JnU Journal of Economics Vol. 4, No. 1, December 2022, (Page 26–42) ISSN: 2707-0689

Measuring Efficiency Changes of Non-Bank Financial Institutions in Bangladesh: Application of Malmquist Indices

Razu Ahmed[1]
Touhidul Islam[2]

Abstract

The study aims to measure the periodical efficiency changes of NBFIs in Bangladesh by applying the Malmquist Indices (MI). The study covers the randomly selected 14 NBFIs listed in the Dhaka Stock Exchange (DSE) and the considered sample period is 2014 to 2018. The value of MI>1 indicates the increasing efficiency of the institutions. The study explored that the overall positive efficiency changes of technical, technological, pure or managerial, scale and total factor productivity of selected NBFIs were 24.30 percent, 1.70 percent, 9.60 percent, 13.20 percent, and 24.90 percent, respectively, during the study period. The study identified the significant space for improving positive efficiency changes of NBFIs in terms of investment, loan provision, capital mix, and operating expenses. So, the efficient operations of NBFIs in the financial market of Bangladesh alongside the banking industry should require the outline of prudent policies. Hence, the study suggests that the authority of NBFIs should adopt the MI analysis in the financial assessment process to capture the real financial outlook and design a policy framework accordingly.

Keywords: Efficiency changes, Malmquist index, NBFIs

1. Introduction

Financial institutions other than deposit money banks mainly carry out the financing business termed Non-Bank Financial Institutions (NBFIs) (Bangladesh Bank, 2020b). The structural limitations, the rigidity of financial regulations, and the limited sphere of financial services in the banking industry lead to the emergence of NBFIs as a financial intermediary in Bangladesh. The NBFIs provide various financial services that the banking industry does not usually offer (Ahmed & Chowdhury, 2007). NBFIs make loans and advances for agriculture, commerce, industries, transport, or building construction. Some NBFIs collect term deposits

[1] Professor, Department of Accounting and Information Systems, Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh-2224, Bangladesh.
E-mail: razuahmed99@jkkniu.edu.bd

[2] Deputy Director (Research), Research Department, Bangladesh Bank, Dhaka-1000, Bangladesh.. E-mail: islam.touhidul@bb.org.bd

Views and analyses expressed here are the authors' own and do not necessarily reflect the views of the authors' institutions.

marked as Non-Bank Depository Corporations (Bangladesh Bank, 2020b). According to the Financial Institutions Act, 1993, the NBFIs are licensed, regulated and supervised by Bangladesh Bank (Bangladesh Bank, 2020a). Just ten years later of the birth of Bangladesh, the Industrial Promotion and Development Company (IPDC) launched its business in the private sector as the first NBFIin 1981 (Hossain & Shahiduzzaman, 2005). As of June 2020, the number of NBFIs in Bangladesh stood at 35 (including Peoples Leasing and Financial Services Limited, under liquidation), comprising 3 government-owned, 13 joint-venture and 19 operated in the private sector (Bangladesh Bank, 2020a). A total of 34 NBFIs are currently serving their activities in the financial market of Bangladesh.

The efficiency of financial institutions is described as one of their prime objectives because efficient firms can achieve maximum outputs from minimum inputs (Afza & Asghar, 2010). To have sustainable development of NBFIs, they must perform their activities efficiently. Measuring the periodical efficiency changes of a firm helps to understand its strength and performance. A financial ratio analysis is appropriate for measuring efficiency changes when the firm manages single input to produce a single output. But the Data Envelopment Analysis (DEA) based MI can process multiple inputs simultaneously (Lall & Srivastava, 2020) to explore the efficiency changes of a firm. Sten Malmquist first introduced the Malmquist Productivity Index (MPI) in 1953, and many researchers developed it. The MPI is based on the production function concept, a function of maximum possible production concerning a set of inputs (Depren & Depren, 2016).

Total factor productivity is one of the prime indices of performance assessment. Productivity means performing the right task at optimal cost with ensuring standard quality. So, productivity is the function of efficiency and effectiveness (Amani et al., 2018). Productivity measurement informs whether the enterprises use the resources effectively and efficiently (Lall & Srivastava, 2020). By applying MPI, it is possible to estimate changes in technical efficiency-Effch, technological efficiency-Techch, pure technical efficiency-Tech, scale efficiency-Sech, and total factor productivity-tfpch (Raphael, 2013). Alimohammadlou and Mohammadi (2016) identified Malmquist Index (MI) as one of the most recent non-parametric methods that measure a company's performance from the perspective of financial and non-financial dimensions.

The present study also employs MI analysis, a non-parametric technique, to investigate the periodical efficiency changes of NBFIs in Bangladesh. The study's findings may help the authority of the NBFIs and the financial policy-makers to outline the possible ways for improving the efficiency of NBFIs in Bangladesh. The remaining of the paper is organized as follows. Following introduction, Section 2 reviews the relevant literature. Section 3 describes the sources of data, conceptual framework and methodological aspects of the study. Results of this study are discussed and analyzed in Section 4, while Section 5 concludes with some recommendation.

2. Literature Review

Several studies have explored the performance in terms of productivity change of financial and non-financial institutions nationally and internationally. To measure the efficiency and productivity of Turkish deposit banks, Depren and Depren (2016) applied the Data Envelopment Analysis (DEA), and Malmquist Productivity Index (MPI) approaches from 2014 to 2015. The study found that the performance of the deposit banks decreased during the study period. Furthermore, the productivity declines correlated with non-interest expenditure to total assets, total loans to total assets and non-interest income to total assets in the intermediation approach, while in the production approach, the average number of staff per branch, total personal expenses to total assets and total deposits to total assets had a vital role for efficiency.

Lall and Srivastava (2020) examined the financial productivity of four energy sector enterprises in India, applying the Malmquist Total Factor Productivity (TFP) technique. The result of the study showed that the TFP scores of selected enterprises were below the unity, and enterprises were not working efficiently due to the reduction in technological change. The study also identified the possibility of improving financial productivity in enterprises by 18 percent. Baten et al. (2015) assessed the technical efficiency change and productivity change of 17 state-owned commercial banks and private commercial banks in Bangladesh by applying cost DEA, profit DEA and Malmquist based DEA. The study revealed that cost DEA's average technical and allocative efficiencies were 75.4 percent and 35.9 percent, respectively, while 74.0 percent and 31.8 percent for profit DEA during the study period. The study also observed that the bank-wise and year-wise productivity change, efficiency change, and technical efficiency change of profit DEA were more significant than the cost DEA of the selected banks.

Raphael (2013) measured the productivity change of Tanzanian commercial banks applying the MPI from 2005 to 2011. The study found that the commercial banks recorded an enhancement in efficiency change by 67 percent, a technical change enhancement by 83 percent, pure technical change improvement by 67 and a scale efficiency change by 50 percent. The study's findings also claimed that small banks have invested in technological innovation to reduce related production costs. Camanho and Dyson (2006) developed the measures based on MI applicable to assess the performance of a group of institutions, including bank branches. The study analyzed the construction of an index reflecting the relative performance of branches in four different regions. The constructed index can decompose into an index to compare efficiency spread within the group, evaluate internal managerial efficiencies, and compare frontier productivity, reflecting the impact of environmental factors and regional managerial policies on branches' productivity.

Moffat et al. (2009) measured the total factor productivity change of 10 financial institutions in Botswana from 2001 to 2006 by applying the MPI. The study found that the loss or little productivity growth in the financial institutions, although the slight improvement in the relative efficiency of most of the financial institutions in

Botswana. The study claimed that the loss is attributed mainly to technological regress. Azad et al. (2016) diagnosed the efficiency of 15 Micro Finance Institutions (MFIs) in Bangladesh using MI from 2008 to 2012. The study revealed that MFIs experienced annual efficiency progress at 93.5 percent, mainly due to pure efficiency. However, compared to total efficiency progress, the contribution of scale efficiency was only 2.20 percent, while the overall technical efficiency of MFIs was 3.70 percent.

Mohammadi and Ranaei (2011) applied the DEA based MI to capture the pattern of productivity change of 22 cement companies registered in the Iran stock exchange market. The study's findings showed that 3 cement companies had the most productivity change from 2003 to 2004. Thus, the study claimed that MI is a good approach for measuring organizational performance as a quantitative measurement of productivity change. Junwen et al. (2017) compared and analyzed the technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE) of state-owned commercial banks (SOCBs), joint-stock commercial banks (JSCBs), city commercial banks (CCBs), and rural commercial banks (RCBs) in China using DEA from 2012 to 2014. The study diagnosed that the performance of SOCBs was stable, and the efficiency was relatively high. The performance of JSCBs was second only to that of SOCBs, but there were fluctuations, and PTE decreased significantly. The TE and SE of CCBs were not ideal due to geographical constraints and local policy implications. However, the RCBs had good performance with a significant increase in TE and SE during the study period.

Faruk and Rahaman (2015) measured the efficiency of 15 life insurance companies in Bangladesh and 5 Takaful life insurance companies in Malaysia using DEA and MI to differentiate the contributions of technical change, efficiency change, and the pure and scale changes total factor productivity growth. The study claimed that the total factor productivity of the life insurance companies in Bangladesh is near an efficient score due to improvements in technical changes. Naz et al. (2017) attempted to estimate the productivity and efficiency of the textile sector in Pakistan using the MI, considering the shareholder equity, total assets, operating expense and cost of goods sold as input variables and total sales as output variable from 2011 to 2015. The study found that the productivity growth of the textile sector was 1.00 from 2011 to 2014 and declined to 0.99 in 2015. The study also found that lack of skilled labor, machinery and power resources are the leading factors of low productivity in the textile sector of Pakistan.

According to Bangladesh Bank (2020a) out of 34 NBFIs, the composite CAMELS rating of 14 NBFIs was "2 or Satisfactory", 10 NBFIs were "3 or Fair", 7 NBFIs were "4 or Marginal", and 1 NBFI was "5 or Unsatisfactory" at the end of June 2019 while 1 NBFI is yet to come in this rating and another is in the liquidation process. Hence, the scenario of performance indicators entails the ample scope of NBFIs for developing their business efficiently and effectively in Bangladesh using the existing resources of the industry.

The reviewed works of literature in the study express the significance of the Malmquist Indices model for measuring institutional periodical efficiency changes.

The study on measuring periodical efficiency changes of non-bank financial institutions using the non-parametric technique like Malmquist Indices is the dearth in Bangladesh. The results of the estimation of efficiency changes help the firm's manager and stakeholders find out the direction of strengths and weaknesses of the firm, which is essential for making better policy decisions to improve the firm's efficiency. Moreover, the efficient operation of the business of NBFIs in the competitive financial market of Bangladesh requires measuring the periodical efficiency changes of NBFIs. Therefore, the study intends to estimate the efficiency changes of NBFIs in Bangladesh using one of the most reliable non-parametric methods, the Malmquist Indices analysis.

3. Data and Methods of the Study

3.1 Data Source

Efficiency changes of NBFIs from one period to another are measured and interpreted based on the secondary data collected from selected NBFIs of Bangladesh. The present study estimated the efficiency changes of selected NBFIs from 2014 to 2018 based on the availability and uniformity of data on the required variables for measuring the Malmquist Indices. Currently, 34 NBFIs are in Bangladesh, of which 22 are listed on the Dhaka Stock Exchange (DSE), and the present study covers randomly selected DSE listed 14 NBFIs. These are - Bay Leasing and Investment Limited (BLIL), FAS Finance and Investment Limited (FASFIL), GSP Finance Company (Bangladesh) Limited (GSPFCL), Infrastructure Development Company Limited (IDLC), International Leasing and Financial Services Limited (ILFSL), IPDC Finance Limited (IPDCFL), Islamic Finance and Investment Limited (IFIL), Lanka Bangla Finance Limited (LBFL), National Housing Finance and Investment Limited (NHFIL), Phoenix Finance and Investments Limited (PFIL), Premier Leasing and Finance Limited (PLFL), Union Capital Limited (UCL), United Finance Limited (UFL) and Uttara Finance and Investments Limited (UFIL). Periodical efficiency changes of NBFIs are calculated using the MI model and compared based on the data collected from the study's annual reports of the selected NBFIs. The other key data sources for the study are published books, journals, relevant websites, the DSE website, Bangladesh Economic Review, and the Bangladesh Bank annual reports.

3.2 Analyzing and Interpreting of Data

Efficiency changes from one period to another has identified through Malmquist Indices analysis. The DEA software version 2.1 has been used for data processing and estimating the efficiency changes of NBFIs.

3.2.1 Malmquist Indices

The MI is one of the most significant indices in evaluating the efficiency of growth of all units. Sten Malmquist first introduced the Malmquist Productivity Index (MPI) in 1953, which was developed by many researchers (Depren & Depren, 2016). Caves et al. (1982) first introduced the Malmquist indes and later Fare et al.

(1994) further developed it in performance assessments (Camanho & Dyson, 2006). Literature found several models that have been introduced to develop the productivity index based on DEA. The Malmquist Indices (MIs) compute using the distance function. Distance functions allow multi-input, multi-output production technology without the need to specify a behavioural objective. The total factor productivity changes (Tfpch) at time t+1 and t by using input-oriented DEA-MI can express as[1]:

$$MI_0 = \left[\frac{D_0^t(x_0^{t+1},y_0^{t+1})D_0^{t+1}(x_0^{t+1},y_0^{t+1})}{D_0^t(x_0^t,y_0^t)D_0^{t+1}(x_0^t,y_0^t)}\right]^{\frac{1}{2}}.$$

$MI_0 > 1$ indicates progress in Tfpch from period t to t+1; $MI_0 = 1$ means no change of Tfp from period t to t+1, and $MI_0 < 1$ indicates a decrease in Tfpch the period t to t+1. Similarly, the other efficiency changes, like technical efficiency (Effch), technological efficiency (Techch), pure efficiency (Pech), and scale efficiency (Sech) can determine using MI analysis. The Tfpch decomposes into Effch and Techch, and Effch is to decompose into Pech and Sech. DEA based MI can process multiple inputs and outputs at a time to have results. The present study identified investment, loan provision, debt capital, and salary expenses as the input variables, while profit after tax was the MI model's output variable.

3.2.2 Conceptual Framework of Malmquist Indices

This section describes the conceptual framework of Malmquist Indices to clear the roadmap in order to visualizing outcomes.

Technical efficiency: Technical efficiency reflects the ability of a firm to obtain maximum output based on a given set of inputs (Tung, 2013). It is the ability to produce at the maximum output with given quantities of inputs and production technology (Amaza & Maurice, 2005, cited as Anang et al., 2016). Technical efficiency is the ability of a firm to produce as much output as possible with a specified level of inputs, given the existing technology (Erena et al., 2021). Technical efficiency is a sign of expertise use of inputs. An organization is technically efficient if its output is maximum with minimum inputs.

***Technological efficiency*:** Malmquist Productivity Index measures the technological efficiency of a firm as the set of feasible combinations of input and output quantities expands at the productivity limit (Balk, 2001). Technological changes enable the firm to produce increased output from the optimal combination of input and output, which causes the upward shift of the production possibility frontier (Worthington, 2000). Malmquist Productivity Index allows to identify the changes in the production possibility frontier over time and decomposes the overall productivity growth of a firm into technical efficiency gains and technological improvements.

Pure or managerial efficiency: The term "managerial efficiency" refers to the creation of the best social and economic conditions for the organization's activity in

[1] For detail, see Wang and Lan (2011).

terms of achieving the goals and strategies set forth by the company management within the specified time frame and using the least-cost resources (Cheymetova & Scherbakov, 2017). It is usually evaluated in terms of the manager's ability to minimize the consumption of inputs in the production of certain products or maximize production output with minimum inputs (Atristain, 2012).

Scale efficiency: The scale efficiency demonstrates whether or not a company is producing at the optimal scale (Caunic, 2020). It indicates that the operational size of an organization is optimal; any changes in size make the unit less efficient. The scale efficiency value is calculated by dividing aggregate efficiency by technical efficiency.

Total factor productivity: Total Factor Productivity (TFP) is a metric that measures the ratio of output to all input factors and can reflect the overall level and change in productivity (Fan et al., 2021). TFP is the percentage of output that cannot be explained by the number of inputs used in production (Comin, 2008; Şeker & Saliola, 2018). As a result, its level is determined by how efficiently and intensively inputs are used in production. Therefore, its value reflects how efficiently and intensively inputs are used in production. (Şeker & Saliola, 2018).

4. Results and Discussion

The Malmquist productivity index had become the standard approach in productivity measurement over time, mainly when non-parametric specifications apply to micro-data. The study applied the MI model to the estimated efficiency score from the collected data to find the periodical efficiency changes of NBFIs. Then the Malmquist Indices have explored technical efficiency changes (Effch), technological efficiency changes (Techch), pure or managerial efficiency changes (Pech), scale efficiency changes (Sech) and total factor productivity changes (Tfpch) of the NBFIs in Bangladesh over the study period. The estimated results of MI are discussed in this section of the study.

4.1 Technical Efficiency Changes (Effch)

Table 1 depicts the comparative technical efficiency changes (Effch) of the selected NBFIs during the study period. Technical efficiency is the efficacy with which a given set of inputs is used to produce an output. A firm is technically efficient compared to others if it can produce maximum output using the same types of inputs or the same output using the minimum amount of inputs such as labour, capital etc. In this regard, the maximum change was found in FASFIL (244%) for 2017 followed by BLIL (240.50%) in 2017, NHFIL (190.03%) in 2018, UCL (159.70%) in 2017, UFL (153.00%) in 2018, PLFL (130.20%) in 2017, IFIL (100.47%) in 2016, IPDCFL (86%) in 2018, LBFL (83.30%) in 2016, IDLC (59.60%) in 2015, ILFSL (54.30%) in 2018, GSPFCL (44.80%) in 2015, PFIL (6.20%) in 2017 and UFIL (3.90%) in 2016. The maximum decreasing position was detected 78.90 percent for UCL in 2015 and a minimum of 0.30 percent for UFIL in 2015.

Table 1: Comparative technical efficiency changes of the selected NBFIs

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
BLIL	-	1.000	0.294	3.405	1.000	1.425	3.405	0.294
FASFIL	-	1.957	0.290	3.446	1.000	1.673	3.446	0.290
GSPFCL	-	1.448	1.085	1.232	0.526	1.073	1.448	0.526
IDLC	-	1.596	0.891	0.683	0.479	0.912	1.596	0.479
ILFSL	-	1.377	1.184	0.648	1.543	1.188	1.543	0.648
IPDCFL	-	1.817	1.115	0.538	1.860	1.333	1.860	0.538
IFIL	-	1.081	2.047	0.450	2.014	1.398	2.047	0.450
LBFL	-	0.809	1.833	0.814	1.254	1.178	1.833	0.809
NHFIL	-	0.579	2.233	0.309	2.903	1.506	2.903	0.309
PFIL	-	0.863	0.657	1.062	0.710	0.823	1.062	0.657
PLFL	-	0.564	1.431	2.302	0.695	1.248	2.302	0.564
UCL	-	1.000	0.211	2.597	1.822	1.408	2.597	0.211
UFL	-	1.000	1.00	0.378	2.530	1.227	2.530	0.378
UFIL	-	0.997	1.039	1.000	1.000	1.009	1.039	0.997
Mean	-	1.149	1.094	1.347	1.381	1.243	1.381	1.094
Max.	-	1.957	2.233	3.446	2.903	2.635	3.446	1.957
Min.	-	0.564	0.211	0.309	0.479	0.391	0.564	0.211

Source: Authors' calculations based on data from annual reports of selected companies

According to the mean technical efficiency change, the maximum change was 67.30 percent in FASFIL. On the other hand, the maximum decrease result found in PFIL by 17.70 percent. The change of mean technical efficiency of other twelve companies was BLIL (42.50%), GSPFCL (7.30%), IDLC (-8.80%), ILFSL (18.80%), IPDCFL (33.30%), IFIL (39.80%), NBFL (17.80%), PLFL (24.80%), UCL (40.80%), UFL (22.70) and UFIL (0.90%) during the study period. If look at the year wise change of the mean technical efficiency found 14.90 percent for 2015, 9.40 percent for 2016, 34.70 percent for 2017 and 38.10 percent for 2018. However, overall positive change (24.30%) observed for the sample during the study period.

4.2 Technological Efficiency Changes (Techch)

Comparative technological efficiency changes of selected companies over the study period are reported in Table 2. Technology is the methods and processes that firms use to produce goods and/or services. A firm would be operating with technological efficiency when it produces a certain output level with the least amount of input.In this regard, the maximum change was found in IPDCFL (305.80%) for 2016 followed by UFL (180.90%), ILFSL (124.50%), UFIL (114.30%), UCL (107.10%), FASFIL (89.10%), IDLC (88.10%), PLFL (71.10%), GSPFCL (66.80%), IFIL (49.60%), PFIL (28.00%), BLIL (15.30%), and NHFIL (6.40%). All the maximum changes made during the year 2016 except PFIL and UCL in 2018. The maximum decreasing position found 59.40 percent for UFL in 2017 and a minimum of 28.80 percent for IFIL in 2017.

As per the mean technological efficiency change, the maximum change was 53.40 percent in IPDCFL. On the other hand, the maximum decrease was in LBFL

by 24.30 percent. The change of mean technological efficiency of other twelve companies was BLIL (-22.70%), FASFIL (-1.80%), GSPFCL (-17.50%), IDLC (-8.30%), ILFSL (11.20%), IFIL (-3.80%), NBFL (-19.30%), PFIL (-1.40%), PLFL (-0.06%), UCL (17.80%), UFL (24.90) and UFIL (16.50%) during the study period. The year-wise change of the mean technological efficiency found -32.80 percent for 2015, 83.80 percent for 2016, -35.30 percent for 2017 and -9.30 percent for 2018. However, an overall positive change (1.70%) was observed for the sample during the study period.

Table 2: Comparative technological efficiency changes of the selected NBFIs

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
BLIL	-	0.735	1.153	0.759	0.446	0.773	1.153	0.446
FASFIL	-	0.722	1.891	0.750	0.565	0.982	1.891	0.565
GSPFCL	-	0.576	1.668	0.559	0.497	0.825	1.668	0.497
IDLC	-	0.586	1.881	0.482	0.719	0.917	1.881	0.482
ILFSL	-	0.667	2.245	0.500	1.034	1.112	2.245	0.500
IPDCFL	-	0.620	4.058	0.467	0.989	1.534	4.058	0.467
IFIL	-	0.720	1.496	0.712	0.918	0.962	1.496	0.712
LBFL	-	0.722	0.884	0.595	0.825	0.757	0.884	0.595
NHFIL	-	0.695	1.064	0.709	0.760	0.807	1.064	0.695
PFIL	-	0.784	1.234	0.647	1.280	0.986	1.280	0.647
PLFL	-	0.679	1.711	0.895	0.691	0.994	1.711	0.679
UCL	-	0.529	1.490	0.621	2.071	1.178	2.071	0.529
UFL	-	0.802	2.809	0.406	0.977	1.249	2.809	0.406
UFIL	-	0.648	2.143	0.950	0.919	1.165	2.143	0.648
Mean	-	0.678	1.838	0.647	0.907	1.017	1.838	0.647
Max.	-	0.802	4.058	0.950	2.071	1.970	4.058	0.802
Min.	-	0.529	0.884	0.406	0.446	0.566	0.884	0.406

Source: Authors' calculations based on data from annual reports of selected companies

4.3 Pure Efficiency Changes (Pech)

Table 3 highlights the comparative pure efficiency changes (Pech) of the selected NBFIs of Bangladesh during the study period from 2014 to 2018. Pure efficiency is the ability of management that extends its capacity, skill, and capability to govern the firm in the right direction. A firm is purely efficient compared to others if it can enjoy maximum output using the same input types and volume. In this regard, the maximum change was found in BLIL (134.20%) for 2017 followed by IFIL (117.60%) in 2018, UCL (108.20%) in 2017, FASFIL (85.00%) in 2017, IPDCFL (84.80%) in 2018, NHFIL (72.90%) in 2016, ILFSL (62.00%) in 2015, IDLC (61.20%) in 2015, PLFL (35.30%) in 2016, LBFL (32.00%) in 2018, PFIL (15.80%) in 2017, GSPFCL (14.80%) in 2017, UFL (2.70%) in 2018 and there was no change for UFIL. The maximum decreasing position watched 57.30 percent for BLIL in 2016 and a minimum of 2.90 percent for GSPFCL in 2018.

According to the mean pure efficiency change, the maximum change was 21.20 percent in IFIL. On the other hand, the maximum decrease was in UFL by 0.40

percent. The change of mean pure efficiency of other twelve companies was BLIL (19.20%), FASFIL (13.70%), GSPFCL (3.10%), IDLC (16.60%), ILFSL (20.20%), IPDCFL (12.00%), LBFL (6.70%), NHFIL (4.20%), PLFL (0.60%), UCL (15.80%), and UFIL (0.00%) during the study period. The mean pure efficiency year-wise change was viewed 9.00 percent for 2015, -2.10 percent for 2016, 10.50 percent for 2017 and 20.90 percent for 2018. However, an overall positive change (9.60%) was uncovered for the sample during the study period.

Table 3: Comparative pure efficiency changes of the selected NBFIs

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
BLIL	-	1.000	0.427	2.342	1.000	1.192	2.342	0.427
FASFIL	-	1.157	0.541	1.850	1.000	1.137	1.850	0.541
GSPFCL	-	0.994	1.012	1.148	0.971	1.031	1.148	0.971
IDLC	-	1.612	1.000	0.679	1.373	1.166	1.612	0.679
ILFSL	-	1.620	1.000	0.650	1.538	1.202	1.620	0.650
IPDCFL	-	1.091	1.000	0.541	1.848	1.120	1.848	0.541
IFIL	-	1.283	0.939	0.451	2.176	1.212	2.176	0.451
LBFL	-	1.060	1.273	0.616	1.320	1.067	1.320	0.616
NHFIL	-	0.846	1.729	1.000	0.594	1.042	1.729	0.594
PFIL	-	0.860	1.004	1.158	1.000	1.006	1.158	0.860
PLFL	-	0.739	1.353	1.000	0.958	1.013	1.353	0.739
UCL	-	1.000	0.428	2.082	1.123	1.158	2.082	0.428
UFL	-	1.000	1.000	0.958	1.027	0.996	1.027	0.958
UFIL	-	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Mean	-	1.090	0.979	1.105	1.209	1.096	1.209	0.979
Max.	-	1.620	1.729	2.342	2.176	1.967	2.342	1.620
Min.	-	0.739	0.427	0.451	0.594	0.553	0.739	0.427

Source: Authors' calculations based on data from annual reports of selected companies

4.4 Scale Efficiency Changes (Sech)

Table 4 represents the comparative scale efficiency changes (Sech) of the selected NBFIs during the study period. A unit is scale efficient when its size of operations is optimal so that any modifications to its size will render the unit less efficient. In this regard, the maximum change was found in NHFIL (388.70%) for 2018 followed by UFL (146.30%) in 2018, PLFL (130.20%) in 2017, IFIL (118.00%) in 2016, FASFIL (86.30%) in 2017, IPDCFL (66.50%) in 2015, UCL (62.30%) in 2018, GSPFCL (45.70%) in 2015, BLIL (45.40%) in 2017, LBFL (44.00%) in 2016, ILFSL (18.40%) in 2018, UFIL (3.90%) in 2016, IDLC (0.70%) in 2017 and PFIL (0.40%) in 2015. The maximum decreasing position detected 69.10 percent for NHFIL in 2017 and a minimum of 0.03 percent for UFIL in 2015.

According to the mean scale efficiency change, the maximum changes were viewed at 79.30 percent in NHFIL. On the other hand, the maximum decrease was found in UFL by 19.10 percent. The change in mean scale efficiency of other twelve companies was BLIL (3.60%), FASFIL (27.30%), GSPFCL (3.60%), IDLC (19.10%), ILFSL (0.09%), IPDCFL (19.50%), IFIL (23.70%), LBFL (11.90%), PFIL ((-17.90%), PLFL (21.20%), UCL (9.10%), UFL (21.50) and UFIL (0.09%) during

the study period. The year-wise change of the mean scale efficiency was found 5.10 percent for 2015, 4.60 percent for 2016, 13.40 percent for 2017 and 29.90 percent for 2018. However, an overall positive change (13.20%) was found for the sample during the study period.

Table 4: Comparative scale efficiency changes of the selected NBFIs

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
BLIL	-	1.000	0.688	1.454	1.000	1.036	1.454	0.688
FASFIL	-	1.692	0.537	1.863	1.000	1.273	1.863	0.537
GSPFCL	-	1.457	1.072	1.073	0.542	1.036	1.457	0.542
IDLC	-	0.990	0.891	1.007	0.349	0.809	1.007	0.349
ILFSL	-	0.850	1.184	0.996	1.004	1.009	1.184	0.850
IPDCFL	-	1.665	1.115	0.994	1.006	1.195	1.665	0.994
IFIL	-	0.843	2.180	0.997	0.926	1.237	2.180	0.843
LBFL	-	0.764	1.440	1.321	0.950	1.119	1.440	0.764
NHFIL	-	0.683	1.291	0.309	4.887	1.793	4.887	0.309
PFIL	-	1.004	0.654	0.917	0.710	0.821	1.004	0.654
PLFL	-	0.763	1.057	2.302	0.725	1.212	2.302	0.725
UCL	-	1.000	0.494	1.248	1.623	1.091	1.623	0.494
UFL	-	1.000	1.000	0.395	2.463	1.215	2.463	0.395
UFIL	-	0.997	1.039	1.000	1.000	1.009	1.039	0.997
Mean	-	1.051	1.046	1.134	1.299	1.132	1.299	1.046
Max.	-	1.692	2.180	2.302	4.887	2.765	4.887	1.692
Min.	-	0.683	0.494	0.309	0.349	0.459	0.683	0.309

Source: Authors' calculations based on data from annual reports of selected companies

4.5 Total Factor Productivity Changes (Tfpch)

Comparative total factor productivity changes (Tfpch) of selected companies over the study period are presented in Table 5. The Tfpch measures the residual growth in total output of a firm, industry, or national economy that the accumulation of traditional inputs only cannot explain. Tfpch is the measure of output of an industry or economy relative to the size of all of its primary factor inputs. In this regard, the maximum change was found in IPDCFL (352.40%) for 2016 followed by UCL (277.30%) in 2018, IFIL (206.30%) in 2016, UFL (180.90%) in 2016, ILFSL (165.90%) in 2016, FASFIL (158.40%) in 2017, BLIL (158.30%) in 2017, PLFL (144.80%) in 2016, NHFIL (137.60%) in 2016, UFIL (122.70%) in 2016, GSPFCL (80.90%) in 2016, IDLC (67.60%) in 2016, LBFL (62.00%) in 2016 and PFIL (-9.10%) in 2018. The maximum decreasing position for UFL was viewed 84.70 percent in 2017 and a minimum 32.30 percent for PFIL in 2015.

Table 5: Comparative total factor productivity changes of the selected NBFIs

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
BLIL	-	0.735	0.339	2.583	0.446	1.026	2.583	0.339
FASFIL	-	1.412	0.549	2.584	0.565	1.278	2.584	0.549
GSPFCL	-	0.835	1.809	0.689	0.262	0.899	1.809	0.262
IDLC	-	0.935	1.676	0.329	0.344	0.821	1.676	0.329
ILFSL	-	0.919	2.659	0.324	1.596	1.375	2.659	0.324

Year / Comp.	2014	2015	2016	2017	2018	Mean	Max.	Min.
IPDCFL	-	1.127	4.524	0.251	1.840	1.936	4.524	0.251
IFIL	-	0.779	3.063	0.321	1.849	1.503	3.063	0.321
LBFL	-	0.584	1.620	0.484	1.034	0.931	1.620	0.484
NHFIL	-	0.401	2.376	0.219	2.207	1.301	2.376	0.219
PFIL	-	0.677	0.811	0.687	0.909	0.771	0.909	0.677
PLFL	-	0.383	2.448	2.060	0.480	1.343	2.448	0.383
UCL	-	0.529	0.315	1.613	3.773	1.558	3.773	0.315
UFL	-	0.802	2.809	0.153	2.471	1.559	2.809	0.153
UFIL	-	0.646	2.227	0.950	0.919	1.186	2.227	0.646
Mean	-	0.769	1.945	0.946	1.335	1.249	1.945	0.769
Max.	-	1.412	4.524	2.584	3.773	3.073	4.524	1.412
Min.	-	0.383	0.315	0.153	0.262	0.278	0.383	0.153

Source: Authors' calculations based on data from annual reports of selected companies

As per the mean Tfpch, the maximum change was 93.60 percent in IPDCFL. On the other hand, the maximum decrease found in PFIL by 22.90 percent. The change of mean total factor productivity of other twelve companies was BLIL (2.60%), FASFIL (27.80%), GSPFCL (-10.10%), IDLC (-17.90%), ILFSL (37.50%), IFIL (50.30%), LBFL (-6.90%), NHFIL (30.10), PLFL (34.30%), UCL (55.80%), UFL (55.90%) and UFIL (18.60%) during the study period. The year-wise change of the mean total factor productivity found -23.10 percent for 2015, 94.50 percent for 2016, -5.40 percent for 2017 and 33.50 percent for 2018. However, overall positive change (24.90%) found for the sample during the study period.

4.6 Malmquist Mean Indices Summary for the Study Period

Table 6 highlights the features of year-wise average changing positions of Effch (Technical efficiency change), Techch (Technological change), Pech (Pure or Managerial efficiency change), Sech (Scale efficiency change) and Tfpch (Total factor productivity change) over the study period.

Table 6: MalmquistIndices summary of annual mean of the selected companies

Year	Effch	Techch	Pech	Sech	Tfpch
2014	-	-	-	-	-
2015	1.076	0.673	1.064	1.011	0.724
2016	0.888	1.698	0.913	0.972	1.507
2017	0.995	0.628	0.981	1.015	0.625
2018	1.194	0.840	1.151	1.038	1.003
Mean	1.038	0.960	1.027	1.009	0.965
Max.	1.194	1.698	1.151	1.038	1.507
Min.	0.888	0.628	0.913	0.972	0.625

Source: Authors'calculations based on table number 1, 2, 3, 4, and 5

Tfpch enjoyed greater than 1 position for 2 years where the other 2 years do not. It is because of the decreasing condition of Techch in the year 2015 by 38.70 percent, and in 2017 all the components of Tfpch except Sech were found to be decreased position. The maximum Tfpch changes were found to be 50.70 percent in the year 2016, where a 13.7 percent reduction of Effch was offset by 54.5 percent increasing Techch. In 2015, Tfpch held a negative change of 27.60 percent in 2015

due to a heavy decrease of Techch by 32.70 percent though there was a positive change of Effch of 7.60 percent. In 2017, there was 37.50 percent negative change of Tfpch due to the negative changes of both Effch and Techch by 0.50 percent and 37.20 percent, respectively. Slide positive change of Tfpch (0.30%) observed in 2018 due to a positive shift in Effch by 19.50 percent. The maximum Effch change found 19.40 percent in 2018 because Pech increased by 15.10 percent and Sech by 3.80 percent. Other than 2016, all the years i.e. 2015, 2017 and 2018 all the components of Effch observed to be increased position. When considering the mean value, Tfpch disclosed a negative change due to the negative change of mean Techch of 2015 and 2017. However, the Effch enjoyed an average positive increase of 3.80 percent with a small positive change of Pech by 2.70 percent and Sech by 0.90 percent.

4.7 Malmquist Mean Indices Summary for the Selected Companies

Malmquist mean indices summary for Effch, Techch, Pech, Sech, and Tfpch of selected companies is presented in Table 7. Tfpch found to have enjoyed greater than 1 position for 6 companies (FASFIL, ILFSL, IPDCFL, IFIL, UCL and UFIL) out of 14 of the selected companies. The Techch of the companies BLIL, GSPFCL, LBFL, NHFIL and PLFL were decreasing position by 26.80, 28.10, 25.20, 20.50 and 7.90 percents respectively; was the cause of the negative growth of Tfpch during the study

Table 7: Malmquist indices summary of firm mean of the selected companies

Companies	Effch	Techch	Pech	Sech	Tfpch
BLIL	1.000	0.732	1.000	1.000	0.732
FASFIL	1.183	0.872	1.037	1.140	1.031
GSPFCL	1.005	0.719	1.029	0.976	0.722
IDLC	0.826	0.786	1.107	0.746	0.649
ILFSL	1.130	0.938	1.128	1.002	1.060
IPDCFL	1.193	1.038	1.022	1.167	1.239
IFIL	1.190	0.916	1.043	1.141	1.091
LBFL	1.109	0.748	1.023	1.084	0.830
NHFIL	1.037	0.795	0.966	1.074	0.824
PFIL	0.809	0.946	1.000	0.809	0.765
PLFL	1.066	0.921	0.989	1.077	0.981
UCL	1.000	1.004	1.000	1.000	1.004
UFL	0.989	0.972	0.996	0.993	0.961
UFIL	1.009	1.049	1.000	1.009	1.059
Mean	1.039	0.888	1.024	1.016	0.925
Max.	1.193	1.049	1.128	1.167	1.239
Min.	0.809	0.719	0.966	0.746	0.649

Source: Authors' calculations based on table number 1, 2, 3, 4, and 5

period. The other 3 companies (IDLC, PFIL and UFL) also depicted Tfpch value of less than 1. This is because of the decreasing condition of Effch and Techch for the company IDLC by 17.40 percent and 21.40 percent, for the company PFIL by 19.10 percent and 5.40 percent, and for the company UFL by 1.10 percent and 2.80 percent, respectively. The maximum Tfpch was 23.90 percent for the company IPDCFL where 19.30 percent Effch and 3.80 percent Techch played a positive Tfpch. For company FASFIL, Tfpch holds positive change by 3.10 percent, while

the 12.80 percent decrease of Techch was offset by 18.30 percent increase of Effch. For ILFSL, Tfpch has a positive change of 6.00 percent, while 6.20 percent reduces Techch offset by a 13.0 percent increase of Effch. For IFIL, Tfpch holds positive change by 9.10 percent where 8.40 percent decrease of Techch was offset by 19.00 percent increase of Effch. But for UCL, positive Tfpch was the product of a positive change of Techch only because Effch value was 1.00. For UFIL, both the Effch and Techch had positive change and produced 5.90 percent of the positive change of Tfpch. The maximum Effch chang found 19.30 percent for the company IPDCFL because of increasing Pech by 2.20 percent and Sech by 16.70 percent. For the company FASFIL, ILFSL, IFIL and LBFL Effch change was found 18.30, 13.00, 19.00 and 10.90 percent respectively because of increasing of Pech by 3.70, 12.80, 4.30 and 2.30 percent respectively and Sech by 14.00, 0.20, 14.10 and 8.40 percent respectively. For the company GSPFCL, NHFIL and PLFL Effch change found 0.50, 3.70, and 6.60 though one component depicts negative change. The Effch for IDLC, PFIL, and UFL observed to be decreased position. For the rest of the companies (BLIL and UCL) Effch showed no change, i.e., 1.00 over the study period. Considering the mean value, Effch was holding a favourable position (3.90%) due to the positive impact of Pech (2.40%) and Sech (1.60%). However, the Tfpch have a value less than 1.00 indicating the mean Tfpch decreases by 7.5 percent with a small positive change of Effch by 3.9 percent and a negative change of Techch by 11.2 percent.

5. Conclusion and Recommendations

The study focuses on the efficiency changes of NBFIs in Bangladesh, applying the MI analysis from 2014 to 2018. During the study period, the technical efficiency changes, the technological efficiency changes, the pure efficiency changes, the scale efficiency changes, and the total factor productivity changes explored overall positive changes of 24.30 percent, 1.70 percent, 9.60 percent, 13.20 percent, and 24.90 percent respectively for the selected NBFIs in Bangladesh. Again, the average changes in annual mean and average changes of firm average depict mix up results. The average changes of annual mean of the selected companies are Effch (3.80%), Tecch (-4.00%), Pech (2.70%), Sech (0.90%) and Tfpch (-3.50%) and the average changes of firm mean are Effch (3.90%), Tecch (-11.20%), Pech (2.40%), Sech (1.60%) and Tfpch (-7.50%). The MI analysis depicts the efficiency changes fluctuating year to year and even negative changes observed in some years. The same scenario is brought into being when considering the efficiency changes between the NBFIs during the study period. The mean efficiency changes are also not satisfactory as a whole for the selected NBFIs. The positive efficiency changes by MI of a firm for a given year signal its better position than the previous year. So, to sustain in the competitive financial markets or within the NBFI industry, NBFIs should periodically measure efficiency changes and emphasize positive efficiency changes. However, the study is conducted on the randomly selected 14 NBFIs of Bangladesh, and the different scenarios of efficiency changes of NBFIs may be found if the study is conducted on the whole NBFI industry in Bangladesh, which is a limitation of the study. Despite the limitation, the MI analysis on NBFIs in

Bangladesh identified the significant space for improving positive efficiency changes through making a precise investment, arranging adequate loan provisions, mixing up proper debt and equity capital, and reducing excess operating expenses considering the smooth operation of the business and the like.

References

Afza, T., & Asghar, M. J. E. K. A. (2010). Efficiency of insurance industry in Pakistan: an application of non-parametric approach. *Interdisciplinary Journal of Contemporary Research in Business, 2*(8), 84-98.

Ahmed, M. N., & Chowdhury, M. I. (2007). Non-bank financial institutions in Bangladesh: An analytical review, *Working Paper Series: WP 0709*, Bangladesh Bank.

Alimohammadlou, M., & Mohammadi, S. (2016). Evaluating the productivity using Malmquist index based on double frontiers data. *Procedia-Social and Behavioral Sciences*, 230, 58-66.

Amani, N., Valami, H. B., & Ebrahimnejad, A. (2018). Application of Malmquist productivity index with carry-overs in power industry. *Journal of Alexandria Engineering*, (57), 3151-3165.

Anang, B. T., Bäckman, S. & Sipiläinen, T. (2016). Technical efficiency and its determinants in smallholder rice production in northern Ghana. *The Journal of Developing Areas, 50*(2), 311-328.

Atristain, C. (2012). Qualitative determinants of the managerial efficiency toward improving the organizational performance and competitiveness of SMEs in Mexico. *International Journal of Business Competition and Growth, 2*(4), 370-399.

Azad, M. A. K., Masum, A. K. M., Munisamy, S., & Sharmin, D. F. (2016). Efficiency analysis of major microfinance institutions in Bangladesh: A Malmquist index approach. *Quality & Quantity, 50*(4), 1525–1537.

Balk, B. M. (2001). Scale efficiency and productivity change. *Journal of Productivity Analysis, 15*, 159–183.

Bangladesh Bank (2020a). *Annual Report, 2019-20,* Dhaka: Bangladesh Bank.

Bangladesh Bank (2020b). *Quarterly NBFIs Statistics*. Statistics Department, Bangladesh Bank. Available from https://www.bb.org.bd/pub/ quaterly/nbfistat/ oct_dec_20/introduction.pdf. [23 September 2021].

Baten, A., Kasim, M. M., & Rahman, M. (2015). Efficiency and productivity change of selected online banks in Bangladesh: A non-parametric Malmquist approach. *Journal of Internet Banking and Commerce, 20*(3), 1-6.

Bay Leasing and Investment Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Camanho, A. S., & Dyson, R. G. (2006). Data envelopment analysis and Malmquist indices for measuring group performance. *Journal of Productivity Analysis, 26*(1), 35–49.

Caunic, R. E. (2020). Technical and scale efficiency in Romanian public hospitals: Estimating with data envelopment analysis. *Proceedings of the International Conference on Applied Statistics 2*(1), 89-99.

Caves, D.W., Christensen, L.R., & Diewert, W.E. (1982). The economic theory of index numbers and the measurement of input, output and productivity. *Econometrica*, *50*(6), 1393-1414.

Cheymetova, V. A., & Scherbakov, V. V. (2017). Methodological approaches to managerial efficiency evaluation of organization. *Journal of Revista ESPACIOS*, *38*(48), 1-8.

Comin D. (2008). Total Factor Productivity. In Durlauf, S. N. and Blume, L. E. (Eds.): The New Palgrave Dictionary of Economics. 2nd edition. https://doi.org/10.1057/978-1-349-95121-5_1681-2.

Depren, S. K., & Depren, O. (2016). Measuring efficiency and total factor productivity using data envelopment analysis: An empirical study from banks of Turkey. *International Journal of Economics and Financial Issues*, *6*(2), 711-717.

Erena, O. T., Kalko, M. M., & Debele, S. A. (2021). Technical efficiency, technological progress and productivity growth of large and medium manufacturing industries in Ethiopia: A data envelopment analysis. *Journal of Cogent Economics and Finance*, *9*(1), 1-38.

Fan, Q., Mu, T., & Jia, W. (2021). Analysis on the trend and factors of total factor productivity agricultural export enterprises in China. *Sustainability*, *13*(12), 6855.

Fare, R., Grosskopf, R., Norris, M., & Zhang, Z. (1994). Productivity growth, technical progress, and efficiency change in industrialized counties. *American Economic Review*, *84*(1), 66–83.

Faruk, M. M., & Rahaman, A. (2015). Measuring efficiency of conventional life insurance companies in Bangladesh and takaful life insurance companies in Malaysia: A non-parametric approach. *Management Studies and Economic Systems*, *2*(2), 129-144.

FAS Finance and Investment Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

GOB. (2019). *Financial Institutions Report-2018-19*, Bangladesh Financial Institutions Division of Ministry of Finance, Dhaka, Bangladesh.

GSP Finance Company (Bangladesh) Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Hossain, M. & Shahiduzzaman, M, (2005). Development of non-bank financial institutions to strengthen the financial system of Bangladesh.*MPRA Paper 24734, University Library of Munich, Germany*. https://ideas.repec.org/p/ wpa/ wuwpfi/0409006.html

Infrastructure Development Company Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

International Leasing and Financial Services Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

IPDC Finance Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Islamic Finance and Investment Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Junwen, F., Jie, C., & Yucheng, W. (2017). Efficiency analysis of commercial banks in China based on DEA and Malmquist index. *BioTechnology: An Indian Journal, 13*(3):139.

Lall, M., & Srivastava, L. (2020). Measuring financial productivity of energy sector in Uttar Pradesh: Malmquist total factor productivity. *Journal of Critical Reviews, 7*(2), 491-496.

Lanka Bangla Finance Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Moffat, B., Valadkhani, A., & Harvie, C. (2009). Malmquist indices of productivity change in Botswana's financial institutions. *Global Business and Economics Review, 11*(1), 28-43.

Mohammadi, A., & Ranaei, H. (2011). The application of DEA based Malmquist productivity index in organizational performance analysis. *International Research Journal of Finance and Economics, 62*(2011), 68-76.

National Housing Finance and Investment Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Naz, F., Khan, H., & Syyed, M. (2017). Productivity and efficiency analysis of Pakistani tex-tile industry using Malmquist productivity index approach. *Journal of Management and Research,4*(2), 65-87.

Phoenix Finance and Investments Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Premier Leasing and Finance Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Raphael, G. (2013). A DEA- Based Malmquist productivity index approach in assessing performance of commercial banks: Evidence from Tanzania. *European Journal of Business and Management, 5*(6), 25-35.

Şeker, M. & Saliola, F. (2018). A cross-country analysis of total factor productivity using micro-level data. *Journal of Central Bank Review*, 18, 13-27.

Tung, D.T. (2013). Changes in the technical and scale efficiency of rice production activities in the Mekong delta, Vietnam. *Journal of Agricultural and Food Economics, 1*(16), 1-16.

Union Capital Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

United Finance Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Uttara Finance and Investments Limited. (2014-2018). *Annual reports*. Dhaka, Bangladesh.

Wang,Y. M., & Lan, Y. X. (2011). Measuring Malmquist productivity index: A new approach based on double frontiers data envelopment analysis. *Journal of Mathematical and Computer Modelling, 54*(11-12), 2760-2771.

Worthington, A. C. (2000). Technical Efficiency and Technological Change in Australian Building Societies. *Abacus 36*(2), 180-197.