Journal of Economic Cooperation, **28**,1 (2007), 115-150

# MALMQUIST INDICES OF PRODUCTIVITY CHANGE IN MALAYSIAN ISLAMIC BANKING INDUSTRY: FOREIGN VERSUS DOMESTIC BANKS

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Do Malaysian Islamic banks performed productively in its role as an intermediary? Although the phenomenon of Islamic banking and finance has developed significantly in recent years, only a few studies have tackled this question. To address this issue, this paper attempts to provide new empirical evidence on the performance of Malaysian Islamic banks over the period of 2001-2004. This paper makes significant contribution on at least three fronts. Firstly, this will be the first study to investigate the relative productivity between the domestic and foreign banks Islamic Banking operations. Secondly, the period chosen has also witnessed the intensification of competition among the domestic and foreign banks in Malaysia, brought about by the Malaysian government's move to further liberalise the banking system. Thirdly, the period chosen has witnessed growing awareness among Malaysian consumers about Islamic financial products and services, which renders the importance of the efficiency and productivity issues from both the policymakers and public point of views. Our preferred methodology is the Malmquist Total Factor Productivity Index (MPI), which allows us to examine five different indices namely, the productivity change (TFPCH), technological change (TECHCH), efficiency change (EFFCH), pure technical efficiency change (PEFFCH) and scale efficiency change (SECH) indices. In specifying the variables input-output, the intermediation approach is chosen, which could be argued to be much in line with the Islamic financial system's principle. Additionally, to investigate whether the domestic and foreign banks

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were drawn from the same population, we have performed a series of parametric and non-parametric tests.

## 1. INTRODUCTION

In recent years, financial institutions have experienced a dynamic, fast-paced, and competitive environment at a cross-border scale. One of the most growing parts is the new paradigm of Islamic Banking, which has remarkably captured the interest of both Islamic and contemporary economists. The recent survey states that there are more than 160 Islamic financial institutions existed around the world (Dar, 2003). Despite most of Islamic Banks are within Emerging and/or Middle-East countries, many universal banks in developed countries have began to valve the massive demand for Islamic financial products.

The main difference of Islamic banks compared to the contemporary banks is that, while the latter is based on the conventional interest-based principle, the former follows a principle of interest free and profit and loss sharing (PLS) in performing their business as intermediaries (Ariff, 1988). Many Islamic economics studies have discussed in depth about the rationale behind the prohibition of interest (Chapra, 2000) and the importance of PLS in Islamic banking (Dar and Presley, 2000). Furthermore, under the term of Islamic PLS, the relationship between borrower, lender and intermediary are rooted on financial trust and partnership. The importance of interest-free in Islamic Banking has created an innovative environment among practitioners in which the alternative of interest is anticipated. Dar (2003) classifies four types of financing acted as alternatives of interest; investment-based, sale-based, rent-based and service-based.

The existing research in Islamic banking and finance has focused primarily on the conceptual issues underlying interest-free financing (Ahmed, 1981; Karsen, 1982). These issues include the viability of Islamic banks and their ability to mobilise saving, pool risks and facilitates transactions. On the other hand, few studies have focused on the policy implications of a financial system without interest payments (Khan, 1986; Khan and Mirakhor, 1987). What is noteworthy is that, empirical work on the performance evaluation of Islamic banks is sparse. The lack of complete data impeded any comprehensive analysis

of the experience of the last three decades. To date, empirical works done in this area of research has yielded inconclusive results (Bashir *et al.*, 1993; Bashir, 1999).

The Malaysian banking system has a unique setting, where conventional banks are allowed to offer Islamic banking and finance products along with the conventional products. This dual banking system provides an interesting ground to investigate the efficiency of domestic and foreign banks. As Malaysia is the only country in this world that implement the dual banking system, this study would be the first empirical investigation to examine the efficiency of domestic versus foreign banks that provides Islamic banking services alongside the traditional conventional banking services.

By applying the non-parametric Malmquist Productivity Index (MPI) methodology, we attempt to investigate the sources of productivity change of Malaysian Islamic banks during the period of 2001-2004. The preferred methodology has allowed us to isolate efforts to catch up to the frontier (efficiency change) from shifts in the frontier (technological change). Also, the Malmquist index enables us to explore the main sources of efficiency change: either improvements in management practices (pure technical efficiency change) or improvements towards optimal size (scale efficiency change). Additionally we have also performed a series of parametric and non-parametric tests to examine whether the domestic and foreign banks were drawn from the same population. Finally, we have employed the Spearman Rho Rank-Order and the Parametric Pearson correlation coefficients to investigate the association between the efficiency scores derived from the Malmquist results with the traditional accounting ratios to measure banks performance.

Our results suggest that Malaysian Islamic banks productivity have exhibited an inverted U-shaped behaviour during the period of our study. The Malaysian Islamic banks have exhibited 8.4% productivity progress in year 2002, increasing to record the highest productivity change of 11.2% in year 2003, before declining to record 4.6% productivity regress in year 2004. Our results suggest that the domestic banks have exhibited higher productivity growth compared to its foreign

counterparts. The decomposition of the productivity change index suggests that Malaysian Islamic banks productivity progress was mainly attributable to technological change rather than efficiency change during the years 2002 and 2003 while the opposite was true during the year 2004 when the results suggest that Malaysian Islamic banks have exhibited higher efficiency change. Further decomposition of the efficiency change index into its pure technical and scale efficiency components suggest that, during the period of study pure technical efficiency has largely resulted in Malaysian Islamic banks efficiency increase. However, the results may have to be interpreted with caution as Malaysian Islamic banks were found to have exhibited pure technical efficiency decline in years 2000 and 2003 before increasing strongly in year 2004, which has eliminated the negative effects of years 2002 and 2003.

We have also explored the relationship between different Malaysian Islamic banks size and their productivity. Our results indicate that while the majority of Malaysian Islamic banks experiencing productivity progress due to technological progress came from the medium banks group, on the other hand, the majority of Malaysian Islamic banks that experienced productivity regress due to technological regress came from the small banks group. The results imply that the small Malaysian Islamic banks with its limited capabilities have lagged behind its larger counterparts in terms of technological advancements.

The remainder of the paper is organised as follows: The following section provides some background on the Islamic banking system in Malaysia. Section 3 reviews the related studies with respect to the Islamic banking industry. Section 4 describes the data, sources and model specification, which is employed in the study. Empirical results are presented in section 5. Finally, we conclude in section 6.

## 2. BACKGROUND

In Malaysia, Islamic finance traces its root back to 1963, with the establishment of the Pilgrims Fund Board or Lembaga Tabung Haji (LTH). This was a savings mechanism under which, devout Malaysian Muslim set aside regular funds to cover the costs of performing the

annual pilgrimage. These funds were in turn invested in productive sectors of the economy, aimed at yielding return uncontaminated by *riba'*.

As a country which population is dominated by Muslims, Malaysia was also affected by the resurgence that had taken place in the Middle East. Many parties were calling for the establishment for an Islamic bank in Malaysia. For example, in 1980, the Bumiputera Economic Congress had proposed to the Malaysian Government to allow the setting up of an Islamic bank in the country. Another effort was the setting up of the National Steering Committee in 1981 to undertake a study and make recommendations to the Government on all aspects of the setting up and operations of Islamic bank in Malaysia, including the legal, religious and operational aspects. The study concluded that the establishment of an Islamic bank in Malaysia would be a viable project from the operation and profits point of views. The conclusion marked the establishment of the first Islamic bank in Malaysia, Bank Islam Malaysia Berhad (BIMB) in July 1983, with an initial paid up capital of RM80 million.

The establishment of BIMB has marked a new milestone for the development of the Islamic financial system in Malaysia. BIMB carries out banking business similar to other commercial banks, but along the principles of *Syari'ah*. The bank offers deposit-taking products such as current and savings deposit under the concept of *Al-Wadiah Yad Dhamanah* (guaranteed custody) and investment deposits under the concept of *Al-Mudharabah* (profit-sharing). The bank grants financing facilities such as working capital financing under *Al-Murabahah* (cost-plus), house financing under *Bai' Bithaman Ajil* (deferred payment sale), leasing under *Al-Ijarah* (leasing) and project financing under *Al-Musyarakah* (profit and loss sharing).

It has been the aspiration of the Government to create a vibrant and comprehensive Islamic banking and finance system operating side-by-side with the conventional system. A single Islamic bank does not fit the definition of a system. An Islamic banking and finance system requires a large number of dynamic and pro-active players, a wide range of products and innovative instruments, and a vibrant Islamic money market. The first step in realising the vision was to disseminate Islamic

banking on a nationwide basis with as many players as possible and within the shortest period possible. This was achieved through the introduction of *Skim Perbankan Islam* (SPI) in March 1993. SPI allows conventional banking institutions to offer Islamic banking products and services using their existing infrastructure, including staff and branches. The scheme was launched on 4 March 1993 on a pilot basis involving three banks. Following the successful implementation of the pilot-run, Bank Negara Malaysia (BNM) has allowed other commercial banks, finance companies and merchant banks to operate the scheme in July 1993 subject to the specific guidelines issued by the central bank. From only three banks offering Islamic financing in March 1993, the number of commercial banks that offered Islamic financing has increased to 15 (of which 4 are foreign banks).

The Islamic banking system, which forms the backbone of the Islamic financial system, plays an important role in mobilising deposits and providing financing to facilitate economic growth. The Malaysian Islamic banking system is currently represented by 15 banking institutions comprised of nine domestic commercial banks, four foreign commercial banks and two Islamic banks offering Islamic banking products and services under the Islamic Banking Scheme (IBS). These Islamic banking institutions offer a comprehensive and broad range of Islamic financial products and services ranging from savings, current and investment deposit products to financing products such as property financing, working capital financing, project financing plant and machinery financing, etc.

The ability of the Islamic banking institutions to arrange and offer products with attractive and innovative features at prices that are competitive with conventional products, has appealed to both Muslim and non-Muslim customers, reflecting the capacity of the Islamic banking system as an effective means of financial intermediation, with extensive distribution networks of Islamic banking institutions, comprising 152-full-fledged Islamic banking branches and more than 2,000 Islamic banking counters. Islamic banking has also spurred the efforts by other non-bank financial intermediaries such as the development financial institutions, savings institutions and housing

credit institutions to introduce Islamic schemes and instruments to meet their customer demands.

Today, Malaysia has succeeded in implementing a dual banking system and has emerged as the first nation to have a full-fledged Islamic system operating side by side with the conventional banking system. Throughout the years, the Islamic banking has gained its significance, and has been on a progressive upward trend. Since 2000, the Islamic banking industry has been growing at an average rate of 19% per annum in terms of assets. As at end-2004, total assets of the Islamic banking sector increased to RM94.6 billion, which accounted for 10.5% of the total assets in the banking system. The market share of Islamic deposits and financing increased to 11.2% and 11.3% of total banking sector deposits and financing respectively. The rapid progress of the domestic Islamic banking system, accentuated by the significant expansion and developments in Islamic banking and finance has become increasingly more important in meeting the changing requirements of the new economy (Bank Negara Malaysia, 2004).

## 3. RELATED STUDIES

Despite the considerable development of Islamic banking sector, there are still limited studies focusing on the efficiency of Islamic banks. Several studies that have been devoted to assess the performance of Islamic banks have generally examined the relationship between profitability and banking characteristics. Bashir (1999) and Bashir (2001) perform regression analyses to determine the underlying determinants of Islamic performance by employing bank level data in the Middle East. His results indicate that the performance of banks, in terms of profits, are mostly generated from overhead, customer short term funding, and non-interest earning assets. Furthermore, Bashir (2001) claims that since deposits in Islamic banks are treated as shares, reserves held by banks propagates negative impacts such as reducing the amount of funds available for investment.

Samad and Hassan (1999) applied financial ratio analysis to investigate the performance of a Malaysian Islamic bank over the period 1984-1997. Their results suggest that in general, the managements' lack of

knowledge was the main reason for slow growth of loans under profit sharing. Despite that, the bank was found to perform better compared to its conventional counterparts in terms of liquidity and risk measurement (lower risks). Although the study was based only on a single Islamic bank in Malaysia, the result has shed some light on the example from outside the Middle East area. In another study, Sarker (1999) utilised a Banking Efficiency Model to examined Islamic Banks efficiency in Bangladesh. He claimed that, Islamic banks could survive even within a conventional banking architecture in which profit and loss modes of financing were less dominated. Sarker (1999) further argued that, Islamic products have different risk characteristics and consequently different prudential regulation should be erected.

More recently, Hassan (2005) examined the relative cost, profit, X-efficiency and productivity of the world Islamic Banking industry. Employing a panel of banks during 1993-2001, he used both the parametric (Stochastic Frontier Approach) and non-parametric (Data Envelopment Analysis) techniques as tools to examine the efficiency of the sample banks. He calculated five DEA efficiency measures namely cost, allocative, technical, pure technical and scale and further correlated the scores with the conventional accounting measures of performance. He found that the Islamic banks are more profit efficient, with an average profit efficiency score of 84% under the profit efficiency frontier compared to 74% under the stochastic cost frontier. He also found that the main source of inefficiency is allocative rather than technical. Similarly, his results suggest that the overall inefficiency was output related. The results suggest that, on average, the Islamic banking industry is relatively less efficient compared to their conventional counterparts in other parts of the world. The results also show that all five efficiency measures are highly correlated with ROA and ROE, suggesting that these efficiency measures can be used concurrently with the conventional accounting ratios in determining Islamic banks performance.

## 4. METHODOLOGY

Three different indices are frequently used to evaluate technological changes: the Fischer (1922), Tornqvist (1936), and Malmquist (1953)

indexes. According to Grifell-Tatje and Lovell (1996), the Malmquist index has three main advantages relative to the Fischer and Tornqvist indices. Firstly, it does not require the profit maximisation, or the cost minimisation, assumption. Secondly, it does not require information on the input and output prices. Finally, if the researcher has panel data, it allows the decomposition of productivity changes into two components (technical efficiency change or catching up, and technical change or changes in the best practice). Its main disadvantage is the necessity to compute the distance functions. However, the Data Envelopment Analysis (DEA) technique can be used to solve this problem.

Following Fare *et al.* (1994) and Fukuyama (1995) among others, the output oriented Malmquist productivity change index will be adopted for this study. Output orientation refers to the emphasis on the equi-proportionate increase of outputs, within the context of a given level of input. The output based Malmquist productivity change index may be formulated as:

$$M_j^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \left[ \frac{D_j^t(y^{t+1}, x^{t+1})}{D_j^t(y^t, x^t)} \times \frac{D_j^{t+1}(y^{t+1}, x^{t+1})}{D_j^{t+1}(y^t, x^t)} \right]^{1/2} \quad (1)$$

where $M$ is the productivity of the most recent production point ($x_t$+1, $y_t$+1) relative to the earlier production point ($x_t$, $y_t$). $D$'s are output distance functions. A value greater than unity will indicate positive factor productivity growth between two periods. Following Fare *et al.* (1993) an equivalent way of writing this index is:

$$M^{t+1}{}_j(y^{t+1}, x^{t+1}, y^t, x^t) = =$$

$$\frac{D_j^{t+1}(y^{t+1}, x^{t+1})}{D_j^t(y^t, x^t)} \times \left[ \frac{D_j^t(y^{t+1}, x^{t+1})}{D_j^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_j^t(y^t, x^t)}{D_j^{t+1}(y^t, x^t)} \right]^{1/2} \quad (2)$$

or

$M = TE$ x $TC$

where

$$\text{Technical Efficiency } (TE) = \frac{D_j^{t+1}(y^{t+1}, x^{t+1})}{D_j^{t}(y^{t}, x^{t})} \quad (3)$$

$$\text{Technical Change } (TC) = \left[ \frac{D_j^{t}(y^{t+1}, x^{t+1})}{D_j^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_j^{t}(y^{t}, x^{t})}{D_j^{t+1}(y^{t}, x^{t})} \right]^{1/2} \quad (4)$$

where *M* is the product of a measure of technical progress *TC* as measured by shifts in the frontier measured at period *t*+1 and period *t* and a change in efficiency *TE* over the same period.

In order to calculate these indices it is necessary to solve several sets of linear programming problems. We assume that there are *N* financial institutions and that each varying amounts of *K* different inputs to produce *M* outputs. The *i* th financial institutions is therefore represented by the vectors $x_i$ $y_i$ and the *K* x *N* input matrix *X* and the *M* x *N* output matrix *Y* represent the data of all financial institutions in the sample. The purpose is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier. The calculations exploit the fact that the input distance functions, *D*, used to construct the Malmquist index are the reciprocals of Farrell (1957) output orientation technical efficiency measures.

The equations 5 and 6 are where the technology and the observation to be evaluated are from the same period and the solution value is less than or equal to unity. The equations 7 and 8 occur where the reference technology is constructed from data in one period, whereas the observation to be evaluated is from another period. Assuming a constant returns to scale, the following output oriented linear programming are used:

$$D_j^{t}[y^{t}, x^{t}]^{-1} = \max_{\theta,\lambda} \theta \quad (5)$$

$$s.t.\ -y_{jt} + Y_t \lambda \geq 0$$

$$\theta x_{jt} - X_t \lambda \geq 0$$

$$\lambda \geq 0$$

$$D_j^{t+1}[y^{t+1}, x^{t+1}]^{-1} = \max_{\theta,\lambda} \theta \quad (6)$$

$$s.t. \; -y_{jt+1} + Y_{t+1} \lambda \geq 0$$

$$\theta x_{jt+1} - X_{t+1} \lambda \geq 0$$

$$\lambda \geq 0$$

$$D_j^{t+1}[y^t, x^t]^{-1} = \max_{\theta,\lambda} \theta \quad (7)$$

$$s.t. \; -y_{jt} + Y_{t+1} \lambda \geq 0$$

$$\theta x_{jt} - X_{t+1} \lambda \geq 0$$

$$\lambda \geq 0$$

$$D^t{}_j[y^{t+1}, x^{t+1}]^{-1} = \max_{\theta,\lambda} \theta \quad (8)$$

$$s.t. \; -y_{jt+1} + Y_t \lambda \geq 0$$

$$\theta x_{jt+1} - X_t \lambda \geq 0$$

$$\lambda \geq 0$$

This approach can be further extended by decomposing the constant returns to scale technical efficiency change into scale efficiency and pure technical efficiency components. This involves calculating further linear programs where the convexity constraint $N_i \lambda = 1$ is introduced to equations 5 to 8. It is apparent that equation (6) and (7) give the Farrell efficiency scores and the programming problems are the dual form of the Charnes *et al.* (1978) data envelopment model. Solutions to these programming models give us the efficiency scores of the *j* th firm in periods *t* and *t+1*. By solving the equations with the same data under a

constant returns to scale and variable returns to scale, measures of overall technical efficiency, *TE*, and pure technical efficiency, *PTE*, are obtained. Hence, dividing the overall technical efficiency, *TE*, by pure technical efficiency yields a measure of scale efficiency, *SE*.
By combining these models and the Fare *et al.* (1994) approach, it is thus possible to provide four efficiency indices for each firm and a measure of technical progress over time. These are (i) Technical Efficiency Change (TE), (ii) Technological Change (TC), (iii) Pure Technical Efficiency Change (PTE), (iv) Scale Efficiency Change and (v) Total Factor Productivity Change (M). *M* indicates the degree of productivity change; $M > 1$ means that period ($t$+1) productivity is greater than period $t$ productivity, whilst $M < 1$ means productivity decline and $M = 1$ corresponds to stagnation.

An assessment can be made of the sources of productivity gains or losses by comparing the values of *TE* and *TC*. If $TE > TC$, then productivity gains are largely the result of improvements in efficiency. Whereas if $TE < TC$, productivity gains are primarily the result of technological progress.

### 4.1. *Data Sample, Inputs-Outputs Definition and the Choice of Variables*

For the empirical analysis, *all* Malaysian conventional banks that offered Islamic banking window services were incorporated in the study (see Table 1). The annual balance sheets and income statements used to construct the variables for the empirical analysis were taken from published balance sheet information in annual reports of each individual bank.

The definition and measurement of inputs and outputs in the banking function remains a contentious issue among researchers. To determine what constitutes inputs and outputs of banks, one should first decide on the nature of banking technology. 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, 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. Hence, according to this approach, the number of accounts or its related transactions is the best measures for output, while the number of employees and physical capital is considered as inputs. Previous studies that adopted this approach are among others by Sherman and Gold (1985), Ferrier and Lovell (1990) and Fried *et al.* (1993).

**Table 1: Banks that Offered Islamic Banking Services in Malaysia**

| **Domestic Banks Offering Window Islamic Banking Services** |
|---|
| Affin Bank |
| Alliance Bank |
| Arab-Malaysian Bank |
| EON Bank |
| Hong Leong Bank |
| Maybank |
| Public Bank |
| RHB Bank |
| Southern Bank |
| **Foreign Banks Offering Window Islamic Banking Services** |
| Standard Chartered Bank |
| Hong Kong Bank |
| OCBC |
| Citibank |
| **Domestic Full Fledged Islamic Banks** |
| Bank Islam Malaysia |
| Bank Muamalat |

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. Previous banking efficiency studies research that adopted this approach are among others Charnes *et al.* (1990), Bhattacharyya *et al.* (1997) and Sathye (2001).

For the purpose of this study, a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) will be adopted in the definition of inputs and outputs used[1]. According to Berger and Humphrey (1997), 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.

The aim in the choice of variables for this study is to provide a parsimonious model and to avoid the use of unnecessary variables that may reduce the degree of freedom. All variables are measured in millions of Ringgit (RM). We model Malaysian Islamic banks as a multi-product firms producing two outputs by employing three inputs. Accordingly, we assume Malaysian Islamic banks produce Total Loans (*y1*) and Income (*y2*) by employing Total Deposits (*x1*), Labour (*x2*) and Fixed Assets (*x3*).

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

| | **2001** (RMb) | **2002** (RMb) | **2003** (RMb) | **2004** (RMb) |
|---|---|---|---|---|
| **Outputs** | | | | |
| | | | | |
| *Total Loans (y1)* | | | | |
| Min | 26,377 | 20,796 | 17,096 | 12,023 |
| Mean | 1,441,734.71 | 1,873,301 | 2,499,915.20 | 3,094,485.80 |
| Max | 6,409,411 | 8,253,532 | 117,03438 | 14,581,517 |
| S.D | 1,937,174.37 | 2,442,768.01 | 3,263,292.70 | 3,868,114.68 |
| | | | | |
| *Income (y2)* | | | | |
| Min | 3,407 | 3,961 | 5,917 | 10,802 |
| Mean | 87,122.43 | 107,506.93 | 159,752.20 | 193,769.33 |
| Max | 431,401 | 490,847 | 571,711 | 611,655 |
| S.D | 127,206.77 | 153,407.31 | 166,571.12 | 193,355.08 |
| | | | | |
| **Inputs** | | | | |

[1] Humphrey (1985) presets an extended discussion of the alternative approaches over what a bank produces.

Table 2 presents the summary of statistics for the outputs and inputs for Malaysian Islamic banking operations. A few conclusions can be drawn. Firstly, over the four-year period, total assets of Malaysian Islamic banking operations grew by about 71% to RM4.82 trillion in year 2004 from RM2.82 trillion in year 2001. Secondly, it is apparent that there has been increasing awareness among Malaysian public about Islamic banking and finance during this period substantiated by the growth in total loans (financing) to the domestic economy and deposits from Malaysian public during this period. During the years (2001-2004), total loans and deposits grew by about 115% and by about 79% respectively. Thirdly, conclusion could also be made about employment in the Islamic banking industry during this period. It is clear from Table 2, the Malaysian Islamic banking and finance industry has created significant employment during this period. As data on the number of employees are not readily made available, we use personnel expenses as a proxy measure. From Table 2 it is apparent that personnel expenses have expanded by approximately 108% during the four-year period. Finally, the Islamic banking and finance industry has increasingly generated awesome returns to Malaysian Islamic banks. During the period of study, we have witnessed more than 122% increase in the mean income of Malaysian Islamic banks, from a mere RM87,122.43 billion in 2001 to RM193,769.33 billion in 2004.

## 5. RESULTS

In this section, we will discuss the productivity change of Malaysian Islamic banking industry, measured by the Malmquist Total Factor Productivity (TFPCH) Index and assign the changes in total factor productivity to Technological Change (TECHCH) and Efficiency Change (EFFCH). We have also attempt to attribute any change in EFFCH to change in Pure Technical Efficiency (PEFFCH) and/or Scale Efficiency (SECH). The summary of annual means of TFPCH, TECHCH, EFFCH, and its decomposition into PEFFCH and SECH for years 2001-2004 is presented in Table 2. Because the year 2001 is the reference year, the Malmquist TFPCH index and its components take an initial score of 1 for 2001. Hence, any score greater (lower) than 1 in

subsequent years indicates an improvement (worsening) in the relevant measure. Annual values of the indices for the industry and each Malaysian Islamic banks subgroups are provided in Table 3.

### *5.1. Total Factor Productivity Growth of Malaysian Islamic Banks: An Analysis Based on the Levels*

As depicted in Panel 2 of Table 3, the Malmquist results suggest that during the period of 2001-2004, Malaysian Islamic banks have exhibited productivity progress in years 2002 and 2003 before declining in year 2004. With respect to year 2001, the average productivity increase was 8.4% in year 2002, increasing to 11.2% in year 2003 before exhibiting 4.6% productivity regress in year 2004. During the years 2002 and 2003, productivity progress of Malaysian Islamic banks was mainly due to technological change, which increased by 20.3% and 8.5% respectively. The Malaysian Islamic banks have exhibited efficiency decrease by 9.9% in year 2002 before increasing by 2.5% in year 2003. From Table 3 it is apparent that Malaysian Islamic banks technological change has declined by 6.7% in year 2004, however the Malaysian Islamic banks have continued to record positive efficiency change of 2.3% during the year albeit at a slightly lower level compared to the level recorded in year 2003.

The decomposition of the efficiency change into its pure technical and scale efficiency components suggest that the dominant source of the decrease in Malaysian Islamic banks efficiency during the year 2002 was managerially related rather than scale related, implying that the Malaysian Islamic banks were less efficient in controlling their costs during the years, rather than operating at the wrong scale of operations. Similarly, the results suggest that scale efficiency has largely resulted in the increase in Malaysian Islamic banks efficiency during the year 2003. During the year, the scale efficiency of Malaysian Islamic banks increased by 3.3% while the pure technical efficiency declined by 0.8%. In contrast, during the year 2004 the results suggest that Malaysian Islamic banks have exhibited 22.0% decline in the scale efficiency, which was offset by the 26.6% increase in pure technical efficiency during the year.

Panel 2 of Table 3 presents the results for the Malaysia domestic Islamic banks (DOM_BNKS). As observed, the DOM_BNKS have exhibited productivity progress during all years, 7.5% in year 2002 relative to 2001, increasing strongly to exhibit 18.5% productivity progress in year 2003 relative to year 2002 before declining markedly to record 6.6% increase in productivity in year 2004 relative to 2003. The decomposition of the productivity change index into its technological and efficiency change components suggest that the drop in the DOM_BNKS productivity in year 2004 was largely a result of the decline in technological change of 6.3% during the year. In contrast, the strong increase in the DOM_BNKS productivity in year 2003 was also a result of the strong increase in technological change, which increased by 24.7%. The results thus suggest that like the productivity change index, the DOM_BNKS technological change index also follow an inverted U-shaped behaviour during the period of our study.

The decomposition of the efficiency change index into its pure technical and scale efficiency components suggest that the dominant source of the decrease in the DOM_BNKS efficiency in year 2002 was pure technically related while on the other hand the decline in the DOM_BNKS efficiency in year 2003 was scale related rather than managerially related. Similarly, the results suggest that scale efficiency has largely resulted in the increase in the DOM_BNKS efficiency during the year 2004. During the year 2004, the DOM_BNKS scale efficiency increased by 12.0% while the pure technical efficiency increased by 1.7%.

To further check for the robustness of our results, we have also examined the results of domestic Malaysian Islamic banks (DOM_BNKS) excluding the full-fledged Islamic banks (DOM_XBNKS). The results are presented in Panel 3 of Table 3. Similar to the results for the domestic Malaysian Islamic banks, during the period of study, the results suggest that DOM_XBNKS have exhibited productivity progress during all years albeit higher. The results from Panel 3 of Table 3 suggest that the DOM_XBANKS have exhibited 7.5% productivity growth in 2002 relative to 2001, 18.5% progress in year 2003 relative to 2002 and 6.6% in 2004 relative to 2003. Again, similar to the results for the domestic Malaysian Islamic

banks, the decomposition of the productivity change index into its technological and efficiency change components suggest that the DOM_XBNKS productivity growth during the years 2002 and 2003 was largely attributed to technological change, while efficiency change which increased by 12.5% has resulted in the productivity progress in year 2004. It is apparent that the exclusion of the full-fledged Malaysian Islamic banks has resulted in higher technological change of 11.3% from 11.0% found for the results in the same panel and the efficiency change has also increase from 0.9% increase to 1.2% when the full-fledged Malaysian Islamic banks were excluded from the sample. The result of the decomposition of the DOM_XBNKS efficiency change into its pure technical and scale efficiency components are presented in Panel 3 of Table 3. The results from Panel 3 of Table 3 suggest that the exclusion of the full-fledged Malaysian Islamic banks has resulted in only slightly higher scale efficiency of 0.5% increase compared to the 0.3% increase when the full-fledged Malaysian Islamic banks were included in the sample.

The results for the foreign Islamic banks (FOR_BNKS) are presented in Panel 4 of Table 3. As observed, during the period of study the FOR_BNKS productivity was on the declining trend, exhibiting productivity progress of 25.6% in year 2002 before declining substantially to exhibit productivity increased of only 0.7% in year 2003 relative to 2002. It is also apparent from Panel 4 of Table 3 that the FOR_BNKS have exhibited 11.6% productivity regress in year 2004. The decomposition of the productivity change index into its technological and efficiency change components suggest that the drop in the FOR_BNKS productivity in year 2004 was largely attributed to the decline in efficiency change of 27.8% during the year. Unlike the DOM_BNKS, the results suggest that the efficiency change has largely resulted in the increase in the FOR_BNKS productivity in years 2002 and 2003. The FOR_BNKS productivity regress during the year 2004 was also the result of the decline in efficiency.

The decomposition of the efficiency change index into its pure technical and scale efficiency components suggest that the dominant source of the decrease in the FOR_BNKS efficiency in year 2003 was pure technically related while on the other hand the decline in the

FOR_BNKS efficiency in year 2004 was scale related rather than managerially related. Similarly, the results suggest that scale efficiency has largely resulted in the increase in the FOR_BNKS efficiency during the year 2002. During the year 2002, the FOR_BNKS scale efficiency increased by 6.9% while the pure technical efficiency was stagnant during the year.

**Table 3: Decomposition of Total Factor Productivity Change (TFPCH) in Malaysian Islamic Banking Industry, 2001-2004**

| Banks | Indices | | | | |
|---|---|---|---|---|---|
| | Productivity Change (TFPCH) | Technological Change (TECHCH) | Efficiency Change (EFFCH) | Pure Technical Efficiency Change (PEFFCH) | Scale Efficiency Change (SECH) |
| **Panel 1**: **ALL_BNKS** | | | | | |
| 2002-2001 | 1.084 | 1.203 | 0.901 | 0.925 | 0.974 |
| 2003-2002 | 1.112 | 1.085 | 1.025 | 0.992 | 1.033 |
| 2004-2003 | 0.954 | 0.933 | 1.023 | 1.258 | 0.813 |
| **Mean** | **1.050** | **1.074** | **0.983** | **1.058** | **0.940** |
| **Panel 2**: **DOM_BNKS** | | | | | |
| 2002-2001 | 1.075 | 1.145 | 0.939 | 0.957 | 0.981 |
| 2003-2002 | 1.185 | 1.247 | 0.950 | 1.046 | 0.908 |
| 2004-2003 | 1.066 | 0.937 | 1.138 | 1.017 | 1.120 |
| **Mean** | **1.109** | **1.110** | **1.009** | **1.007** | **1.003** |
| **Panel 3**: **DOM_XBNKS** | | | | | |
| 2002-2001 | 1.088 | 1.156 | 0.941 | 0.952 | 0.988 |
| 2003-2002 | 1.204 | 1.242 | 0.970 | 1.053 | 0.921 |
| 2004-2003 | 1.059 | 0.941 | 1.125 | 1.017 | 1.106 |
| **Mean** | **1.117** | **1.113** | **1.012** | **1.007** | **1.005** |
| **Panel 4**: **FOR_BNKS** | | | | | |
| 2002-2001 | 1.256 | 1.175 | 1.069 | 1.000 | 1.069 |
| 2003-2002 | 1.007 | 1.031 | 0.977 | 0.913 | 1.070 |
| 2004-2003 | 0.884 | 1.224 | 0.722 | 1.095 | 0.659 |
| **Mean** | **1.049** | **1.143** | **0.923** | **1.003** | **0.933** |

Note: The mean scores of the Total Factor Productivity Change (TFPCH) index and its components, Technical Change (TECCH) and Efficiency Change (EFFCH) that is further decomposed into Pure Technical Efficiency Change (PEFFCH) and Scale Efficiency Change (SECH), for all banks (ALL_BNKS) and different forms in the sample, Domestic Banks.

### *5.2. Total Factor Productivity Growth of Malaysian Islamic Banks: An Analysis Based on the Numbers*

As an analysis based on productivity levels of banks could be biased by a few observations, it would thus be beneficial to perform an analysis based on the number of banks, which is less sensitive to possible outliers. As a robustness check, Table 4 and Table 5 elaborate the productivity of Malaysian Islamic banks by summarising the development in the number of Malaysian Islamic banks, which experienced a productivity progress or regress. As the results in Panel 1 of Table 4 and Table 5 indicate, out of the total 14 Islamic banks operating in Malaysia during the 2001-2004 period, 9 (64.3%) banks had experienced productivity growth in year 2002, increasing to 12 (85.71%) in 2003, before declining to 5 (35.71%) in 2004. Likewise, all Malaysian Islamic banks had seen progress in their technology in 2002, fell to 8 (57.14%) in year 2003, before declining substantially to only 2 (14.3%) in year 2004, with the majority, 12 (85.7%) banks, exhibiting technological regress during the year.

It is also apparent that the number of Malaysian Islamic banks that experienced efficiency increase (decrease) rose (fell) from 3 (8) in year 2002 to 6 (5) in years 2003 and 2004. The decomposition of efficiency change index into its pure technical and scale efficiency components reveals some interesting facts. While the number of Malaysian Islamic banks that exhibit scale efficiency increase and/or decrease remained stable at 8 banks during the period of study, the number of Malaysian Islamic banks that exhibit pure technical efficiency increase (decrease) have increased (decreased) from 2 (5) banks in 2002 to 4 (4) and 7 (1) in 2003 and 2004 respectively.

**Table 4: Developments in the Number of Malaysian Islamic Banks With Productivity Progress (Regress) and Efficiency Increase (Decrease)**

| Period | Productivity Change (TFPCH) | | | Technological Change (TECHCH) | | | Efficiency Change (EFFCH) | | | Pure Efficiency Change (PEFFCH) | | | Scale Efficiency Change (SECH) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Progress (#) | Regress (#) | No Δ (#) | Progress (#) | Regress (#) | No Δ (#) | Increase (#) | Decrease (#) | No Δ (#) | Increase (#) | Decrease (#) | No Δ (#) | Increase (#) | Decrease (#) | No Δ (#) |
| **Panel 1: ALL_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 9 | 5 | 0 | 14 | 0 | 0 | 3 | 8 | 3 | 2 | 5 | 7 | 3 | 8 | 3 |
| 2003-2002 | 12 | 2 | 0 | 8 | 6 | 0 | 6 | 5 | 3 | 4 | 4 | 6 | 3 | 8 | 3 |
| 2004-2003 | 5 | 9 | 0 | 2 | 12 | 0 | 6 | 5 | 3 | 7 | 1 | 6 | 3 | 8 | 3 |
| **Panel 2: DOM_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 6 | 4 | 0 | 9 | 1 | 0 | 2 | 6 | 2 | 1 | 3 | 6 | 3 | 5 | 2 |
| 2003-2002 | 10 | 0 | 0 | 10 | 0 | 0 | 3 | 4 | 3 | 3 | 0 | 7 | 2 | 5 | 3 |
| 2004-2003 | 4 | 6 | 0 | 1 | 9 | 0 | 4 | 3 | 3 | 2 | 0 | 8 | 4 | 3 | 3 |
| **Panel 3: DOM_XBNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 6 | 3 | 0 | 8 | 1 | 0 | 2 | 5 | 2 | 1 | 3 | 5 | 3 | 4 | 2 |
| 2003-2002 | 9 | 0 | 0 | 9 | 0 | 0 | 3 | 3 | 3 | 3 | 0 | 6 | 2 | 4 | 3 |
| 2004-2003 | 3 | 6 | 0 | 1 | 8 | 0 | 3 | 3 | 3 | 2 | 0 | 7 | 3 | 3 | 3 |
| **Panel 4: FOR_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 4 | 0 | 0 | 4 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 4 | 1 | 1 | 2 |
| 2003-2002 | 2 | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 2 | 0 | 1 | 3 | 2 | 0 | 2 |
| 2004-2003 | 2 | 2 | 0 | 3 | 1 | 0 | 0 | 2 | 2 | 0 | 1 | 3 | 0 | 2 | 2 |

Note: Malaysian Islamic banks are categorised according to the following. Productivity Growth: TFPCH > 1, Productivity Loss TFPCH <1, Productivity Stagnation: TFPCH = 1; Technological Progress: TECCH > 1, Technological Regress TECCH <1, Technological Stagnation: TECCH = 1; Efficiency, Pure Technical and Scale increase: EFFCH, PEFFCH and SECH > 1, Efficiency, Pure Technical and Scale decrease: EFFCH, PEFFCH and SECH <1, No Change in Efficiency, Pure Technical and Scale: EFFCH, PEFFCH and SECH = 1.

**Table 5: Developments in the Percentage Change of Malaysian Islamic Banks With Productivity Progress (Regress) and Efficiency Increase (Decrease)**

| Period | Productivity Change (TFPCH) | | | Technological Change (TECHCH) | | | Efficiency Change (EFFCH) | | | Pure Efficiency Change (PEFFCH) | | | Scale Efficiency Change (SECH) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Progress (%) | Regress (%) | No Δ (%) | Progress (%) | Regress (%) | No Δ (%) | Increase (%) | Decrease (%) | No Δ (%) | Increase (%) | Decrease (%) | No Δ (%) | Increase (%) | Decrease (%) | No Δ (%) |
| **Panel 1: ALL_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 64.29 | 35.71 | 0.0 | 100.0 | 0.0 | 0.0 | 21.43 | 57.14 | 21.43 | 14.29 | 35.71 | 50.0 | 21.43 | 57.14 | 21.43 |
| 2003-2002 | 85.71 | 14.29 | 0.0 | 57.14 | 42.86 | 0.0 | 42.86 | 35.71 | 21.43 | 28.57 | 28.57 | 42.86 | 21.43 | 57.14 | 21.43 |
| 2004-2003 | 35.71 | 64.29 | 0.0 | 14.29 | 85.71 | 0.0 | 42.86 | 35.71 | 21.43 | 50.0 | 7.14 | 42.86 | 21.43 | 57.14 | 21.43 |
| **Panel 2: DOM_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 60.0 | 40.0 | 0.0 | 90.0 | 10.0 | 0.0 | 20.0 | 60.0 | 20.0 | 10.0 | 30.0 | 60.0 | 30.0 | 50.0 | 20.0 |
| 2003-2002 | 100.0 | 0.0 | 0.0 | 100.0 | 0.0 | 0.0 | 30.0 | 40.0 | 30.0 | 30.0 | 0.0 | 70.0 | 20.0 | 50.0 | 30.0 |
| 2004-2003 | 40.0 | 60.0 | 0.0 | 10.0 | 90.0 | 0.0 | 40.0 | 30.0 | 30.0 | 20.0 | 0.0 | 80.0 | 40.0 | 30.0 | 30.0 |
| **Panel 3: DOM_XBNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 66.67 | 33.33 | 0.0 | 88.89 | 11.11 | 0.0 | 22.22 | 55.56 | 22.22 | 11.11 | 33.33 | 55.56 | 33.33 | 44.44 | 22.22 |
| 2003-2002 | 100.0 | 0.0 | 0.0 | 100.0 | 0.0 | 0.0 | 33.33 | 33.33 | 33.33 | 33.33 | 0.0 | 66.67 | 22.22 | 44.44 | 33.33 |
| 2004-2003 | 33.33 | 66.67 | 0.0 | 11.11 | 88.89 | 0.0 | 33.33 | 33.33 | 33.33 | 22.22 | 0.0 | 77.78 | 33.33 | 33.33 | 33.33 |
| **Panel 4: FOR_BNKS** | | | | | | | | | | | | | | | |
| 2002-2001 | 100.0 | 0.0 | 0.0 | 100.0 | 0.0 | 0.0 | 25.0 | 25.0 | 50.0 | 0.0 | 0.0 | 100.0 | 25.0 | 25.0 | 50.0 |
| 2003-2002 | 50.0 | 50.0 | 0.0 | 50.0 | 50.0 | 0.0 | 25.0 | 25.0 | 50.0 | 0.0 | 25.0 | 75.0 | 50.0 | 0.0 | 50.0 |
| 2004-2003 | 50.0 | 50.0 | 0.0 | 75.0 | 25.0 | 0.0 | 0.0 | 50.0 | 50.0 | 0.0 | 25.0 | 75.0 | 0.0 | 50.0 | 50.0 |

Note: Malaysian Islamic banks are categorised according to the following. Productivity Growth: TFPCH > 1, Productivity Loss TFPCH <1, Productivity Stagnation: TFPCH = 1; Technological Progress: TECCH > 1, Technological Regress TECCH <1, Technological Stagnation: TECCH = 1; Efficiency, Pure Technical and Scale increase: EFFCH, PEFFCH and SECH > 1, Efficiency, Pure Technical and Scale decrease: EFFCH, PEFFCH and SECH <1, No Change in Efficiency, Pure Technical and Scale: EFFCH, PEFFCH and SECH = 1.

As the results in Panel 2 of Table 4 and Table 5 indicate, 6 (4) the domestic Malaysian Islamic banks (DOM_BNKS) had experienced productivity growth (regress) in year 2002, the number increased (declined) to 10 (0) in year 2003 before declining (increasing) to 4 (6) in year 2004. Likewise, although there was 9 DOM_BNKS had seen progress in their technology in 2002 with only 1 exhibiting technological regress and further increased to 10 banks in 2003, during the year 2004, the results suggest that almost all DOM_BNKS have exhibited technological regress. It is also apparent from Panel (b) of Table 4 and 5 that the number of DOM_BNKS that experienced efficiency increase (decrease) increased (declined) from 2 (6) in 2002 to 4 (3) in year 2004. The decomposition of efficiency change into its pure technical and scale efficiency components suggest that the number of DOM_BNKS that exhibit pure technical efficiency increase rose from only one bank in 2002 to 3 banks in 2003 before falling again to 2 banks in 2004. It is also apparent from Panel 2 of Table 4 and Table 5 that during the period of study the majority of DOM_BNKS have exhibited pure technical efficiency stagnation. On the other hand, the number of DOM_BNKS that experienced scale efficiency increase declined from 3 banks in 2002 to 2 in 2003, before increasing again to 4 banks in 2004.

As the results in Panel 3 of Table 4 and Table 5 suggest, the results by excluding the full-fledged Malaysian Islamic banks (DOM_XBNKS) has resulted in a lower number of banks experiencing productivity regress in year 2002, while the number of banks experiencing productivity progress have also decline in year 2004. The results suggest that 6 DOM_XBNKS had experienced productivity growth in year 2002, 9 in 2003, before declining to 3 in 2004. On the other hand, the number of DOM_XBNKS that experienced productivity decline fell from 4 in year 2002 to 3, while it has remained the same for years 2003 and 2004. Similarly, the number of DOM_XBNKS exhibiting technological change progress declined from 9 and 10 banks in Panel 2 of Table 4 to 8 and 9 banks in Panel 3 of Table 4. It is also apparent from Panel 3 of Table 4 that the number of DOM_XBNKS that experience efficiency increase (decrease) rose (fell) from 2 (5) in year 2002 to 3 (3) in years 2003 and 2004. The decomposition of efficiency change index into its pure technical and scale efficiency components suggest that the number of DOM_XBNKS that exhibited pure technical efficiency increase has

remained stable at 2 in 2002 and 2003, before increasing to 3 in year 2004. During all years, the majority of DOM_XBNKS were found to have recorded stagnation in their pure technical efficiency level. Similarly, the number of DOM_XBNKS that exhibit scale efficiency increase has remained the same as in Panel 2 of Table 4. On the other hand, the results from Panel 3 of Table 4 suggest that the exclusion of the full-fledged Islamic banks has resulted in the number of DOM_BNKS that experienced scale efficiency decline to fall to 4 banks in years 2002 and 2003, while the number of banks that experienced efficiency increase have also declined to 3 banks in 2004.

Panel 4 of Table 4 and Table 5 discussed the results for the foreign Islamic banks in Malaysia (FOR_BNKS). As the results indicate, during the period of study, 4 FOR_BNKS had experienced productivity growth in year 2002, before declining to 2 banks in years 2003 and 2004. Similarly, while all FOR_BNKS had seen progress in its technology in year 2002, the number declined to 2 banks in 2003 before increasing again to 3 banks in 2004. It is also apparent from Panel 4 of Table 4 and Table 5 that although the number of FOR_BNKS that experienced efficiency increase (decrease) remained stable at 1 (1) in years 2002 and 2003, all FOR_BNKS have exhibited efficiency decline in year 2004. The decomposition of efficiency change index into its pure technical and scale efficiency components suggest that, all FOR_BNKS have exhibited stagnation in their pure technical efficiency in year 2002. The number declined for the worse in years 2003 and 2004 when the results suggest that one FOR_BNKS have exhibited pure technical efficiency decline. Similarly, the number of FOR_BNKS that exhibited scale efficiency increase rose from one bank in year 2002 to 2 banks in 2003. The results however suggest that there was no FOR_BNKS that have exhibited scale efficiency increase in year 2004 with two banks exhibited decline in its scale efficiency while another two banks have exhibited scale efficiency stagnation.

**Table 6: Major Source of Productivity Progress (Regress) and Efficiency Increase (Decrease) in Malaysian Islamic Banking Industry**

| Period | Productivity Progress Mainly Due To | | Productivity Regress Mainly Due To | | No Productivity Δ | Efficiency Increase Due To | | Efficiency Decrease Due To | | No Efficiency Δ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Efficiency Increase | Technological Progress | Efficiency Decrease | Technological Regress | | PTE Increase | SE Increase | PTE Decrease | SE Decrease | |
| **Panel 1**: **ALL_BNKS** | | | | | | | | | | |
| 2002-2001 | 2 | 7 | 5 | 0 | 0 | 2 | 1 | 5 | 3 | 3 |
| 2003-2002 | 5 | 7 | 2 | 0 | 0 | 1 | 5 | 3 | 2 | 3 |
| 2004-2003 | 4 | 1 | 3 | 6 | 0 | 4 | 2 | 0 | 5 | 3 |
| **Panel 2**: **DOM_BNKS** | | | | | | | | | | |
| 2002-2001 | 1 | 5 | 4 | 0 | 0 | 0 | 2 | 3 | 3 | 2 |
| 2003-2002 | 1 | 9 | 0 | 0 | 0 | 2 | 1 | 0 | 4 | 3 |
| 2004-2003 | 3 | 1 | 1 | 5 | 0 | 0 | 4 | 0 | 3 | 3 |
| **Panel 2: DOM_XBNKS** | | | | | | | | | | |
| 2002-2001 | 1 | 5 | 3 | 0 | 0 | 0 | 2 | 3 | 2 | 2 |
| 2003-2002 | 1 | 8 | 0 | 0 | 0 | 2 | 1 | 0 | 3 | 3 |
| 2004-2003 | 2 | 1 | 1 | 5 | 0 | 0 | 3 | 0 | 3 | 3 |
| **Panel 3**: **FOR_BNKS** | | | | | | | | | | |
| 2002-2001 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 |
| 2003-2002 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 2 |
| 2004-2003 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 2 |

Note: Malaysian Islamic banks are categorised according to the following. (1) Productivity Progress: TFPCH > 1, (2) Productivity Regress TFPCH <1, (3) Productivity Stagnation: TFPCH = 1. (1) Technological Progress: TECCH > 1, (2) Technological Regress TECCH <1, (3) Technological Stagnation: TECCH = 1. (1) Efficiency, Pure Technical and Scale increase: EFFCH, PEFFCH and SECH > 1, (2) Efficiency, Pure Technical and Scale decrease: EFFCH, PEFFCH and SECH <1, (3) No Change in Efficiency, Pure Technical and Scale: EFFCH, PEFFCH and SECH = 1.

Table 6 is constructed to examine the major sources of productivity progress (regress) and efficiency increase (decrease) in Malaysian Islamic banking sector during the 2001 to 2004 period. The results given in Table 6 are simply a decomposition of Table 4 and Table 5. For instance, of those 9 Malaysian Islamic banks that experienced productivity progress in year 2002 as shown in Panel 1 of Table 6, the majority, 7, were the result of technological progress, while two banks productivity progress was mainly due to efficiency increase. On the other hand, of the 5 Malaysian Islamic banks experienced productivity regress in year 2002, all were due to the decline in efficiency.

The results from Panel 1 in Table 6 indicates that of the 3 Malaysian Islamic banks that experienced efficiency increase during the year 2002, 2 banks experienced the increase in efficiency due to the increase in pure technical efficiency while another one bank was due to the increase in its scale efficiency. Also, from the 8 Malaysian Islamic banks that experienced efficiency loss during the year 2002, 5 banks experienced the reduction in their efficiency mainly due to a decrease in their pure technical efficiency, whereas another 3 banks faced the reduction mostly due to a decrease in their scale efficiency. The subgroups results in Panel 2, 3 and 4 of Table 6 yield interesting findings. During the period of study, the results suggest that, the Malaysian Islamic banks productivity progress could mainly be attributed to technological progress, while on a similar account the efficiency increase of Malaysian Islamic banks have largely been the result of the increase in scale efficiency rather than pure technical efficiency. On the other hand, our results suggest that, during the period of study Malaysian banks productivity regress could mainly be attributed to efficiency decrease rather than technological regress, while on a similar note the major source of Malaysian Islamic banks efficiency decline was the result of scale efficiency decline.

### 5.3. *Total Factor Productivity Growth of Malaysian Islamic Banks: An Analysis Based on the Size*

Malaysian Islamic banks of different sizes might exhibit different operational characteristics. Thus, in this section we attempt divide our sample by size (gross of total assets), to explore the relationship between

the Malaysian Islamic banks size and their productivity. Panel 1 of Table 7 exhibit the TFPCH of Malaysian Islamic banks and its components according to size. The results from Panel 1 (a) of Table 7 the row view (r%) suggest that, for instance, during the year 2002, 2 out of 4 SML_BNKS that experienced productivity progress was due to technological progress while the other 2 SML_BNKS was due to efficiency increase. On the other hand, all of the 3 SML_BNKS that experienced productivity regress during the year was due to efficiency decrease.

From a column view perspective (c%), during the year 2002, majority of the Malaysian Islamic banks that experienced productivity progress due to technological progress came from the MED_BNKS group (57.1%) followed by the SML_BNKS group (28.6%). On the other hand, the results from Panel 1 (a) of Table 7 suggest that, of the 5 banks that experienced productivity regress in year 2002, the majority, 60.0%, were from the SML_BNKS followed by the LRG_BNKS and MED_BNKS with (20.0%) share each. The results imply that the small banks with its limited capabilities have lagged behind its larger counterparts in terms of technological advancements.

**Table 7: The Source of Productivity Progress (Regress) in Malaysian Islamic Banks With Respect to Size**

| Year/Size | No. Of Banks | Indices | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Of Banks with Productivity Progress | | | | | | No. Of Banks With Productivity Regress | | | | | | No Efficiency Δ | |
| | | Due to Technological Progress | | | Due Efficiency Increase | | | Due Technological Regress | | | Due Efficiency Decrease | | | | |
| **Panel 1:** | | # | r% | c% | # | r% | c% | # | r% | c% | # | r% | c% | # | r% | c% |
| (a) 2002-2001 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 2 | 28.6 | 28.6 | 2 | 28.6 | 100.0 | 0 | 0 | 0 | 3 | 42.8 | 60.0 | 0 | 0 | 0 |
| MED_BNKS | | 4 | 80.0 | 57.1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 20.0 | 20.0 | 0 | 0 | 0 |
| LRG_BNKS | | 1 | 50.0 | 14.3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 50.0 | 20.0 | 0 | 0 | 0 |
| **Total** | | **7** | | **100.0** | **2** | | **100.0** | **0** | | **0** | **5** | | **100.0** | **0** | | **0** |
| (b) 2003-2002 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 3 | 42.8 | 42.85 | 2 | 28.6 | 40.0 | 0 | 0 | 0 | 2 | 28.6 | 100.0 | 0 | 0 | 0 |
| MED_BNKS | | 3 | 60.0 | 42.85 | 2 | 40.0 | 40.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LRG_BNKS | | 1 | 50.0 | 14.3 | 1 | 50.0 | 20.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | | **7** | | **100.0** | **5** | | **100.0** | **0** | | **0** | **2** | | **100.0** | **0** | | **0** |
| (c) 2004-2003 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 0 | 0 | 0 | 2 | 33.3 | 50.0 | 1 | 16.7 | 16.7 | 3 | 50.0 | 100.0 | 0 | 0 | 0 |
| MED_BNKS | | 0 | 0 | 0 | 1 | 20.0 | 25.0 | 4 | 80.0 | 66.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| LRG_BNKS | | 1 | 33.3 | 0 | 1 | 33.3 | 25.0 | 1 | 33.3 | 16.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | | **1** | | **100.0** | **4** | | **100.0** | **6** | | **100.0** | **3** | | **100.0** | **0** | | **0** |

**Table 7 (Continued): The Source of Efficiency Increase (Decrease) in Malaysian Islamic Banks With Respect to Size**

| Year/Size | No. Of Banks | Indices | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. Of Banks with Efficiency Increase | | | | | | No. Of Banks with Efficiency Decrease | | | | | | No Efficiency Δ | | |
| | | PTE Increase | | | Scale Increase | | | PTE Decrease | | | SE Decrease | | | | | |
| **Panel 2:** | | # | r% | c% | # | r% | c% | # | r% | c% | # | r% | c% | # | r% | c% |
| (a) 2002-2001 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 1 | 14.3 | 50.0 | 1 | 14.3 | 100.0 | 3 | 42.8 | 60.0 | 0 | 0 | 0 | 2 | 28.6 | 66.7 |
| MED_BNKS | | 1 | 20.0 | 50.0 | 0 | 0 | 0 | 2 | 40.0 | 40.0 | 2 | 40.0 | 66.7 | 0 | 0 | 0 |
| LRG_BNKS | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 50.0 | 33.3 | 1 | 50.0 | 33.3 |
| **Total** | | **2** | | **100.0** | **1** | | **100.0** | **5** | | **100.0** | **3** | | **100.0** | **3** | | **100.0** |
| (b) 2003-2002 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 1 | 14.3 | 100.0 | 1 | 14.3 | 20.0 | 3 | 42.8 | 100.0 | 1 | 14.3 | 50.0 | 1 | 14.3 | 33.3 |
| MED_BNKS | | 0 | 0 | 0 | 3 | 60.0 | 60.0 | 0 | 0 | 0 | 1 | 20.0 | 50.0 | 1 | 20.0 | 33.3 |
| LRG_BNKS | | 0 | 0 | 0 | 1 | 50.0 | 20.0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 50.0 | 33.3 |
| **Total** | | **1** | | **100.0** | **5** | | **100.0** | **3** | | **100.0** | **2** | | **100.0** | **3** | | **100.0** |
| (c) 2004-2003 | 14 | | | | | | | | | | | | | | | |
| SML_BNKS | | 3 | 50.0 | 75.0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 50.0 | 60.0 | 0 | 0 | 0 |
| MED_BNKS | | 1 | 20.0 | 25.0 | 1 | 20.0 | 50.0 | 0 | 0 | 0 | 1 | 20.0 | 20.0 | 2 | 40.0 | 66.7 |
| LRG_BNKS | | 0 | 0 | 0 | 1 | 33.3 | 50.0 | 0 | 0 | 0 | 1 | 33..3 | 20.0 | 1 | 33.3 | 33.3 |
| **Total** | | **4** | | **100.0** | **2** | | **100.0** | **0** | | **0** | **5** | | **100.0** | **3** | | **100.0** |

Note: SML_BNKS is defined as banks with total assets < industry's mean, MED_BNKS is defined as banks with total assets in the mean range, while LRG_BNKS is defined as banks with total assets > industry's mean.

r% indicates row wise (relative to the same size group). c% indicates column wise (relative to other size groups).

Panel 2 (a) of Table 7 exhibit the sources of efficiency increase (decrease) of Malaysian Islamic banks according to size. The results from the row view (r%) suggest that, for instance, during the year 2002, one out of the 2 SML_BNKS that experienced efficiency increase, one SML_BNKS efficiency increase was due to pure technical efficiency increase while another SML_BNKS efficiency increase was due to scale efficiency increase. On the other hand, all of the 3 SML_BNKS that experienced efficiency decrease during the year was due to pure technical efficiency. From a column view perspective (c%), during the year 2002, 50.0% of Malaysian Islamic banks that experienced efficiency increase due to pure technical efficiency increase came from the SML_BNKS group, while another 50.0% came from the MED_BNKS group. The results from Panel 2 (a) of Table 7 suggest that, of the 5 banks that experienced efficiency decrease in year 2002 due to pure technical efficiency, the majority, 60.0%, came from the SML_BNKS group, while the MED_BNKS made the rest 40.0%.

After examining the Malmquist results, the issue of interest now is whether the two samples were drawn from the same population and whether the merchant banks and finance companies possess the same technology. The null hypothesis tested was that the domestic banks and foreign banks were drawn from the same population or environment. We tested the null hypothesis that the domestic and foreign banks were drawn from the same population and have identical technologies by using a series of parametric (ANOVA and *t*-test) and non-parametric (Kolmogorov-Smirnov, Mann-Whitney [Wilcoxon Rank-Sum] and Kruskall-Wallis) tests. Based on most of the results presented in Table 8, we failed to reject the null hypothesis at the 0.05 levels of significance that the domestic banks and foreign banks were drawn from the same population and have identical technologies. This implies that, there is no significant difference between the domestic and foreign banks technologies (frontiers) and that it is appropriate to construct a combined frontier. Furthermore, the results from the Levene's test for equality of variances do not reject the null hypothesis that the variances among domestic banks and foreign banks were equal, implying that we could assume the variances among domestic and foreign banks to be equal. Our findings corroborates with the findings by among others, Sathye (2001) and Isik and Hassan (2002).

**Table 8: Summary of Parametric and Non-Parametric Tests for the Null Hypothesis that Domestic Banks (*db*) and Foreign Banks (*fb*) Possess Identical Technologies (Frontiers)**

| | **Test Groups** | | | | |
|---|---|---|---|---|---|
| | **Parametric Test** | | **Non-Parametric Test** | | |
| **Individual Tests** | Analysis of Variance (ANOVA) test | *t*-test | Kolmogorov-Smirnov [K-S] test | Mann-Whitney [Wilcoxon Rank-Sum] test | Kruskall-Wallis Equality of Populations test |
| **Hypotheses** | $Mean_{mb} = Mean_{fc}$ | | $Distribution_{mb} = Distribution_{fc}$ | $Median_{mb} = Median_{fc}$ | |
| **Test Statistics** | *F* (Prb > *F*) | *t* (Prb > *t*) | *K-S* (Prb > *K-S*) | *z* (Prb > *z*) | $\chi^2$ (Prb > $\chi^2$) |
| Productivity Change (TFPCH) | 0.101 (0.752) | 0.318 (0.752) | 0.342 (1.000) | -0.168 (0.867) | 0.028 (0.867) |
| Technological Change (TECHCH) | 0.598 (0.282) | 0.531 (0.598) | 0.586 (0.883) | -0.445 (0.656) | 0.198 (0.656) |
| Efficiency Change (EFFCH) | 0.820 (0.053) | 0.229 (0.820) | 0.488 (0.971) | -0.088 (0.930) | 0.008 (0.930) |
| Pure Technical Efficiency Change (PEFFCH) | 0.533 (0.395) | 0.628 (0.533) | 0.537 (0.936) | -0.084 (0.933) | 0.007 (0.933) |
| Scale Efficiency Change (SECH) | 0.590 (0.295) | 0.543 (0.526) | 0.683 (0.739) | -0.571 (0.568) | 0.326 (0.568) |

Note: Test methodology follows among others, Aly *et al.* (1990), Elyasiani and Mehdian (1992) and Isik and Hassan (2002). Parametric (ANOVA and t-test) and Non-Parametric (Kolmogorov-Smirnov, Mann-Whitney and Kruskall-Wallis) tests test the null hypothesis that merchant banks and finance companies are drawn from the same efficiency population (environment).
The numbers in parentheses are the *p*-values associated with the relative test.
*** indicate significant at the 0.01 level.
** indicates significant at the 0.05 level.
* indicates significant at the 0.10 level.

## 6. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

This paper attempts to investigate the productivity changes of Malaysian Islamic banks during the post crisis period of 2001-2004, by applying a non-parametric Malmquist Productivity Index (MPI) method. The preferred methodology has allowed us to isolate efforts to catch up to the frontier (efficiency change) from shifts in the frontier (technological change). Also, the Malmquist index enables us to explore the main sources of efficiency change: either improvements in management practices (pure technical efficiency change) or improvements towards optimal size (scale efficiency change). Additionally we have also performed a series of parametric and non-parametric tests to examine whether the domestic and foreign banks were drawn from the same set of population.

Our results suggest that Malaysian Islamic banks productivity have exhibited an inverted U-shaped behaviour during the period of our study. The Malaysian Islamic banks have exhibited 8.4% productivity progress in year 2002, increasing to record the highest productivity change of 11.2% in year 2003, before declining to record 4.6% productivity regress in year 2004. Our results suggest that the domestic banks have exhibited higher productivity growth compared to its foreign counterparts. The decomposition of the productivity change index suggests that Malaysian Islamic banks productivity progress was mainly attributable to technological change rather than efficiency change during the years 2002 and 2003 while the opposite was true during the year 2004 when the results suggest that Malaysian Islamic banks have exhibited higher efficiency change. Further decomposition of the efficiency change index into its pure technical and scale efficiency components suggest that, during the period of study pure technical efficiency has largely resulted in Malaysian Islamic banks efficiency increase. However, the results may have to be interpreted with caution as Malaysian Islamic banks were found to have exhibited pure technical efficiency decline in years 2000 and 2003 before increasing strongly in year 2004, which has eliminated the negative effects of years 2002 and 2003.

We have also explored the relationship between different Malaysian Islamic banks size and their productivity. Our results indicate that while the majority of Malaysian Islamic banks experiencing productivity progress due to technological progress came from the medium banks group, on the other hand, the majority of Malaysian Islamic banks that experienced productivity regress due to technological regress came from the small banks group. The results imply that the small Malaysian Islamic banks with its limited capabilities have lagged behind its larger counterparts in terms of technological advancements.

Further, to address the issue whether the domestic and foreign banks were drawn from the same sample of population or environment, or whether the domestic and foreign banks have the same technological (frontiers) attribution, we have performed a series of parametric and non-parametric tests. Our results from the parametric and non-parametric tests could not reject the null hypotheses at the 0.05 levels of significance that the domestic and foreign banks operating in were drawn from the same population or environment, suggesting that it is appropriate to construct a single frontier for both the domestic and foreign banks.

Due to its limitations the paper could be extended in a variety of ways. It is suggested that further analysis into the investigation of Malaysian Islamic banks productivity to consider the risk exposure factors. As to establish overall Islamic banks performance, risk exposure factors should be taken into consideration along with the productive efficiency measures. As the best banks may not necessarily be the most efficient producer of loans, but also one, which balances high efficiency with low risk assumptions. Investigation of changes in the efficiency changes over time as a result of technical change or technological progress or regress by employing the Data Envelopment Analysis (DEA) could yet be another extension to the paper. Future research into the efficiency and productivity of Malaysian Islamic banks could also consider the production function along with the intermediation function.

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