RESERVE BANK OF FIJI

POLICY RESEARCH WORKING PAPER #4

Technical Efficiency and Total Factor Productivity of Banks in Fiji: Empirical Analysis and Policy Implications

Parmendra Sharma[a,b],Savaira Manoa[c], Seci Taleniwesi[c],*
Son Nghiem[d] and Nurul Kabir[a]
[a]Department of Accounting, Finance and Economics, Griffith University
[b]Griffith Asia Institute, Griffith University
[c]Reserve Bank of Fiji
[d]Australian Centre for Health Services Innovation,
Queensland University of Technology

Reserve Bank of Fiji
December 2015

*The views and opinions expressed in this paper are those of the authors and do not reflect those of the Reserve Bank of Fiji or its Board. This paper is an outcome of the 2015 Australian Government's Department of Foreign Affairs and Trade funded Australian Awards Fellowship program involving research training of RBF Fellows at Griffith University. The paper is also part of the on-going joint RBF-Griffith research initiatives commenced in 2014. Corresponding author: (p.sharma@griffith.edu.au; +61 07 37357834)

Abstract

Motivated by findings of three related previous studies signalling a policy review and interest by the relevant banking regulator to make the country's banking system more efficient, this study uses an alternative approach to empirically test the findings so that policy review may indeed be initiated. Using a similar sample size but an extended time period, the present study estimates technical efficiencies, total factor productivity growth and its components, using a stochastic distance function approach. Results confirm the findings of previous studies that there is substantial scope for improving banking efficiency in Fiji. Policy implications are eminent and methodically outlined.

Keywords: Distance function SFA, technical efficiency, total factor productivity, banks, Fiji

1.0 Introduction

The motivations for this study are the findings of three previous studies by Sharma et al. (2015a, b) and Sharma, Gounder, and Xiang (2013) signalling a policy review and interest by the relevant banking regulator in indeed making the country's banking system more efficient. Using the Data Envelopment Analysis (DEA) with both the intermediation and production approaches and a sample period of 2000–2010, Sharma, Gounder, and Xiang (2015) find that there is substantial scope to improve efficiency levels of banks in Fiji, an open, small island, developing economy in the Pacific. For instance, both the intermediation and production approaches suggest that the sector as a whole, with decades of extensive—almost persistently 100%—foreign bank presence, dominated by two of Australia's big four, could have produced around 38% more outputs, such as loans, with the same level of inputs.

A subsequent study, confirms the Sharma et al. (2015a) findings. Using a number of common measures, a similar sample period and a host of comparative countries and regions, Sharma et al. (2015b) find that the efficiency performance of banks in Fiji might indeed be a concern compared especially to the sector's overall stability performance in the same period. The Sharma et al. (2013) study also indicates a significant room for improving banking efficiency in Fiji. Using again a similar sample size and period, the authors find that the efficiencies of particularly the big two—ANZ and WBC—could be considerably improved. For example, ANZ's production efficiency level appeared to be only around half of the optimum level and WBC's had not reached its full capacity in the sample period; its production efficiency appeared to have peaked in 2006 (90%) and the trend has been steadily declining thereafter to rest at 64% in 2010.

The above findings do indeed signal, among others, a need for policy evaluation and formulation, especially in light of the substantial foreign bank presence, particularly because the Australian banks—Fiji's "big two"—are shown to be more efficient in their home country (e.g. (Kirkwood & Nahm, 2006; Shamsuddin & Xiang, 2012; Sturm & Williams, 2004). If indeed more efficient banks could supply greater amounts of intermediated funds at more affordable prices, and at the same time remain profitable, safe and sound then, considered strategies and policies to improve banking efficiency in Fiji would be most appropriate and timely with wide implications at both the micro and macro levels. Indeed, in Fiji as elsewhere across the Pacific Island Countries (PICs), the finance–led channels to address the constant economic growth and poverty alleviation challenges rests predominantly with the banks—banks are more or less *the* financial system—(e.g. Sharma and

Brimble, 2012)—more efficient banks might provide the much needed impetus to foster the country's economic growth and development. On the other hand, continued relative inefficiencies, especially since financial markets are small, governments, firms and individuals are heavily bank–dependent, may actually retard economic growth and potentially increase poverty and inequality (Beck, Demirgüç-Kunt, & Peria, 2008). It is towards initiating a review of existing policy and possible formulation of new policies relating to banking efficiency in Fiji that this study is essentially directed.

In doing so, however, it is imperative that the findings of the Sharma et al. (2015a, b) and Sharma et al. (2013) studies be at least once more robustly tested, which this study also endeavours to do. In a sense, the present study is an extension of the Sharma et al. (2015a, b) and Sharma et al. (2013) studies but, as outlined below, makes significant new contribution to the literature and the policy review and formulation process. The contributions of the present study are as follows. First, the period of analysis is 2000–2014; previous studies covered the 2000 to 2010/11 sample periods. This is useful for a number of reasons, including that our study updates the trends in efficiency levels beyond 2010/11 and importantly, estimates the efficiencies both pre– and post– the Global Financial Crisis (GFC)—a historical event that extraordinarily changed the financial landscape of countries worldwide; this is the first study to do that in the case of banks in Fiji and across the PICs. Second, the present study estimates technical efficiencies, total factor productivity (TFP) growth and its components, using a stochastic distance function approach, which has not been previously done in the case of Fiji or other PICs. Third, this is the first paper to articulate an appropriate policy response with regard to improving bank efficiency in Fiji.

The rest of the paper is organised as follows. Section 2 provides an overview of Fiji's banking sector reforms and the current structure. Section 3 provides a review of the related literature. Section 4 outlines the methodology and data. Section 4 presents the empirical results. Section 5 discusses the policy approach and implications. Section 6 concludes.

2.0 **Key reforms and the current banking structure**

A chronology of key reforms

Fiji's banking sector has undergone major reforms over the past several decades; a summary of key reforms is highlighted in table 1. As the table shows, the first noticeable reform appears to have taken place in 1973 when banks were required to hold minimum cash reserves, followed a year later by the introduction of the regulation on lending and deposit rates, which was removed in 1987. A number of other regulations and directives have similarly been relaxed or removed over the years, including,

among others: the loans–to–deposit ratio, introduced in 1980, removed in 1987; the liquid asset ratio, introduced in 1974, removed in 1999; and mandatory lending, introduced in 1979, removed in 1987.

A number of steps appear to have been taken by the regulator to improve and strengthen banking system soundness and stability, including, importantly, the introduction of the Bank of International Settlement (BIS) proposed, internationally adopted, Basel Accord on capital adequacy in 1993, with an increase in the minimum legal ratio in 2010 to 12% for banks, in line with international practice, in response to the GFC. Other key policies, guidelines and regulations adopted to strengthen the banking system—largely BIS recommended—include: loan classification and provisioning in 1998; the role of external auditors in 2001; liquidity risk management in 2005; and market risk management in 2014. Another key reform that needs mention is the revision of the Banking Act. In recognition of the rapidly changing international financial environment, the 1983 Act was substantially revised in 1995 to provide the Reserve Bank of Fiji (RBF) with more flexible and specific powers to discharge its stability and soundness duties.

Table 1
Key reforms in Fiji's banking sector, 1973 to 2015

Year	Event
1973	Cash reserve requirements introduced
1974	Regulation of lending and deposit rates
	Government stock requirements introduced (later known as local assets ratio)
	Credit ceiling introduced
	Priority lending qualitative guidelines introduced
1978	Interest paid on balances held by banks in the Statutory Reserve Deposit (SRD). Interest payment stopped on settlement accounts
	Agricultural Loans ratio introduced
1981	Deregulation of rates of interest on deposits of $250,000 and over, kept for a minimum of one month.
1983	Replacement of Banking Ordinance with Banking Act 1983
1984	Local assets ratio replaced with minimum holdings of unimpaired liquid assets.
	Reserve Bank legislation came into force.
1985	Revision of Banking Act 1983
1987	Interest rates on bank lending and deposits deregulated
	Credit ceiling reintroduced temporarily
1989	The Banking Supervision & Examination Department was established.
1992	Development of Banking Supervision Policy Framework.
1993	Introduction of Capital Adequacy requirements
1995	Banking Act 1983 replaced – Banking Act 1995 passed.
1996	Risk based capital adequacy policy for banks and credit institutions implemented.
	Guidelines for loan classification and provisioning for impaired assets for banks and credit institutions implemented.
1997	Foreign Currency Exposure Policy introduced.
1998	Large Credit Exposures Policy implemented.
1999	Issued policy on Disclosure Requirements for Banks effective 31 Dec 1999.
	Issued guidelines to Licensed Financial Institutions for countering money laundering activities – effective 1 July 2000. Extended to 1 Jan 2001.

2001	Policy on Role of External Auditors in the Supervision of Banks and Credit Institutions introduced.
2002	Policy on The Disclosure Guidelines on Fees and Charges for Banks and Credit Institutions issued.
2005	Liquidity Risk Management Policy for Banks and Credit Institutions issued
2007	Policy on Fit & Proper Requirements for Licensed Financial Institutions introduced
	Policy on Minimum Requirements on Corporate Governance for Licensed Financial Institutions in Fiji introduced
2009	Revision of Policy on Loans classification and provisioning for impaired assets
2010	Capital adequacy ratio requirements increased – Banks 12%.
	Policy on Minimum Guidelines on the Establishment of a Local Advisory introduced
	Policy Guideline on Complaints Management introduced
	Minimum Requirements for Commercial Banks on Internal Microfinance Divisions and Units introduced
	Policy on Minimum Requirements for the Management of Operational Risks for Licensed Financial Institutions introduced
	Policy on Interest Spread Disclosure Requirements for Banks introduced
	Policy on Appointment of Heads of LFIs introduced
	Removal of remuneration on SRD, Interest payments on settlement accounts reintroduced
2011	Implementation of revised policy on Accountability and Disclosure Guidelines on Interest Rates and Fees and Charges for Licensed Banks in Fiji
2012	Policy on Accountability & Disclosure Guidelines on Interest Rates & Fees and Charges for Cis reviewed
	Credit card levy introduced by FRCA
	Removal of select Bank penalty Fees & Charges
	Reintroduction of Agricultural loans ratio and introduction of renewable energy loans ratio
2014	Policy on Minimum Requirements for the Management of Market Risk introduced
	Review of policy on Minimum Requirements for the Management of Money Laundering & Terrorist Financing Risk

Source: CMA Annual Reports 1974-1983; RBF Annual Reports 1984-2014

Current structure

Regulatory structure

The RBF is the country's central bank, responsible for formulating and implementing monetary policy. The RBF is also responsible for the country's payments system, and managing the official foreign exchange reserves and promoting a sound financial system. With respect to the financial system, the RBF has the responsibility for a wide range of financial institutions and markets, including, commercial banks, credit institutions, the country's only pension fund, insurance companies, the capital markets, the stock exchange, foreign exchange dealers and money changers. Figure 1 provides a snapshot of all institutions and markets regulated and supervised by the RBF.

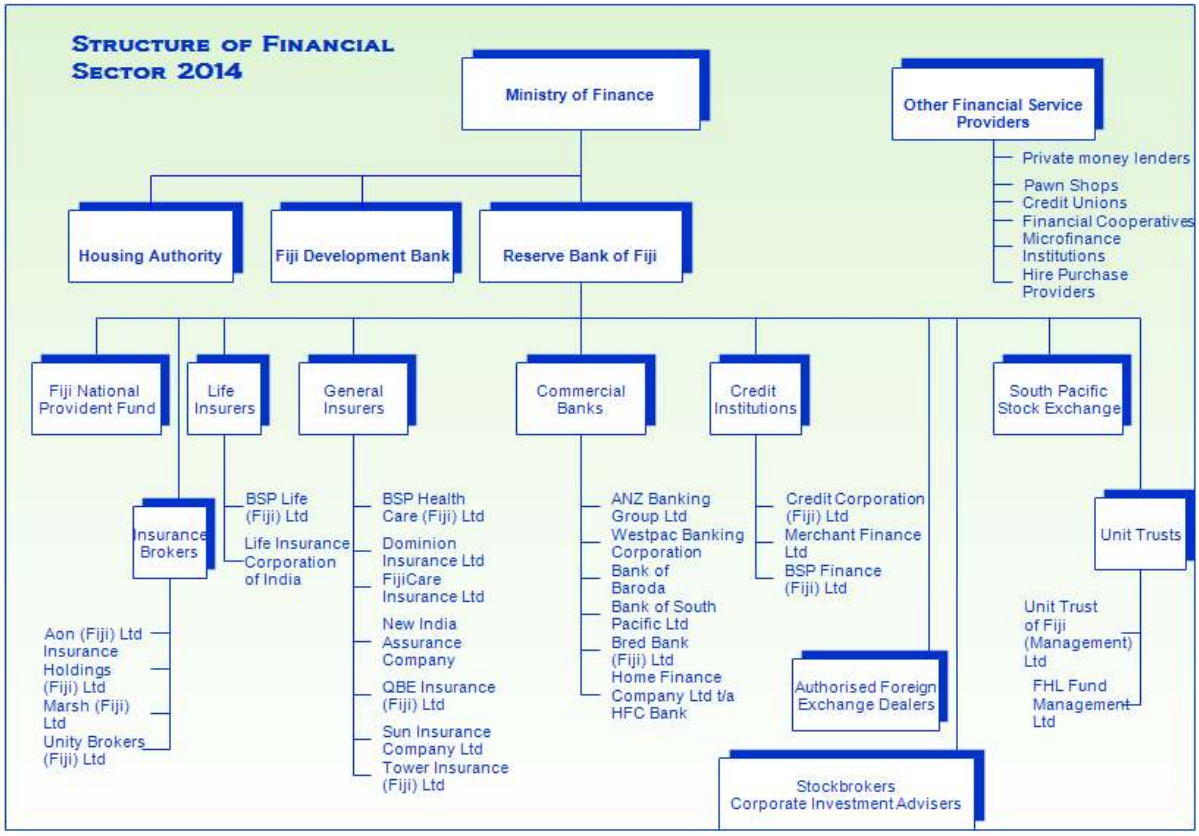

Figure 1: Structure of the Fijian Financial Sector

The banking structure

In 2014, there were six commercial banks in Fiji; made up as follows: the "big two" Australian; one regional; one from the Indian subcontinent; one French; and one majority owned by the country's only, and state–owned, pension fund—Fiji National Provident Fund (FNPF). Together, the "big two", namely ANZ Banking Group Ltd and Westpac Banking Corporation controlled 59% of Fiji's total banking assets in 2014; in fact, before the licencing of HFC Bank, they had controlled around 70% of the total banking assets over the past 15 years. In 2014, their combined total assets were FJ$4.0 billion. Apparently, Fiji's "big two" are also part of the "big four" in Australia, who between them held 40% of the Australia's total banking assets in 2014.

The "big" two

Of the "big two", ANZ, which has operated in Fiji for over 130 years was the country's largest bank in 2014, controlling by itself around 35% of the total banking assets. With total global assets of US$631.88 billion and total global market capitalisation of US$71.67 billion, it was also the world's

50th and 22nd largest bank, respectively, in 2014[1]. ANZ was also the largest bank in New Zealand in 2014 and had operations in 32 countries around the world, including across the South Pacific (Papua New Guinea, Solomon Islands, Kiribati, Vanuatu, New Caledonia, Cook Islands, Tonga, American Samoa, Samoa) and in the US, UK, China and elsewhere.

Fiji's second largest bank in 2014 was WBC, controlling by itself around 24% of the total banking assets. WBC has operated in Fiji for over 115 years (established 1901). With total global assets of US$630.9 billion and total global market capitalisation of US$83.63 billion it was also the world's 51st and 15th largest bank, respectively, in 2014. WBC had operations in 16 countries around the world, including across the South Pacific (Papua New Guinea, Cook Islands, Solomon Islands, Vanuatu, Samoa and Tonga) and in the US, UK, China and elsewhere.

The other banks

Of the remaining banks, Bank South Pacific (BSP) was the third largest operating in Fiji in 2014, controlling around 24% of the total banking assets. BSP is the only, and relatively large, regional bank, with operations now in the Solomon Islands as well. The bank has been operating in the region since 1957 and is owned by major PNG institutions. Total global asset of BSP in 2014 was US$5.3 billion. Ranked the next largest bank in Fiji, Bank of Baroda (BOB), controlled 9% of the total bank assets in 2014. From the Indian continent, BOB has operated in Fiji since 1961 and has operations in 26 countries around the world, including in the US, UK and China. Their total global asset in 2014 was US$101.7 billion. The other two banks in Fiji are BRED (French) and Home Finance Company (HFC), controlling around 6% and 2% of the total banking assets in 2014. Both HFC and BRED are fairly new with banking operations beginning in 2014 and 2012, respectively—although HFC has been operating as a licenced credit institution in Fiji since 1996.

Other bank–type institutions

In Fiji, banking institutions are of two types—the western style commercial banks (CBs) and "credit institutions". Credit Institutions (CIs) are like a smaller version of commercial banks, allowed to provide most banking services but not permitted to provide demand deposits, and term deposits must not be less than F$500 in value. Otherwise, the products and services of CIs are similar to CBs. The business models are also similar, i.e. funding sources and investment activities are mainly domestic. Moreover, both types of institutions are supervised by the same regulator—RBF—and supervisory

[1] Readers may have a look at Appendix 1 for details of rankings.

guidelines, policies and rules are similar. Thus, it would be interesting to see how the efficiency of CBs compare with CIs.

3.0 Data and methodology

3.1 *Data*

Our sample includes four of the six commercial banks operating in Fiji in 2014, namely, Australia and New Zealand Banking Corporation Ltd (ANZ); Bank of Baroda (BOB); Bank South Pacific Limited (BSP); and Westpac Banking Corporation Limited (WBC). BRED Bank (Fiji) Ltd (BRED) is not included in the sample—essentially for the reason that, as indicated above, it is fairly new. Home Finance Company Bank (HFCB), which obtained a commercial banking licence in 2014 is included as a credit institution since, for the large part of the sample period, it had operated as a credit institution. Technical efficiencies of banks are compared with that of credit institutions, which include Credit Corporation Fiji Limited (CCFL); Merchant Finance Limited (MF); and Home Finance Company Limited (HFC). Relevant and complete data for these institutions are available on–line for the years 2000–2014 from RBF.

3.2 *Methodology*

Why distant SFA?

The distant function approach is a widely used method to measure efficiency in the banking literature. A major advantage is that a distance function represents multiple-outputs and multiple inputs production technology, which facilitates efficiency study for industries such as banking. Employing distant function approach is suitable when the price information is not available or inaccurately measured and behaviour assumptions of cost-minimization or profit-maximization are inappropriate (Jiang, Yao, & Zhang, 2009).

Furthermore, using the distant function approach allows us to measure the total factor productivity (TFP) in the banking system of Fiji. Earlier studies have documented the level of efficiency in Fiji by using DEA methods as well as factors that affect efficiency in Fiji. TFP can be decomposed into technological progress and change in technical efficiency measures. The former reflects improvement stemming from innovation and the diffusion of new knowledge and technologies while the latter measures the movement of production towards the frontier. These decompositions provide an avenue for more detailed examination of the underlying sources of TFP growth. Hamit-Haggar (2009) also notes a notable advantage of the stochastic frontier approach is the fact that the restrictive assumptions about firms operating with full efficiency are relaxed.

Input—Output variables

In the efficiency literature, there is no consensus on the input and output variable selection as well as there is no restriction that one must use particular inputs or outputs (Berger & Humphrey, 1997). There are five approaches that define the input and output variable section in the banking efficiency analysis. These are intermediation approach, production approach, assets approach, user cost approach and value added approach. To select the relevant variables, this study follows the commonly accepted intermediation proposed by Sealey and Lindley (1977). This approach assumes that banks act as an intermediary between the borrower and depositors which is more consistent with the function of banks rather than the production approach which assumes that banks produce loans and services. This approach treats deposits as inputs and loans as outputs. On the output side, this study includes three outputs which are net income, interest and similar revenue, loans as outputs. On the input side, this study includes interest and similar expenses, general expense and capital as inputs.

The concept of distance function was proposed by Shephard (2012) and Malmquist (1953), but Farrell (1957) pioneered its application to efficiency measurement. In general, the distance function measures the distance between the *observed* input-output combinations to the *ideal* input-output combinations on the efficiency frontier. Defining $x \in R_+^K$ as the vector of inputs, $y \in R_+^M$ as the vector of outputs, for a given technology *T*, the production process of a firm at period *t* may be defined as:

$$T^t = \left\{ \left(x^t, y^t \right) : x^t \text{ can produce } y^t \right\} \qquad (1)$$

A distance function can be measured either by focusing on inputs (the minimization of inputs while producing a given level of outputs) or outputs (maximizing output from a given combination of inputs). Thus, an output distance function (D_O) at period *t* of a firm is defined as a technology that given input quantity, the output level can be expanded by 1/θ (0<θ<1):[2]

$$D_O^t \left(x^t, y^t \right) = Min_\theta \left\{ \left(x^t, \frac{y^t}{\theta} \in T \right) \right\} \qquad (2)$$

To measure the changes in efficiency between periods, Caves et al. (1982) introduced the Malmquist productivity index (MPI), which is the ratio of the distance function using inputs and outputs from different periods. The MPI of period *t* and period *t+1* are defined as:

$$MPI^t = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)}; \; MPI^{t+1} = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)} \qquad (3)$$

[2] An input distance function is represented in a similar manner. For more details, see for example, Coelli et al. (2005)

Färe et al. (1992) proposed that changes in the MPI between the two periods are the geometric mean of MPIs, which can be decomposed into two components: shifts of the frontier, which are attributable to technological progress, and movement towards the frontier, which are attributable to improvements in technical efficiency, respectively.

$$MPI^{t,t+1} = \sqrt{\frac{D^t(x^{t+1},y^{t+1})}{D^t(x^t,y^t)} \times \frac{D^{t+1}(x^{t+1},y^{t+1})}{D^{t+1}(x^t,y^t)}} = \frac{D^{t+1}(x^{t+1},y^{t+1})}{D^t(x^t,y^t)} \times \sqrt{\frac{D^t(x^{t+1},y^{t+1})}{D^{t+1}(x^{t+1},y^{t+1})} \times \frac{D^t(x^t,y^t)}{D^{t+1}(x^t,y^t)}} \quad (4)$$

Distance functions can be estimated using non-parametric methods (for example, data envelopment analysis) or parametric methods (for example, stochastic frontier analysis). In this study we use the stochastic frontier analysis (SFA) to estimate the distance function. The main advantage of SFA is that it takes into account the random noise that may be associated with data measurements. Also, unlike the standard SFA method, the distance function SFA does not require any assumptions to be made about the objective function (for example, assumptions regarding cost-minimisation or profit-maximisation) and it can be used to take into account multi-outputs production processes. The SFA method does require an assumption about the functional form of the production functions (Cobb-Douglas or trans-logarithmic functions). In this study, we choose the trans-logarithmic (translog) functional form because it can mimic an impressive degree of flexibility (Berndt, 1991). Assuming that technological progress is represented by the time trend *t*, the output distance function of bank *i* with *K* inputs and *M* outputs under the assumption of the translog functional form may be written as:

$$\begin{aligned}\log(D_{Oi}) = {} & \alpha_0 + \sum_{m=1}^{M}\alpha_m \log(y_{mi}) + \sum_{k=1}^{K}\beta_k \log(x_{ki}) + \frac{1}{2}\sum_{m=1}^{M}\sum_{n=1}^{M} \alpha_{mn} \log(y_{mi}) \times \log(y_{ni}) \\ & + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \beta_{kl} \log(x_{ki}) \times \log(x_{li}) + \sum_{k=1}^{K}\sum_{m=1}^{M}\delta_{km} \log(x_{ki}) \times \log(y_{mi}) \\ & + \sum_{m=1}^{M}\gamma_m \log(y_{mi}) \times t + \sum_{k=1}^{K}\eta_k \log(x_{ki}) \times t + \delta_1 \log(t) + \delta_1 (\log(t))^2 + \varepsilon_i \end{aligned} \quad (5)$$

where ε is the random error and the functional form satisfies the constraint for homogeneity of degree one in outputs ($\sum \alpha_m = 1$, $\sum \alpha_{mn} = 0$, and $\sum \alpha_{km} = 0$), and the constraint of symmetry ($\alpha_{mn} = \alpha_{nm}$, $\alpha_{kl} = \alpha_{lk}$, and $\alpha_{km} = \alpha_{mk}$).

Unfortunately, the distance function is not observed, thus Equation 5 cannot be estimated as is. In the case of a single output, one can estimate Equation 5 by rearranging the distance function to the right-hand-side, and applying a standard SFA approach to decompose the composite error term (

$\varepsilon_i - \log(D_{Oi})$) into a random error component ε_i, and an inefficiency component $\log(D_{Oi})$, which is assumed to follow a non-negative distribution. In case of multiple outputs, we can apply the method proposed by Coelli and Perelman (2000), which exploits the homogeneity of degree one in outputs, selecting arbitrarily one output (for example, Y_{Mi}) as the *numeraire*. Recall that a function with homogeneity of degree ω is defined as:

$$D_O(x, \omega y) = \omega D_O(x, y) \qquad \text{for } \omega > 0 \quad (6)$$

Defining one output arbitrarily as a *numeraire* ($\omega = \frac{1}{y_{Mi}}$) this transformation can be expressed as:

$$D_O(X, Y/y_{Mi}) = D_O(X, Y) / y_{Mi} \quad (7)$$

Applying this to the translog distance function in Equation 5, we can transform it to a SFA specification, as follows:

$$\begin{aligned} -\log(y_{Mi}) = {} & \alpha_0 + \sum_{m \# M} \alpha_m \log(y_{mi} / y_{Mi}) + \sum_{k=1}^{K} \beta_k \log(x_{ki}) \\ & + \frac{1}{2} \sum_{m \# M} \sum_{n \# M} \alpha_{mn} \log(y_{mi} / y_{Mi}) \times \log(y_{ni} / y_{Mi}) \\ & + \frac{1}{2} \sum_{k=1}^{K} \sum_{l=1}^{K} \beta_{kl} \log(x_{ki}) \times \log(x_{li}) + \sum_{k=1}^{K} \sum_{m \# M} \delta_{km} \log(x_{ki}) \times \log(y_{mi} / y_{Mi}) \quad (8) \\ & + \sum_{m \# M} \gamma_m \log(y_{mi} / y_{Mi}) \times t + \sum_{k=1}^{K} \eta_k \log(x_{ki}) \times t + \delta_1 \log(t) \\ & + \delta_1 (\log(t))^2 + \varepsilon - \log(D_{Oi}) \end{aligned}$$

Efficiency changes can then be estimated from Equation 8 as the ratio of the efficiency score between the current and the reference periods while technological changes are measured as the average of the time derivatives between periods. To take into account effects of the operational environment, we apply the technical efficiency effects model by Battese and Coelli (1995), which specifies that $m_i = z_i \sigma$ where m_i is the mean of the inefficiency component $\log(D_{Oi})$ and z_i is the vector of environmental variables. This procedure produces more consistent estimates than the second-stage regression approach (Coelli, 1996).

Under this specification, technical efficiency (TE) scores are defined as the exponentiation of the distance function:

$$TE_i = \exp[-\log(D_{Oi})] \quad (9)$$

Efficiency changes (EC) are defined as the ratio of efficiency scores between two periods:

$$EC = \frac{TE_{t+1}}{TE_t} \qquad (10)$$

Technical changes (TC) are defined as geometric means of the time derivatives between two periods:

$$TC = \exp\left\{\frac{1}{2} \times \left[\frac{\delta \log(y_{Mi,t+1})}{\delta_{t+1}} + \frac{\delta \log(y_{Mi,t})}{\delta_t}\right]\right\} \qquad (11)$$

TFP changes (TFPC) are the product of efficiency changes and technical changes ($TFPC = EC \times TC$). One can also calculate scale changes (SC) as the geometric means of scale efficiency between two periods:

$$SC = \exp\left\{\frac{1}{2} \times \log(\frac{x_{ni,t+1}}{x_{ni,t}}) \times \sum_{n=1}^{N} [\varepsilon_{ni,t} SF_{i,t} + \varepsilon_{ni,t+1} SF_{i,t+1}]\right\} \qquad (12)$$

where $SF_{it} = (\varepsilon_{it} - 1) / \varepsilon_{ni,t}; \varepsilon_{it} = \sum_{n=1}^{N} \varepsilon_{ni,t}$; and $\varepsilon_{ni,t} = \frac{\delta \log(y_{Mi,t})}{\delta \log(x_{ni,t})}$.

4.0 **Empirical results**

4.1 *Descriptive statistics*

Descriptive statistics of the variables used in the technical efficiency calculations is presented in **table 2**. To recap, the inputs include: interest and similar expense (x_1), general administration expense as a proxy of labour (x_2) and capital (x_3). As **table 2** shows, the average interest (x_1) paid by the sample financial institutions over the sample period was FJD7,848 with a standard deviation of FJD8,329. The average administration expense (x_2) was FJD17,699 with a standard deviation of FJD21,578. The average amount capital (x3) investment was FJD12,620. The output variables include: net profit (y_1), total income (y_2) and deposits and borrowing (y_3). The average net profit was FJD17,290 for the sample period with a standard deviation of FJD18,858. The proxy of revenue considered in this study is total income derived from interest and similar revenue which averagedFJD28,886. Deposits and borrowings averaged FJD416,803. To control for heterogeneity, this study employs four environmental variables—loan and advances (z_1), capital adequacy ratio(z_2), liquid assets (z_3) and bank type (z_4). The average loans and advances for the sample institutions was FJD346,200. Capital adequacy ratio lies between 6.35% and 62.57% with a mean value of 18.85%. Liquid assets averaged value FJD137,663.

Table 2: Descriptive statistics

Variable	Description	Mean	SD	MIN	MAX
x_1	Interest and similar expenses	7,848	8,329	15	42,559
x_2	General expenses and admin expenses	17,699	21,578	245	80,086
x_3	Capital	12,620	12,922	1,000	42,133
y_1	Net profit before tax	17,290	18,859	100	71,529
y_2	Interest and similar revenues	28,886	28,095	100	109,247
y_3	Deposits and similar borrowings	416,803	485,858	16,054	2,085,290
z_1	Loans and advances	346,200	420,042	5,262	1,953,351
z_2	Capital adequacy ratio (%)	19	9	6.35	63
z_3	Liquid assets	137,663	150,876	3,225	592,364
z_4	Bank type (Banks=1)	0.61	0.49	0.00	1.00

4.2 *Technical efficiency by year*

Table 3 reports the estimates of average technical efficiency over the sample period which is the mean value of all inputs and outputs in that year. An industry becomes more technically efficient as the estimated technical efficiency moves closer to one. The scores of technical efficiency show a low level of efficiency in the case of Fiji's financial institutions, ranging from 26% to 61%, indicating that on average a 40-70% proportional increase in outputs could have been achieved by being simply more efficient, without altering production technology and input usage. The estimated technical efficiency score was 28% in 1999—the first year of the sample period and 61% in 2014—the last year of the sample period—which indicates improvement in technical efficiency among the financial institutions in Fiji; moreover, efficiency scores tend to have steadily improved over the sample period. The fall in 2009 might be attributable to the effects of the Global Financial Crisis (GFC). On the other hand, post-GFC, the average industry scores have continued to improve.

While the overall trend over the sample period appears positive, further examination of the results show that there might be considerable differences across institutions. For example, in 1999, the maximum average TE was 0.90 while the minimum was only 0.09; similarly, in 2014, the maximum average had increased to 0.99 while the minimum had actually declined to 0.07. These trends are intriguing; it requires, from a policy perspective, a closer look at the technical efficiencies of individual financial institutions to get a better understanding of their year–to–year performance over the last 15 years and identify those that might be relatively and/or persistently inefficient, which is the context of the discussion that follows.

Table 3: Technical efficiency by year

Year	Mean	SD	MIN	MAX
1999	0.28	0.30	0.09	0.90
2000	0.26	0.25	0.10	0.75
2001	0.27	0.28	0.06	0.80
2002	0.28	0.31	0.06	0.94
2003	0.32	0.33	0.07	0.96
2004	0.33	0.35	0.07	0.96
2005	0.34	0.34	0.06	0.98
2006	0.36	0.35	0.06	0.98
2007	0.42	0.39	0.07	0.99
2008	0.44	0.39	0.08	0.99
2009	0.41	0.38	0.07	0.99
2010	0.47	0.41	0.08	0.99
2011	0.52	0.38	0.08	0.99
2012	0.57	0.45	0.08	0.99
2013	0.60	0.46	0.07	0.99
2014	0.61	0.46	0.07	0.99
Average	0.40	0.36	0.06	0.99

4.4 *Technical efficiency pre– and post–GFC*

For this study, we have taken the GFC period to be 2007–2009; thus the pre–GFC period is 1999–2006 and the post period is 2010–2014. It seems that the GFC is associated with reduction in average technical efficiency of Fijian banks but the effects were short-lived (see **Figure 2**). The overall mean TE of financial institutions in Fiji might have improved in the post–GFC period; from 0.30 to 0.53

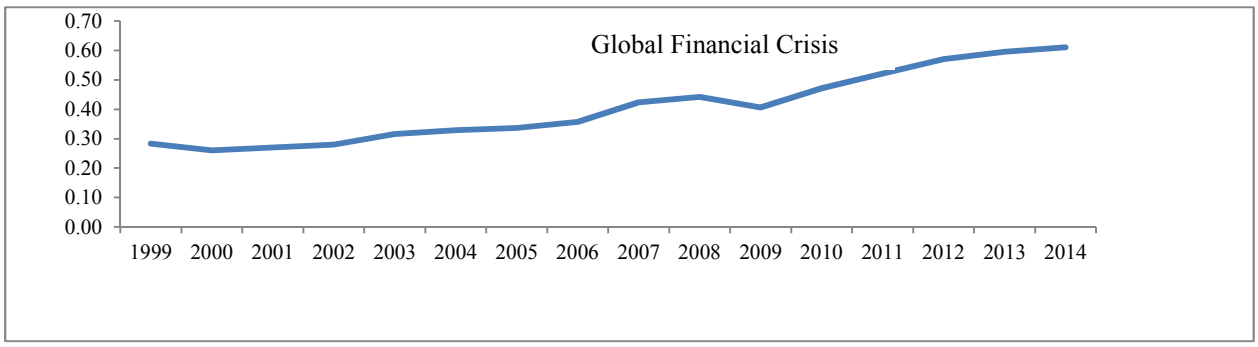

Figure 2: Average technical efficiency over time

4.5. *Total factor productivity growth and its components*

One advantage of having panel data is that we can also estimate growth in total factor productivity (TFP) and its components: technical efficiency changes, technological changes, and scale changes. As shown in **Table 5**, there is positive total factor productivity growth over most of the sample period, except for the years 2000 (the burst of dot com bubbles) and 2009 (immediately after the FC); the

average annual growth rate has been 8.7%. The highest productivity change was achieved in 2003 which was 21.88%, however it decreased sharply to 6.28% in 2004, and even negative in 2009.

The average *technical efficiency change* was 5.14% over the sample period, which is the highest across the three components. However, the change varies from a high of 19.08% to a low of -5.97%, indicating substantial scope for an improvement in the technical efficiency change. The larger contribution of technical changes suggest that Fijian banks are better-off by learning and adopting existing technology rather than inventing new technology. The average *technological change* is 3.97%; and as expected there was no technological regress in the study period. Moreover, while the difference between the high and low scores is not as conspicuous, there is scope for improvement here as well. The magnitude of technological changes shows that investing in new technology is an important factor to improve efficiency in Fijian banks. Finally, the last component of total factor productivity growth is *scale change* which has an average value of -0.41%. This indicates that scale change might have contributed mostly adversely total factor productivity change over the sample period. Noticeable also is the marked difference between the high and low scores—+6.53 to -4.26, indicating again, scope for huge improvement in scale changes. The limitation contribution of scales change show that most banks in Fiji are already operating at their optimal scale. Also, changes in operational scales require long-term investment, which may not be realised in a relatively short time frame like this study.

Table 5: TFP changes and its decomposition by years (%)

Year	TFP Changes	TE changes	Technological changes	Scale changes
2000	-3.04	-4.57	4.37	-2.85
2001	3.68	-4.75	4.30	4.13
2002	2.90	1.04	3.81	-1.95
2003	21.88	11.18	4.17	6.53
2004	6.28	3.31	4.71	-1.74
2005	10.40	3.37	4.70	2.33
2006	11.59	5.52	5.39	0.69
2007	14.04	12.85	4.47	-3.28
2008	13.01	6.97	3.42	2.62
2009	-6.34	-5.97	3.89	-4.26
2010	16.54	12.66	3.25	0.63
2011	15.41	19.08	2.59	-6.26
2012	11.98	8.91	2.48	0.59
2013	3.28	2.39	3.70	-2.81
2014	8.86	5.16	4.29	-0.59
Average	8.70	5.14	3.97	-0.41

Pre– and post–GFC

Interestingly, the pre– and post–GFC results show that that the TFP performance might have improved in the post–GFC period–from an average of 7.67% to 10.82%, indicating that the GFC might not have had any major implications for the financial institutions in Fiji. However, on the components, only TE change appears to have improved—from an average of 2.16% to 8.92%. In the case of technical change, the average declined from 4.49% to 3.38%; the case of scale change was more pronounced—the average declined from 1.02% to -1.48%. This confirms that scale efficiency is the component of TFP that requires most attention.

5.0 Conclusion and policy implications

Previous research on banking efficiency in the case of Fiji have used the Data Envelopment Analysis (DEA) and accounting ratio methods. Using DEA and both the intermediation and production approaches and a sample period of 2000–2010, Sharma et al. (2015a) find that there is substantial scope to improve efficiency levels of banks in Fiji. Using a number of common measures, a similar sample period and a host of comparative countries and regions, Sharma et al. (2015b) find that the efficiency performance of banks in Fiji might indeed be a concern compared especially to the sector's overall stability performance in the same period. Using also the DEA approach but focussing on X and scale efficiencies, the Sharma et al. (2013) study indicates a significant room for improving banking efficiency in Fiji.

The consistent findings of these studies signal a policy review, which, together with an interest by the relevant banking regulator to make the country's banking system more efficient, since more efficient banks might provide the much needed impetus to foster the country's economic growth and development, provides the motivation for the present study. This study uses an alternative approach to empirically test the previous findings so that policy review may indeed be initiated. Using a similar sample size but an extended time period, the present study estimates technical efficiencies, total factor productivity growth and its components, using a stochastic distance function approach. Results confirm the findings of previous studies that there is substantial scope for improving banking efficiency in Fiji.

If indeed more efficient banks are deemed to supply greater amounts of intermediated funds at more affordable prices, and at the same time remain profitable, safe and sound, then in light of the foregoing, a policy review appears eminent and the process might follow the steps recommended here.

First, it might be useful to do further research on the following issues: (i) where the institutions operate internationally, such as ANZ, WBC, BOB and BSP, what has been the efficiency performance of these banks in other countries? (ii) in the case where banking business is confined to the local market only and otherwise, what is the efficiency performance of institutions in countries with similar economic, size and scale characteristics as Fiji, including the South Pacific? (iii) as well, what is the efficiency performance of institutions in countries that Fiji might aspire to emulate, such as Malta? The following research might also be useful: (iv) what is really the link between efficiency and loan production, for instance? (v) what is the link between efficiency and cost of loans? And, (vi) what is trade-off between efficiency and stability?

Answers the above questions will help in developing well-grounded, sound and effective policies and strategies for improving efficiencies of banking institutions in Fiji and provide a template for doing this elsewhere around the world, including the rest of the South Pacific countries. Second, the findings of the present and previous studies need to be appropriately communicated to the relevant stakeholders to signal a policy change, via a relevant forum, followed by another forum to share the findings of the further studies indicated above. The foregoing would logically lead to policy reform and development, which might entail further rounds of stakeholder consultations. At a time of growing interest in banking efficiency around the world, this paper and its recommendations are timely and most relevant for policy makers, practitioners, stakeholders, academia and the wider public.

References

Battese, G. E., & Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical economics, 20*(2), 325-332.

Beck, T., Demirgüç-Kunt, A., & Peria, M. S. M. (2008). Banking services for everyone? Barriers to bank access and use around the world. *The World Bank Economic Review*.

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European journal of operational research, 98*(2), 175-212.

Coelli, T., & Perelman, S. (2000). Technical efficiency of European railways: a distance function approach. *Applied Economics, 32*(15), 1967-1976.

Coelli, T. J. (1996). A guide to FRONTIER version 4.1: a computer program for stochastic frontier production and cost function estimation: CEPA working paper.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*: Springer Science & Business Media.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society. Series A (General)*, 253-290.

Hamit-Haggar, M. (2009). *Total Factor Productivity growth, Technological Progress, and Efficiency Changes: Empirical Evidence from Canadian Manufacturing Industries*: Department of Economics, University of Ottawa= Dép. de Science économique, Université d'Ottawa.

Jiang, C., Yao, S., & Zhang, Z. (2009). The effects of governance changes on bank efficiency in China: a stochastic distance function approach. *China Economic Review, 20*(4), 717-731.

Kirkwood, J., & Nahm, D. (2006). Australian banking efficiency and its relation to stock returns. *Economic Record, 82*(258), 253-267.

Malmquist, S. (1953). Index numbers and indifference surfaces. *Trabajos de Estadistica y de Investigacion Operativa, 4*(2), 209-242.

Sealey, C. W., & Lindley, J. T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *The Journal of Finance, 32*(4), 1251-1266.

Shamsuddin, A., & Xiang, D. (2012). Does bank efficiency matter? Market value relevance of bank efficiency in Australia. *Applied Economics, 44*(27), 3563-3572.

Sharma, P and M. Brimble (2011). Sustainable development in the small states of the South Pacific: toward a corporate social responsibility for international banks, *Fijian Studies*, 9(2), 23–51.

Sharma, P., Gounder, N., & Xiang, D. (2013). Foreign banks, profits, market power and efficiency in PICs: some evidence from Fiji. *Applied Financial Economics, 23*(22), 1733-1744.

Sharma, P., E. Roca, V. Dakai, and S. Manoa, (2015a). An assessment of Fiji's banking system on a global scale, 2000-2011 (RBF–Griffith WP #1)

Sharma, P., Gounder, N., & Xiang, D. (2015b). Level and Determinants of Foreign Bank Efficiency in a Pacific Island Country. *Review of Pacific Basin Financial Markets and Policies, 18*(01), 1550005.

Shephard, R. W. (2012). *Cost and production functions* (Vol. 194): Springer Science & Business Media.

Sturm, J.-E., & Williams, B. (2004). Foreign bank entry, deregulation and bank efficiency: Lessons from the Australian experience. *Journal of Banking & Finance, 28*(7), 1775-1799.

Appendix 1: World's largest banks, 2014

A. By total *assets*

Rank	Bank name	Country	Total assets (USD billion)
1	Industrial & Commercial Bank of China (ICBC)	China	3,328.48
2	China Construction Bank Corporation	China	2,704.16
3	HSBC Holdings	UK	2,634.14
4	Agricultural Bank of China	China	2,579.81
5	JPMorgan Chase & Co	US	2,573.13
6	BNP Paribas	France	2,526.98
7	Bank of China	China	2,463.08
8	Mitsubishi UFJ Financial Group	Japan	2,337.04
9	Credit Agricole Group	France	2,143.88
10	Barclays PLC	UK	2,114.13
11	Bank of America	US	2,104.53
12	Deutsche Bank	Germany	2,078.13
13	Citigroup Inc	US	1,842.53
14	Japan Post Bank	Japan	1,736.34
15	Wells Fargo	US	1,687.16
16	Mizuho Financial Group	Japan	1,640.71
17	Royal Bank of Scotland Group	UK	1,635.93
18	China Development Bank	China	1,614.99
19	SocieteGenerale	France	1,591.00
20	Banco Santander	Spain	1,540.08
21	Groupe BPCE	France	1,487.78
22	Sumitomo Mitsui Financial Group	Japan	1,470.78
23	Lloyds Banking Group	UK	1,330.99
24	UBS Group AG	Switzerland	1,074.80
25	UniCredit S.p.A	Italy	1,026.74
26	Postal Savings Bank of China	China	1,017.44
27	Bank of Communications	China	1,012.32
28	ING Bank N.V.	Netherlands	996.07
29	Credit Suisse Group	Switzerland	932.14
30	Goldman Sachs Group	US	856.24
31	Rabobank Group	Netherlands	828.34
32	Toronto-Dominion Bank	Canada	814.10
33	Nordea Bank	Sweden	814.06
34	Royal Bank of Canada	Canada	810.48
35	Morgan Stanley	US	801.51
36	Norinchukin Bank	Japan	797.94
37	Intesa Sanpaolo	Italy	786.19

38	BBVA	Spain	768.57
39	China Merchants Bank	China	764.18
40	Standard Chartered Plc	UK	725.91
41	National Australia Bank	Australia	722.89
42	Industrial Bank Co. Ltd	China	712.21
43	Commonwealth Bank of Australia	Australia	696.22
44	Bank of Nova Scotia	Canada	694.25
45	Commerzbank	Germany	678.17
46	Shanghai Pudong Development Bank	China	677.64
47	China CITIC Bank Corp	China	668.41
48	China Minsheng Banking Corp	China	648.44
49	CM11-CIC Group	France	648.13
50	**Australia & New Zealand Banking Group**	**Australia**	**631.88**
51	**Westpac Banking Corp**	**Australia**	**630.86**

Source: http://www.relbanks.com/worlds-top-banks/assets-2014

A. By total *market capitalisation*

Rank	Bank name	Country	Total market capitalisation(USD billion)
1	Wells Fargo	USA	284.39
2	Industrial and Commercial Bank of China (ICBC)	China	269.70
3	JP Morgan Chase	USA	233.94
4	China Construction Bank (CCB)	China	213.18
5	Bank of America (BoA)	USA	188.14
6	Agricultural Bank of China (ABC)	China	187.34
7	HSBC Holdings	USA	181.24
8	Bank of China	China	177.65
9	Citigroup Inc.	UK	163.93
10	Commonwealth Bank of Australia (CBA)	Australia	112.37
11	Banco Santander	Spain	107.07
12	Royal Bank of Canada	Canada	99.63
13	Toronto-Dominion Bank	Canada	88.21
14	Goldman Sachs Group	US	84.42
15	**Westpac Banking Corporation**	**Australia**	**83.63**
16	Lloyds Banking Group	UK	82.79
17	US Bancorp	US	80.43
18	Mitsubishi UFJ Financial Group	Japan	78.41
19	Morgan Stanley	US	75.95
20	Bank of Communications	China	74.66
21	BNP Paribas	France	73.20

22	**Australia and New Zealand Banking Group**	**Australia**	**71.67**

Source: http://www.relbanks.com/worlds-top-banks/market-cap-201