alpha)$ percentage confidence interval for the *i*-th Malmquist index is given by:

$$\hat{M}_i^o(t_1,t_2) + a_\alpha^* \leq M_i^o(t_1,t_2) \leq \hat{M}_i^o(t_1,t_2) + b_\alpha^* \tag{13}$$

The MPI for the *i*-th bank is said to be significantly different from unity (which would indicate no productivity change), at the *α*% level, if the interval in Equation (13) does not include unity. With the information provided, it is possible to ascertain whether productivity growth (or decline) measured by the MPI is significant i.e. whether it is greater than (or less than) unity at the desired levels of significance. The same holds for the sources of TFPCH as it is now possible to assess the significance of both efficiency change and technological change if they occur.

It should be noted that by using the bootstrap value computed in step 4, we can also correct for any finite-sample bias in the original estimators of the Malmquist indices. We only need to apply a simple procedure outlined by Simar and Wilson (1999) as follows:

The bootstrap bias estimate for the original estimator $\hat{M}_i^o(t_1,t_2)$ is:

$$\widehat{bias}_B\left[\hat{M}_i^o(t_1,t_2)\right] = B^{-1}\sum_{b=1}^{B} {}^*\hat{M}_i^o(t_1,t_2)(b) - \hat{M}_i^o(t_1,t_2) \tag{14}$$

Thus, the bias-corrected estimate of $M_i^o(t_1,t_2)$ can be computed as:

$$\tilde{M}_i^o(t_1,t_2) = \hat{M}_i^o(t_1,t_2) - \widehat{bias}_B\left[\hat{M}_i^o(t_1,t_2)\right] = 2\hat{M}_i^o(t_1,t_2) - B^{-1}\sum_{b=1}^{B} {}^*\hat{M}_i^o(t_1,t_2)(b) \tag{15}$$

However, as explained by Simar and Wilson (1999), the bias-corrected estimator may have a higher mean-square error than the original estimator, and hence it will be less reliable. Overall, the bias-corrected estimator should only be considered if the sample variance ${}^*s_i^2$ of the bootstrap values $\left\{{}^*\hat{M}_i^o(t_1,t_2)(b)\right\}_{b=1,\ldots,B}$ is less than a third of the squared bootstrap bias estimate for the original estimator, that is:

$${}^*s_i^2 < \frac{1}{3}\left(\widehat{bias}_B\left[\hat{M}_i^o(t_1,t_2)\right]\right)^2 \tag{16}$$

Specification of Inputs, Outputs, and Data

Elyasiani and Mehdian (1990) suggest three advantages of the intermediation approach over other approaches. They suggest that (i) it is more inclusive of the total banking cost as it includes interest expense on deposits and other liabilities; (ii) it appropriately categorizes deposits as inputs; and (iii) it has an edge over other definitions for data quality considerations. Furthermore, Berger and Humphrey (1997) point out that the production approach might be more suitable for branch efficiency studies, as at most times bank branches basically process customer documents and bank funding, while investment decisions are mostly not under the control of branches. Therefore, as in majority of the empirical literature, we adopt a modified version of intermediation approach as opposed to the production approach for selecting input and output variables to construct the total factor productivity frontiers.

Accordingly, we regard Malaysian banks as intermediary between savers and borrowers, producing three outputs namely, Total Loans (*y1*), which include loans to customers and other banks, Investments (*y2*), which include investment securities held for trading, investment securities available for sale (AFS), and investment securities held to maturity, and Non-Interest Income (*y3*). In order to produce the outputs, we assume Malaysian banks employ three inputs namely, Total Deposits (*x1*), which include deposits from customers and other banks, Capital (*x2*), measured as the book value of property, plant and equipment, and Labor (*x3*), which is inclusive of total expenditures on employees such as salaries, employee benefits, and reserve for retirement pay.

Table 1 presents the summary statistics of the output and input variables used to construct the productivity frontiers. All the variables are measured in millions of Malaysian Ringgit (RM). It is apparent that on average the domestic banks are about four times larger (in terms of physical capital), command higher market share for both loans and deposits, have greater intensity towards loans financing, and employ more personnel compared to their foreign bank counterparts. From Table 1 it is also clear that the smallest domestic bank (in terms of physical capital) is more than four times larger than the smallest foreign bank, while the largest domestic bank is 2.9 times larger in terms of physical capital compared to the largest foreign bank operating in the Malaysian banking sector.

Table 1 Descriptive statistics for inputs and outputs (RM million)

	Loans (Y1)	Investments (Y2)	Non-Interest Income (Y3)	Total Deposits (X1)	Capital (X2)	Labour (X3)
			Domestic Banks			
Min	607.5	74.2	4.4	869.6	17.2	11.2
Mean	33,178.3	9,079.1	522.5	43,399.2	374.3	396.9
Max	138,985.7	36,423.4	4,602.1	182,169.9	1,452.4	1,419.9
S.D	31,120.7	8,601.1	700.7	40,710.1	346.9	353.3
			Foreign Banks			
Min	38.4	39.7	-87.8	187.3	3.6	0.7
Mean	7,624.9	2,458.0	171.2	10,636.0	93.7	79.2
Max	56,023.8	12,660.4	1,052.6	62,429.5	497.4	486.2
S.D	9,655.0	2,846.2	215.2	12,745.9	116.4	109.2

Notes: Y1: Loans (includes loans to customers and other banks), Y2: Investments (includes dealing and investment securities), Y3: Non-Interest Income (defined as fee income and other non-interest income, which among others consist of commission, service charges and fees, guarantee fees, and foreign exchange profits), X1: Total Deposits (includes deposits from customers and other banks), X2: Capital (measured by the book value of property, plant, and equipment), X3: Personnel Expenses (inclusive of total expenditures on employees such as salaries, employee benefits and reserve for retirement pay).
Source: Banks annual reports and authors own calculations.

■4.0 EMPIRICAL RESULTS

In this section, we will discuss the sources of the Malaysian banking sector's productivity changes measured by the semi-parametric Malmquist Productivity Index (MPI) and assign changes in Total Factor Productivity Change (TFPCH) to Technological Change (TECHCH) and Efficiency Change (EFFCH). We will also attempt to attribute change in EFFCH to changes in Pure Technical Efficiency (PEFFCH) and/or Scale Efficiency (SECH). Because the year 1998 is the reference year, the MPI and its components takes an initial score of 1.000. Hence, any score greater (lower) than 1.000 in subsequent years indicates progress (regress) in the relevant measures. It is worth mentioning that favorable EFFCH is interpreted as evidence of "catching up" to the frontier, while favorable TECHCH is interpreted as innovation (Cummins *et al*. 1999). The summary of annual means for the industry, domestic, and foreign banks' TFPCH, TECHCH, EFFCH, and its decomposition into PEFFCH and SECH for the years 1998 – 2008 are given in Panels A, B, and C of Table 2 respectively. We estimate Equation (15) in Section 3.1 by using the FEAR 2.0 software developed by Wilson (2008) to compute the bias-corrected TFPCH, TECHCH, EFFCH, PEFFCH, and SECH indices.

Total Factor Productivity of the Malaysian Banking Sector

As depicted in Panel A of Table 2, the MPI results indicate that the Malaysian banking sector has on average exhibited TFPCH progress of 9.7%. The results seem to suggest that Malaysian banks have exhibited TFPCH progress during all years ranging from a low of 1.5% during the year 2001 to a high of 17.8% during the year 2004. During the period under study, the 9.7% progress in TFPCH of the Malaysian banking sector could be attributed mainly to the 7.1% increase in TECHCH. On the other hand, it can be observed from Panel A of Table 2 that the EFFCH of Malaysian banks seem to have increased at a slower rate of 1.2%. The decomposition of the EFFCH index into its PEFFCH and SECH components indicate that the source of the increase in Malaysian banks' EFFCH was mainly attributed to scale rather than pure technical efficiency. The results imply that Malaysian banks have been operating at the optimal scale of operations, but have been managerially inefficient in controlling their operating costs.

Panel B of Table 2 presents the results for the domestic banks. During the period under study, the findings seem to suggest that the domestic banks have exhibited progress in TFPCH by 9.5%. The decomposition of the TFPCH index into its TECHCH and EFFCH components indicate that the progress in the domestic banks' TFPCH were solely attributed to the 4.9% increase in TECHCH. On the other hand, the domestic banks' EFFCH seem to have increased by a slower rate of 2.7% during the period under study. The decomposition of the EFFCH index into its PEFFCH and SECH components suggest that the dominant source of the increase in the domestic banks' EFFCH were mainly attributed to managerial rather than scale. This implies that although the domestic banks have been managerially efficient in controlling their operating costs, they have been operating at the non-optimal scale of operations.

We next turn to discuss the foreign banks results. The empirical findings presented in Panel C of Table 2 seem to suggest that the foreign banks' TFPCH have increased by 9.6%, a slightly faster rate compared to their domestic bank counterparts. Similar to their domestic bank peers, the decomposition of the TFPCH index into its TECHCH and EFFCH components indicate that the 5.3% increase in TECHCH has largely contributed to the foreign banks' TFPCH progress. On the other hand, the foreign banks seem to have exhibited an increase of 4.1% in EFFCH. In contrast to EFFCH, the foreign banks have exhibited TECHCH progress during most of the years under study. The favorable condition has resulted in the foreign banks to exhibit a faster progress in TFPCH during the period under study. The decomposition of the EFFCH index into its PEFFCH and SECH components indicate that the dominant source of the increase in the foreign banks' EFFCH were mainly scale rather than managerially related. If anything could be delved, the results clearly indicate that the foreign banks have been operating at the optimal scale of operations, but were managerially inefficient in controlling their operating costs.

Table 2 Decomposition of total factor productivity change in malaysian banking sector

	TFPCH Index	TECHCH Index	EFFCH Index	PEFFCH Index	SECH Index
Panel A: **ALL_BNKS**					
1998	1.000	1.000	1.000	1.000	1.000
1999	1.090	1.108	0.984	0.982	1.002
2000	1.148	1.146	1.001	1.001	1.000
2001	1.015	1.015	1.000	1.014	0.986
2002	1.122	1.099	1.021	1.015	1.006
2003	1.087	1.085	1.002	1.005	0.997
2004	1.178	1.180	0.998	0.998	1.000
2005	1.059	1.062	0.997	0.992	1.005
2006	1.119	1.129	0.991	0.977	1.014
2007	1.115	1.090	1.023	1.003	1.020
2008	1.146	1.018	1.126	1.006	1.012
Geometric Mean	**1.097**	**1.071**	**1.012**	**0.999**	**1.004**
Panel B: **DOM_BNKS**					
1998	1.000	1.000	1.000	1.000	1.000
1999	1.093	0.993	1.101	0.986	1.007
2000	1.148	1.141	1.006	1.003	1.003
2001	1.032	1.001	1.030	1.033	0.997
2002	1.139	1.112	1.024	1.031	0.993
2003	1.057	0.994	1.063	1.006	0.988
2004	1.185	1.176	1.008	1.001	1.007
2005	1.072	1.070	1.002	0.998	1.003
2006	1.102	1.150	0.958	0.960	0.998
2007	1.085	1.094	0.992	0.990	1.002
2008	1.146	1.018	1.126	1.006	1.012
Geometric Mean	**1.095**	**1.049**	**1.027**	**1.018**	**1.001**
Panel C: **FOR_BNKS**					
1998	1.000	1.000	1.000	1.000	1.000
1999	1.086	0.972	1.118	0.977	0.995
2000	1.147	1.150	0.997	1.000	0.997
2001	1.001	1.026	0.976	0.998	0.978
2002	1.108	1.088	1.018	1.002	1.016
2003	1.111	1.009	1.101	1.005	1.004
2004	1.173	1.184	0.991	0.996	0.995
2005	1.048	1.055	0.994	0.988	1.006
2006	1.130	1.115	1.014	0.988	1.026
2007	1.135	1.087	1.045	1.012	1.032
2008	1.137	1.020	1.115	1.005	1.014
Geometric Mean	**1.096**	**1.053**	**1.041**	**0.997**	**1.006**

Source: Authors' own calculations

Technological Change and the Malaysian Banking Sector's Total Factor Productivity

An analysis based on productivity levels of banks may be biased by a few observations (Isik and Hassan, 2002). Furthermore, it is also essential to examine for which option the obtained TFPCH is more representative (Casu and Girardone, 2005). To address this issue, in the subsequent analysis, we summarize the developments in the number of banks experiencing productivity progress or regress during the 1998 to 2008 period. The results are given in Panels A – C of Table 3.

As the results in Panel A of Table 3 indicate, of those 21 banks that experienced productivity progress during the year 2000 as shown in Panel A of Table 4, the majority, 20 (83.33%), were the result of technological progress, while a (4.17%) bank's productivity progress were mainly attributed to efficiency increase. On the other hand, of the 3 banks, which experienced productivity regress during the year 2000, the majority, 2 (8.33%) banks, were the result of efficiency decline, while a (4.17%) bank's productivity regress was mainly due to technological regress. The results from Panel A in Table 4 indicates that of the 5 banks that experienced efficiency increase during the year 2000, 4 (16.67%) banks experienced the increase in efficiency attributed to the increase in scale efficiency while a (4.17%) bank experienced increase in pure technical efficiency. Also, from the 4 banks that experienced efficiency loss during the year 2000, 3 (12.50%) banks experienced the reduction in their efficiency mainly due to the decline in scale efficiency, whereas a (4.17%) bank faced the reduction mostly due to the decline in pure technical efficiency.

Table 3 Main source of productivity progress (regress) in malaysian banks

Period	Productivity Progress Mainly Due To		Productivity Regress Mainly Due To		No Productivity Δ
	Efficiency Increase # (%)	Technological Progress # (%)	Efficiency Decrease # (%)	Technological Regress # (%)	# (%)
	Panel A: **All Banks**				
1998– 1999	0 (0.00)	26 (81.25)	5 (15.63)	1 (3.13)	0 (0.00)
1999– 2000	1 (4.17)	20 (83.33)	2 (8.33)	1 (4.17)	0 (0.00)
2000– 2001	3 (12.50)	10 (41.67)	3 (12.50)	8 (33.33)	0 (0.00)
2001– 2002	3 (12.50)	17 (70.83)	2 (8.33)	2 (8.33)	0 (0.00)
2002– 2003	1 (4.35)	16 (69.57)	2 (8.70)	4 (17.39)	0 (0.00)
2003– 2004	0 (0.00)	22 (95.65)	0 (0.00)	1 (4.35)	0 (0.00)
2004– 2005	1 (4.35)	14 (60.87)	3 (13.04)	5 (21.74)	0 (0.00)
2005– 2006	1 (4.55)	18 (81.82)	3 (13.64)	0 (0.00)	0 (0.00)
2006– 2007	2 (9.09)	17 (77.27)	0 (0.00)	3 (13.64)	0 (0.00)
2007– 2008	1 (4.55)	13 (59.09)	2 (9.09)	5 (22.73)	1 (4.55)
	Panel B: **Domestic Banks**				
1998-1999	0 (0.00)	15 (78.95)	3 (15.79)	1 (5.26)	0 (0.00)
1999-2000	1 (9.09)	8 (72.73)	1 (9.09)	1 (9.09)	0 (0.00)
2000-2001	3 (27.27)	4 (36.36)	1 (9.09)	3 (27.27)	0 (0.00)
2001-2002	1 (9.09)	9 (81.82)	1 (9.09)	0 (0.00)	0 (0.00)
2002-2003	0 (0.00)	7 (70.00)	1 (10.00)	2 (20.00)	0 (0.00)
2003-2004	0 (0.00)	9 (90.00)	0 (0.00)	1 (10.00)	0 (0.00)
2004– 2005	0 (0.00)	8 (80.00)	0 (0.00)	2 (20.00)	0 (0.00)
2005– 2006	0 (0.00)	7 (77.78)	2 (22.22)	0 (0.00)	0 (0.00)
2006– 2007	0 (0.00)	8 (88.89)	0 (0.00)	1 (11.11)	0 (0.00)
2007– 2008	1 (11.11)	5 (55.56)	1 (11.11)	2 (22.22)	0 (0.00)
	Panel C: **Foreign Banks**				
1998-1999	0 (0.00)	11 (84.62)	2 (15.38)	0 (0.00)	0 (0.00)
1999-2000	0 (0.00)	12 (92.31)	1 (7.69)	0 (0.00)	0 (0.00)
2000-2001	0 (0.00)	6 (46.15)	2 (15.38)	5 (38.46)	0 (0.00)
2001-2002	2 (15.38)	8 (61.54)	1 (7.69)	2 (15.38)	0 (0.00)
2002-2003	1 (7.69)	9 (69.23)	1 (7.69)	2 (15.38)	0 (0.00)
2003-2004	0 (0.00)	13 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)
2004– 2005	1 (7.69)	6 (46.15)	3 (23.08)	3 (23.08)	0 (0.00)
2005– 2006	1 (7.69)	11 (84.62)	1 (7.69)	0 (0.00)	0 (0.00)
2006– 2007	2 (15.38)	9 (69.23)	0 (0.00)	2 (15.38)	0 (0.00)
2007– 2008	0 (0.00)	8 (61.54)	1 (7.69)	3 (23.08)	1 (7.69)

Note: Malaysian Banks are categorized according to the following. (1) Productivity Progress: TFPCH > 1, (2) Productivity Regress TFPCH <1, (3) Productivity Stagnation: TFPCH = 1. (1) Technological Progress: TECHCH > 1, (2) Technological Regress TECHCH <1, (3) Technological Stagnation: TECHCH = 1. (1). *Source:* Authors' own calculations.

Panel B of Table 4 shows the results for the major source of productivity progress (regress) and efficiency increase (decrease) of the domestic banks. The results indicate that of the 9 domestic banks that experienced productivity progress during the year 2000, the majority, 8 (72.73%) banks, were the result of technological progress, while only a (9.09%) bank productivity progress was mainly attributed to efficiency increase. On the other hand, of the 2 domestic banks, which experienced productivity regress during the year 2000, a (9.09%) bank experienced the regress due to efficiency decrease, while a (9.09%) bank's productivity regress was due to technological regress. The results from Panel B in Table 4 indicates that of the 3 domestic banks that experienced efficiency increase during the year 2000, 2 (18.18%) banks experienced the increase in efficiency attributed to the increase in scale efficiency, while a (9.09%) bank experienced increase in pure technical efficiency. In addition, from the 2 banks that experienced efficiency loss during the year 2000, a (9.09%) bank experienced the decline due to the decline in pure technical efficiency, while a (9.09%) bank's efficiency decline was mainly due to scale efficiency.

Panel C of Table 4 exhibits the results for the major source of productivity progress (regress) and efficiency increase (decrease) of the foreign banks. The results indicate that productivity progress of the 12 (92.31%) foreign banks during the year 2000 was mainly attributed to technological progress. On the other hand, a (7.69%) foreign bank experienced productivity regress during the year 2000 due to efficiency decline. The results from Panel C in Table 4 indicate that of the 2 (15.38%) foreign banks that experienced efficiency increase during the year 2000, both banks experienced the increase attributed to scale efficiency. On the other hand, both foreign banks that experienced efficiency loss during the year 2000 were the result of scale efficiency decline.

■5.0 CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The present study employs the semi-parametric Malmquist Productivity Index (MPI) method to examine the evolution of Malaysian banking sector's productivity during the period of 1998-2008. The preferred methodology provides bias-corrected estimates of efforts to catch up to the frontier (efficiency change) from shifts in the frontier (technological change). The empirical findings suggest that the Malaysian banking sector has exhibited productivity progress attributed to progress in technological change. We also find that shift in the frontier (technological change) strongly and positively influence both domestic and foreign banks total factor productivity change. The decomposition of the scale efficiency estimates into its mutually exhaustive pure technical and scale efficiency components show that scale efficiency has largely contributed to the favourable increase in the efficiency of the foreign owned banks. On the other hand, the domestic owned Malaysian banks have benefited largely from favourable increase in pure technical efficiency.

The empirical findings from this study have considerable policy relevance. In view of the increasing competition resulting from the more liberalized environment, the continued success of the Malaysian banking sector depends on its efficiency and competitiveness. Therefore, bank managements as well as policymakers will be more inclined to find ways to obtain the optimal utilization of capacities as well as making the best use of their resources, so that these resources are not wasted during the production of banking products and services. Therefore, from the regulatory perspective, the performance of the banks will be based on their efficiency and productivity. Moving forward it is reasonable to expect that the policy direction to be directed towards enhancing the efficiency and productivity of banks operating in the Malaysian banking sector with the aim of intensifying the robustness and stability of the financial system.

The present study can be extended in several meaningful and interesting ways. First, future research may also consider the latter years to investigate the impact of further liberalization on the Malaysian banking sector. As part of Malaysia's World Trade Organization (WTO) commitments to liberalize the banking sector, the Malaysian government has issued six new commercial banking licenses under the Banking and Financial Institutions Act, 1989, to foreign financial institutions. Subsequently, Industrial and Commercial Bank of China starts its operations in 2009, BNP Paribas and Mizuho Corporate Bank commence operations in 2010, while in 2011 India International Bank, National Bank of Abu Dhabi, and Sumitomo Mitsui Banking Corporation officially begin to provide commercial banking services in Malaysia.

The move to further liberalize the banking sector for greater foreign participation is applauded as the new foreign players may bring in greater product innovation and development. The entry of foreign banks into a country's domestic banking sector may help improve the efficiency of the incumbent banks and increase the stability of the banking sector as a whole. However, in the case of developing countries where financial markets are relatively under-developed, the competition from foreign banks could pose serious challenges and the impact on the incumbent domestic banks particularly the small players could be severe and far-reaching (Claessens et al. 2001; Claessens and Laeven, 2004; Lensink and Hermes, 2004). Therefore, it would be interesting to find out whether the entry of the new foreign owned banks enhances the performance of the incumbent domestic and foreign owned banks operating in the Malaysian banking sector.

Secondly, future studies could also examine the impact of mergers on the performance of the Malaysian banking sector. In this particular vein, during the pre-merger period most banks in Malaysia were relatively small by global standards. Within the context of the Malaysian banking sector, earlier studies have found that the small financial institutions are at disadvantage in terms of technological advancements compared to their large counterparts (e.g. Sufian, 2008). Thus, the relatively larger institutions post-merger could have better capability to invest in the state of the art technologies. To this end, the role of technology advancement is particularly important given that banks with relatively more advanced technologies may have added advantage compared to their peers. Furthermore, investments in technology has important ramifications since it could help to both reduce the negative effect of macroeconomic shocks and to use its changes to acquire (or retain) competitive advantage (Žvirblis and Buračas, 2010). Consolidation among the small banking institutions may also enable them to better withstand macroeconomic shocks like the Asian financial crisis. From the economies of scale perspectives, the merger programme could have entailed the small Malaysian banks to better reap the benefits of economies of scale.

Finally, future research may also consider examining the impact of diversification benefit or curse on the performance of banks operating in the Malaysian banking sector. During the past decades, the main activities of modern banking have changed dramatically. In this regard, Nedzvedskas and Aniūnas (2007) suggest that modern banks have moved into new areas of off-balance sheet banking. Within the context of the Malaysian banking sector, Sufian and Ibrahim (2005) and Sufian (2008) among others suggest that non-traditional activities (off-balance sheet banking) have resulted in a higher total factor productivity level of banks reflecting the importance of off-balance sheet activities in determining the level of total factor productivity of banks operating in the Malaysian banking sector. However, the increased involvement of Malaysian banks into the non-traditional activities business involved higher risks and as a consequence, risk management technologies of the Malaysian banks have to be expanded to include not just asset–liability management, but the management of risks arising from off-balance sheet activity (Nedzvedskas and Aniūnas, 2007).

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Appendix

Appendix A Detailed summary of inputs and outputs used to construct the mpi frontiers

	Y1	Y2	Y3	X1	X2	X3
N=20			Domestic Banks (1998)			
Min	645.2	72.7	4.6	787.1	17.0	9.9
Mean	12,837.0	3,839.5	159.8	16,321.2	149.9	210.0
Max	77,852.1	23,084.1	973.0	89,662.6	825.2	988.2
S.D	17,465.1	5,679.0	232.1	21,224.9	201.6	267.7
N=13			Foreign Banks (1998)			
Min	263.4	71.2	8.5	320.0	4,490.0	2.1
Mean	4,866.9	1,454.3	110.5	5,737.3	62.2	90.9
Max	14,989.6	5,547.3	476.1	19,068.2	233.5	348.0
S.D	5,117.6	1,699.7	131.7	6,215.0	70.7	102.8
N=20			Domestic Banks (1999)			
Min	607.5	74.2	4.4	869.6	17.2	11.2
Mean	12,950.5	3,361.9	158.7	17,366.8	125.9	235.8
Max	76,301.4	24,941.4	1,151.8	94,803.3	747.8	1,042.2
S.D	17,567.3	5,762.8	260.1	22,747.4	165.5	295.2
N=13			Foreign Banks (1999)			
Min	212.7	66.8	5.7	320.7	4.9	1.9
Mean	4,763.6	2,290.4	109.4	6,021.9	67.2	77.5
Max	11,995.7	16,713.3	364.1	19,179.0	281.4	345.3
S.D	4,793.4	4,436.0	119.6	6,453.2	80.2	100.9
N=11			Domestic Banks (2000)			
Min	3,999.8	1,310.5	32.1	5,118.5	42.2	25.0
Mean	21,860.6	7,961.8	303.8	29,157.4	259.8	374.1
Max	79,826.1	25,299.6	1,264.8	101,957.1	827.2	1,148.4
S.D	22,036.2	7,434.7	353.7	28,305.5	253.5	360.5
N=13			Foreign Banks (2000)			
Min	146.3	75.8	5.7	407.2	5.2	1.8
Mean	5,064.6	1,946.4	118.4	7,021.4	72.9	76.8
Max	13,096.1	6,366.8	371.5	21,171.2	239.8	354.0
S.D	5,183.1	2,004.0	127.2	7,260.2	79.5	104.6
N=11			Domestic Banks (2001)			
Min	4,849.3	1,425.4	54.4	7,322.0	55.6	22.4
Mean	27,541.9	8,136.3	331.8	33,480.6	327.6	428.4
Max	98,093.8	27,885.4	1,307.0	115,573.4	1,029.6	1,418.0
S.D	26,069.9	7,767.2	364.7	30,668.8	297.8	423.1
N=13			Foreign Banks (2001)			
Min	114.6	186.2	4.8	187.3	3.6	2.3
Mean	5,307.6	2,042.7	122.1	6,777.6	70.7	78.3
Max	14,720.6	6,073.0	425.2	19,638.9	235.5	336.8
S.D	6,290.1	2,105.0	143.5	7,479.0	81.4	108.8
N=11			Domestic Banks (2002)			
Min	5,208.9	673.3	55.5	6,698.7	61.2	15.3
Mean	28,507.6	8,512.5	374.9	35,275.7	334.0	422.6
Max	95,507.0	29,986.6	1,597.6	116,647.1	1,042.9	1,376.6
S.D	25,546.6	8,394.8	438.6	31,291.6	287.8	413.3
N=13			Foreign Banks (2002)			
Min	165.0	50.1	3.5	190.2	3.6	2.6
Mean	6,148.7	1,695.0	124.4	7,198.0	77.6	81.1
Max	17,115.3	4,800.8	407.3	20,532.9	257.0	322.4
S.D	7,311.2	1,757.7	144.4	8,027.5	89.8	113.2
N=10			Domestic Banks (2003)			
Min	7,227.4	1,256.5	35.2	9,023.6	61.9	33.5
Mean	33,200.2	9,752.3	405.4	40,754.7	385.1	478.5
Max	102,488.5	32,145.2	1,570.0	123,207.3	1,149.2	1,420
S.D	28,285.8	9,045.8	444.2	33,227.1	324.1	425.5
N=12			Foreign Banks (2003)			

Min	136.1	93.5	14.0	513.0	4.8	1.9
Mean	6,760.2	2,425.7	123.5	8,827.9	74.3	74.0
Max	18,985.3	6,451.0	407.3	24,274.3	254.3	298.0
S.D	8,150.4	2,507.4	144.0	9,896.8	87.0	108.0
	Y1	Y2	Y3	X1	X2	(X3
N=10			Domestic Banks (2004)			
Min	36,030.2	11,042.5	473.7	45,867.9	442.5	473.0
Mean	109,070.5	36,423.4	1,800.7	137,864.1	1,273.6	1,382.8
Max	30,756.8	10,400.5	513.7	39,191.9	380.9	419.3
S.D	36,030.2	11,042.5	473.7	45,867.9	442.5	473.0
N=13			Foreign Banks (2004)			
Min	114.5	92.2	4.4	522.5	5.4	1.2
Mean	7,428.7	3,547.0	153.1	10,433.9	87.4	75.0
Max	19,964.2	12,292.2	520.2	30,586.5	295.8	299.7
S.D	9,006.6	4,078.5	177.0	12,003.9	104.5	109.2
N=11			Domestic Banks (2005)			
Min	13,952.0	1,874.9	83.4	16,195.9	170.7	145.9
Mean	45,783.2	10,632.6	976.3	56,968.3	420.1	497.2
Max	115,481.6	22,387.1	4,602.1	138,149.9	1,217.4	1,188.9
S.D	31,174.0	8,429.6	1,333.3	38,585.2	319.7	337.4
N=13			Foreign Banks (2005)			
Min	84.2	56.4	7.1	499.5	4.6	0.9
Mean	12,431.8	3,470.6	233.0	15,553.3	97.3	113.1
Max	56,023.8	12,660.3	797.1	62,429.5	356.4	486.2
S.D	16,260.2	3,994.2	268.0	18,660.1	120.0	157.7
N=11			Domestic Banks (2006)			
Min	12,901.2	2,841.3	137.8	16,845.7	209.1	137.3
Mean	48,971.0	11,678.5	715.6	62,708.7	516.7	431.1
Max	127,848.4	26,889.7	2,179.4	153,175.3	1,418.6	1,179.5
S.D	37,515.0	8,689.9	691.0	45,927.1	392.5	312.8
N=13			Foreign Banks (2006)			
Min	38.4	55.8	10.1	717.6	4.8	0.7
Mean	8,563.7	2,447.9	211.6	12,483.5	104.4	73.0
Max	24,343.9	6,916.2	761.9	33,756.6	448.9	303.4
S.D	10,362.2	2,612.1	236.1	13,826.3	145.9	109.6
N=11			Domestic Banks (2007)			
Min	13,019.5	1,571.4	153.6	18,190.5	241.1	103.0
Mean	49,509.4	10,571.4	1,023.7	72,933.0	622.6	376.8
Max	118,557.0	25,378.6	2,375.6	165,026.3	1,418.5	987.2
S.D	36,665.9	8,592.2	927.4	53,015.0	443.4	273.8
N=13			Foreign Banks (2007)			
Min	139.1	55.1	8.5	681.5	5.3	1.4
Mean	9,641.1	2,409.6	226.9	16,165.1	137.0	71.5
Max	26,611.7	7,722.8	869.1	40,756.8	487.2	258.3
S.D	11,607.9	2,556.8	263.7	16,840.0	161.6	100.0
N=11			Domestic Banks (2008)			
Min	15,318.8	2,519.0	197.0	21,271.7	228.7	120.4
Mean	55,237.2	13,368.7	997.0	76,982.8	643.2	413.1
Max	138,985.7	29,711.5	2,286.3	182,169.9	1,452.4	1,062.4
S.D	42,090.4	11,268.6	881.7	57,190.2	416.6	305.8
N=13			Foreign Banks (2008)			
Min	152.9	39.7	14.5	898.1	5.3	2.1
Mean	10,138.5	3,584.8	305.9	15,877.9	148.0	72.0
Max	28,044.2	10,139.1	1,052.6	41,240.6	497.4	255.6
S.D	11,956.2	3,898.8	359.2	17,440.8	172.8	102.9