THE IMPACT OF DEPOSIT GUARANTEE SCHEME ON OPERATION OF AUSTRALIAN FINANCIAL INSTITUTIONS

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Abstract

During the global financial crisis (GFC), the Australian government introduced a deposit guarantee scheme to all the deposit accounts with financial institutions. The scheme is very similar to a deposit insurance scheme to a certain extent, though the premium is not paid by the financial institutions or the depositors. This study adopts Data Envelopment Analysis (DEA) and Malmquist productivity index (MPI) to investigate the impact of the funding scheme on Australian financial institutions during and after the GFC. The study measures the productivity and efficiency gains of large financial institutions, regional banks, credit unions and building societies for its analysis. This data spans the period from 2000 to 2014 and uses financial institutions' input and output variables. The study finds evidence that an ex-ante insurance scheme has a profound impact on the structure and funding of Australia's current insurance scheme. The research contributes to the body of knowledge of the current literature on the deposit guarantee scheme and the practical understanding of a deposit insurance scheme from an Australian perspective.

Keywords: Deposit Scheme, Financial Institutions, GFC

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1. INTRODUCTION

Financial reform and capital requirements are considered one of the most pivotal issues in the global banking industry (Ho, Lai, & Lee 2014). A growing interest developed in the area of bank performance following the 2007-09 global financial crisis (GFC). According to the Reserve Bank of Australia (RBA), the role of financial institutions plays a pivotal role in our modern society as they are a financial institution that acts as a financial intermediary between depositors and savers. Banks are at the centre of the payment system which makes them inherently fragile through exposure to various risks associated with the nature of money handling. This need for economical vigilance is demonstrated by the issues originating in the Murray Inquiry regarding a systematic restructuring of the current implicit (ex-post) guarantee deposit insurance in an explicit (ex-ante) system (The-Treasury, 2014).

Australian banks have very strong capital requirements, due to tight monetary policy and Australia's twin peaks model. The twin peaks model is well articulated in Hill's (2010) study of why Australia fared so well in the GFC. The twin peaks model is the notion that separate regulatory bodies are responsible for different roles. For example, the Australian Prudential Regulation Authority (APRA) is responsible for prudential regulation, the Australian Securities and Investments Commission (ASIC) is responsible for business and consumer protection, which prevents biased decision making. These three bodies are also very closely regulated. Moreover,

other contributing factor in Australian performance was China's demand for Australian resources. This has been the main contributor to the welfare of the Australian economy (Hill, 2010; Vu & Turnell 2011). This combination of variables supports the observed stability of Australia during the late GFC as opposed to many other jurisdictions around the world, with many banks collapses.

Currently in the Australian banking sector faces a transition from mining to the non-mining sector, the problematic outcome that faces the smaller financial institutions in Australia has meant that interest rates have been cut to historic lows. The big four banks in Australia, which are Australian and New Zealand Banking Group (ANZ), National Australia Bank (NAB), Commonwealth Bank of Australia (CBA) and Westpac Banking Corporation (WPC). These banks dominate in an oligopoly market, giving them a major competitive advantage. Due to their ability to source deposits and funds efficiently and easily as opposed to their competitors, more stringent regulations have been imposed on them by the government to create a fairer playing field in the Australian banking sector. Further, the four-pillar policy has been imposed on the four banks so that no further consolidation through merger and acquisitions can be applied. According to IBISWorld industry reports, Credit Unions in Australia are at an all-time low with the industry steadily building down due to the exit of numerous financial institutions from both industries transitioning to mutual banks. Building Societies facing similar circumstances with only 6 institutions left in the sector. Mutual banks provide products and services that banks do, however, the main differing point from a bank is that mutual banks are still owned by its members. Furthermore, there are to be further exits from the industry from both credit unions and building societies. It is because of these exits combined with the Reserve Bank of Australia's rate cuts that have hindered revenue for the two industries. This is to note that, credit unions and building societies have a mutual status meaning they are member-owned. This makes the nature of their institution restricted to the number of members each institution attains.

The Murray Inquiry's financial report released in late November 2014 (The Treasury, 2014). It was the first financial system inquiry in 187 years. The Wallis Inquiry in 1997 made major structural changes to the Australian financial system of which the Australian Prudential Regulation Authority (APRA) was established (Hantarry, 1997). The Murray Inquiry seeks to address several issues in Australia's financial system and proposes recommendations. These focus on resilience, superannuation and retirement incomes, innovation, consumer outcomes, and the regulatory system. To improve the resilience of the Australian financial system, the financial report advocates the introduction of a leverage ratio in conjunction with Australia's adoption of the Basel 3 framework. It serves to act as a backdrop requirement, which provides a floor to financial institutions' current tight risk-weighted capital requirements.

This study strongly focuses on the recommendation by the inquiry on the idea of the adoption of an explicit deposit insurance scheme to be implemented in Australia. This was strongly advocated by Hantarry (1997) which aimed to strengthen the survival of the Australian financial system from the increasing competition from foreign trade. Currently, Australia has not implemented an explicit deposit insurance scheme and this present study seeks to provide empirical evidence regarding changes in efficiency and productivity of Australian banks when government schemes were implemented. The guarantee schemes were applied in three different periods at various amounts. Therefore, the contribution of this research provides further insight and indicates whether guarantee schemes were beneficial or costly to depositors and Australia as a whole. A detailed discussion on guarantee schemes and Australia's current stance on the issue is discussed.

1.1. Deposit insurance

Deposit insurance is an explicit guarantee scheme that ensures the deposits against the risk of loss arising from the failure of a financial institution. Such an insurance scheme forms part of the International Monetary Fund (IMF) recommendations for developing countries (Morrison & White, 2011). Presently, there is no universal insurance scheme adopted worldwide, meaning that each country attributes unique design features that are best tailored to their respective jurisdictions. A one size fits all concept is difficult to achieve, ultimately feasible due to cross-country differences especially political arrangements, government, social and structural variables, which are vastly different across jurisdictions.

1.2. Government guarantee scheme

Australia is yet to adopt has an explicit ex-ante deposit insurance scheme. Although an ex-post guarantee scheme was applied during the GFC, a detailed permanent scheme is not implemented. Australia's current financial system attributes an ex-post funding structure, the Financial Claims Scheme for ADIs. The recommendation of an ex-ante funding model is purported to provide extra layers of financial support to the financial system. This is to ensure that Australia has an appropriate and efficient funding model at the time of the financial crisis. The guarantee scheme applied by the Australian government can be separated into three significant sections. They are stated below:

1. The government provided an unlimited guarantee of deposits in response to the GFC (from November 2008 to the end of March 2010).

2. Large deposits and wholesale liabilities were guaranteed by the government up to $ 1 million per customer per institution (from April 2010 to January 31, 2012).

3. From February 1, 2012 to present government guarantee has decreased to $250,000.

Currently, no studies have been conducted to investigate the impact of guarantee schemes have on the different types of Authorised Deposit-taking Institutions (ADI) in Australia. These ADI's include the big four banks, regional banks, credit unions, and building societies. Therefore, this research aims to fill this gap in the literature as a more situated understanding of deposit insurance, especially from an Australian perspective as the understanding of deposit insurance is still in its infancy (Morrison & White, 2011). This study aims to determine the

potential benefits or risks in the implementation of the ex-ante model measure, to support or oppose whether this model is more appropriate than current practice. This study examines the financial changes in guarantee schemes provided by the Australian government and its effect in the Australian banking system over the period from 2000 to 2014. A predicted beneficial outcome of the insurance scheme implementation would be indicative of the need for change. This research provides a wider understanding of the potential implementation of deposit insurance and predicts the effects the explicit insurance scheme could have on the Australian banking sector. The interest is in giving a wider understanding of deposit insurance and to explore, through the study, each firm's efficiency over the guaranteed schemes period. In contrast, this study seeks to be generalisable and through quantitative mathematical analysis to answer the following research questions:

RQ 1: Did the efficiency of Australian Financial institutions improve when guaranteed schemes were provided by the government?

RQ 2: If deposit insurance was to be implemented, would the adoption of a deposit insurance scheme benefit all Australian Financial Institutions?

The implications of these findings would contribute to the large body of literature of Australian bank performance efficiency measures in an attempt to improve overall economic growth, ultimately to ensure a strong and stabilised financial system. If the failure of a financial institution is to arise, Australia's current ex-post funding scheme allows depositors to access protected deposits quickly without the requirement of an extensive liquidation process. The funding scheme currently protects deposits of up to $250,000 per account holder, per institution. This process requires the government to provide the funds for depositor reclaims. If the impact of the failed financial institution is severe and liquidation is inadequate, the government can source funds by placing a levy on the banking industry to recover additional funds. The remainder of the paper proceeds as follows. Section 2 includes a brief literature review and the development of the hypotheses of our research. Section 3 outlines the research methodology and design. Section 4 reports data analysis descriptive statistics of the results. Section 5 provides a conclusion and limitations of the study.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Arguably, the United States is the main cause of the GFC due to poor policy implementation, such as a sub-prime mortgage landing (Lewis, 2009). This caused a 'contagion effect' and many other jurisdictions felt the full force of the GFC with bank collapse experienced globally (Dungey & Gajurel, 2015). Australia had no bank collapses compared to its international counterparts due to a strong regulatory response by the Australian prudential authority. However, there has been a significant amount of criticism by researchers on the traditional measures of bank performance. Thoraneenitiyan's (2010) study argues that a major concern in financial statement analysis during the GFC was that financial reports positively showed a substantial increase in

loan growth whilst showing very low loan losses. This implies that financial statements alone do not give an accurate depiction of a bank's financial welfare, and financial ratios could be seen as misleading (DeYoung, 1997). Thoraneenitiyan (2010) and DeYoung (1997) studies support the notion that fundamental analysis alone is an inadequate technique to measure bank performance. This is largely due to the inability to explain variations in stock prices and distinguishing between financial and non-financial activities.

Bank performance is traditionally measured by fundamental analysis through financial statement analysis. The objective of fundamental analysis is to predict future movements in stock performance, which then allows financial institutions to strategize a plan (Avkiran & Morita, 2008). It is argued by many researchers that this is an unreliable measurement tool as it gives an inaccurate depiction of the welfare of a particular firm. Since the GFC, awareness in bank performance has seen an increasing number of individual and cross-country analyses conducted observing bank performance across jurisdictions including Europe, Australia, the United Kingdom, Asia, Canada, and the USA (Avkiran & Morita, 2010; Guidara, Lai, Soumaré, & Tchana, 2013; Chen, 2013).

Further, Seelanatha (2007) argues that efficiency and productivity measures are supplementary to the traditional financial performance measurement methods, these include return on assets (ROA), return on equity (ROE), net interest margin (NIM) and market to book value ratios (Vu & Turnell, 2011). Productivity and efficiency are of significant importance as they help to analyse the firm's ability to use resources. These productivity indices highlight the bottlenecks and barriers to performance (Seelanatha, 2007; Reynolds & Thompson, 2002). The measurement of productivity can be applied through the use of total factor productivity (TFP). The researchers use the TFP of which is the percentage of total output over total inputs that are used in the organisation's production. TFP is utilised, as it gives an estimate of the overall utilisation of inputs and outputs by individual firms or organisations being studied. Thus, production frontier measures can indicate the overall efficiency of each firm. There are two main approaches to measure productivity change namely: the econometric estimation of production (parametric methods) and the computation of index numbers (non-parametric method). The three parametric methods are respectively the Distribution Free Approach (DFA), Thick Frontier Approach (TFA) and more popularly used the Stochastic Frontier Approach (SFA) otherwise known as the economic frontier approach. As mentioned above this method assumes a pre-specified functional form of production frontiers. Conversely, the two main non-parametric methods used to measure productivity are Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). Pastor (1999) identifies the positives and negatives of both methods, while Berger and Humphrey's (1997) study has evaluated the advantages and disadvantages from a banking perspective. Although, there are numerous ways to measure productivity and efficiency, however from a banking point of view, production frontier analysis is often the method chosen by contemporary researchers to empirically test efficiency and productivity gains. Both the parametric and non-parametric methods are used to

collect data by researchers for their research and construct a production frontier that is used to estimate efficiency and productivity gains or losses.

Morrison and White (2011) argue that the understanding of DI is still in its 'infancy', including the misconception of the design features and consequences of deposit insurance, such as the presence of a moral hazard and adverse selection (Wheelock & Kumbhakar, 1995). Presently, there is no universal insurance scheme adopted worldwide, and each country attributes unique design features that are best tailored to their respective jurisdictions. A one size fits all concept is difficult to achieve due to cross country differences, especially political arrangements that are vastly different globally. Early literature identified moral hazard and adverse selection as a major issue of DI. Several economists in the 1980s had identified the negative impact that deposit insurance can have in contributing to the banks, savings and loan failures observed during that period. Wheelock and Kumbhake's (1995) research test the Kansa deposit insurance system which operated from 1909 to 1929. The paper found that both moral hazard and adverse selection behaviour were present throughout the Kansa system's first decade of operation. This was contradictory to the main purpose of the system which was meant to decrease risk-taking and protect risk adverse deposits from high risk financial institutions. This reflects that there are widely differing views on how deposit insurance should optimally be structured. Consistent with early research, Demirgüç-Kunt and Detragiache's (2002) empirical investigation observed in 61 countries in the period 1980-1997. Findings suggest that an explicit deposit insurance scheme found that a financial crisis was more likely to occur with a deposit insurance scheme.

To mitigate the issues of moral hazard and adverse selection, researchers have proposed various models. Early research by Calomiris (1989) on the Indiana insurance system of the 19th century suggested a model to rectify moral hazard issues by including coinsurance to the insurance system. Essentially this coinsurance provided financial institutions with the incentive to observe and monitor each bank's behaviour ensuring that they were being cautious. In more recent research, Morrison and White (2011) suggest deposit insurance should be funded in the form of general taxation for it to have any real beneficial effect. Funding would be at the expense of external agents to the banking sector, ultimately taxpayers, and not borne on banks. The reasoning behind this argument is that taxpayers should be expensed over banks. If banks are contributing parts of their capital into an insurance scheme, this means that profitability in any investment undertaken to be automatically reduced.

This increases the safety net which leads to a complete welfare neutral result. In a world where everyone is risk-neutral, the two effects cancel each other out as interest rates on deposit insurances decrease at the same time as lowering market discipline on bank risk-taking. Secondly, a more positive effect is that a financial institution will have to pay a reduced interest rate to encourage depositors to make deposits resulting in an increase in the share price of a successful investment. Furthermore, Anginer, Demirgüç-Kunt, and Zhu (2014) explore the relationship between DI and bank risk and system stability. The study observed the period before and during the GFC. Findings suggest that the presence of moral hazard was only evident in 'good times'. Whilst DI was effective in a financial crisis as bank risk decreased.

Although Australia did not have an explicit deposit insurance scheme during the GFC, Australia remained unscathed in its aftermath. However, as noted in the introduction chapter, in response to the GFC, the Australian government introduced an implicit scheme during the GFC that was in the form of the government guarantee scheme. Australia attributes many other protective measures such as depositor preference, to its resilience. In the event of a financial crisis and a bank's collapse, depositors would be the first people to get money from the assets of the bank during liquidation. However, the Murray inquiry strongly recommended the implementation of deposit insurance, as it is of significant importance for the welfare of Australia's financial system and its progress to a stronger and stabilised system (The-Treasury, 2014).

The discussion above reiterates that deposit insurance is still in its 'infancy' and this reflects on the widely differing views that individual jurisdictions have on the insurance scheme. It is evident from DI literature discussed above, that the major drawbacks of DI are moral hazard and adverse selection. Other issues are how it should be structured and how it should be optimally structured. Due to the extra layer of financial support, moral hazard is existent as there is a lack of motivation by banks to guard against risk. Financial institutions assuming that having deposit insurance subsidise risk and safeguard them from any harm. Hence, banks take more risk, as they otherwise would (Demirgüç-Kunt & Detragiache, 2002; Ho, Lai, & Lee, 2014; Morrison & White, 2011; Wheelock & Kumbhakar, 1995). Furthermore, it is notable that the implementation of a deposit insurance scheme is a debatable matter with great benefits and notable negatives. Further empirical investigations need to be conducted to give a wider understanding and rectify the shortcomings of DI. An appropriate DI framework is necessary to ensure effective DI is implemented in ensuring systemic stability (Anginer, Demirguc-Kunt, & Zhu, 2014). Based on the above literature review survey and our preliminary research agenda, the study developed a four-research hypothesis for analysis, which are:

Hypothesis 1 (H1): There is no relationship between deposit insurance and bank efficiency of Australian financial institutions.

Hypothesis 2 (H2): Deposit Insurance increases the efficiency of Australia's financial system as a whole.

Hypothesis 3 (H3): Deposit insurance would increase Australia's small to medium-sized financial institution's efficiency (i.e. credit unions, building societies).

Hypothesis 4 (H4): Deposit insurance would not increase the efficiency of Australia's four largest financial institutions (i.e. ANZ, CBA, WBC, and NAB).

3. RESEARCH METHODOLOGY AND DESIGN

This research incorporates a quantitative inquiry of the Murray Inquiry's proposal to adopt an explicit deposit insurance scheme in Australia. Secondary data are employed for the analysis of data. The collected secondary data are analysed using Data

Envelopment Analysis (DEA). This research attempts to provide further insight on deposit insurance with a close analysis of Australian authorised deposit-taking financial institutions. Productivity and efficiency studies became increasingly popular due to the incentive to investigate the impact of the GFC on the bank performance of financial institutions, with a heavy onus on efficiency and productivity of the bank's studies (Moradi-Motlagh & Babacan, 2015; Vu & Turnell, 2011).

Production frontier approaches have become a popular approach amongst empirical efficiency and productivity studies and both models can be used to construct a production frontier. Both parametric and non-parametric methods have their inherent advantages and disadvantages. Coelli and Perelman's (1999) study applied both production frontier approaches to their research on European railways and found a similar result. Thus, the researchers justified that any production frontier approach can be applied without heavily affecting the results (Tortosa-Ausina, 2002). This study incorporates the DEA method and is discussed below.

3.1. Data Envelopment Analysis (DEA)

DEA is a non-parametric analytical technique that uses linear programming to identify best practice performance through observation of resources amongst a group of organisations (Abbott, Wu, & Wang, 2013). This constructs a non-linear frontier over the data (Coelli, Prasada, O'Donnell, & Battese, 2005b; Lovell & Schmidt, 1988). When the decision-making units (DMU) are identified as best practice (efficient) or inefficient, these DMUs are given an efficiency score rating. DEA has been increasingly used as an alternative tool to analyse the efficiency of financial institutions both in Australia and overseas. This is due to the arguments made by Berger and Humphrey (1992) that traditional fundamental analysis of financial statements does not give an accurate depiction of a firm's performance in regards to profit and cost. The DEA has become a popular measurement tool in the banking industry as it is an industry well suited to situations where markets are distorted by prices, subsidies and general market contestability (Abbott, Wu, & Wang, 2013). The other major advantage is that stochastic cost frontiers require the need to assume the pre-specified functional form of the production frontier.

3.2. Constant returns to scale (CRS)

In using DEA return to scales need to be used. A return to scale attributes of the technology is vital to total factor productivity measurement. The constant returns to scale (CRS) developed by Charnes, Cooper, and Rhodes (1978) and variables return to scale (VRS) are the most popularly used for DEA formulation. Distinguishing properties of the two models are the assumptions of the returns to scale. The researcher applies CRS for this research due to the argument made by Grifell-Tatjé and Lovell (1995) that the Malmquist index may inaccurately measure the total factor of productivity changes when the VRS model is used to estimate distance functions for the Malmquist index. Thus, by using CRS rectifies the VRS issue.
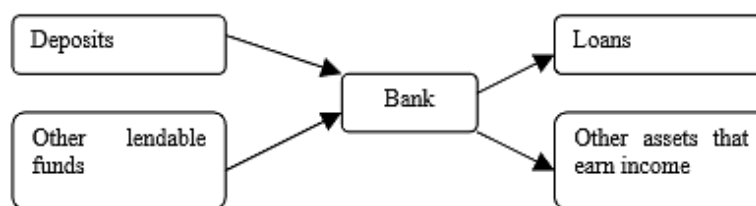
3.3. Intermediation approach

There are two main models used to measure the flow of services provided by banks. These models were highlighted by Mester (1987) and are respectively: the intermediation approach and the productivity approach. The precise definition of input and output variables in the banking industry is a debatable matter (Berger & Humphrey, 1997). Figure 1 and Figure 2 below shows the difference between the production and intermediation approaches. The production approach gives banks the interpretation that they are also a business. This approach acknowledges that commercial activities take place during the running of a bank. Therefore, under this approach output is defined as the number of bank transactions processed on the accounts. Inputs consist of physical capital and labour used (Abbott, Wu, & Wang, 2013). In contrast to the production approach, loans and investments are outputs. The intermediation approach views banks as financial intermediaries. This means that banks are defined as a process between depositors and savers and variables are measured as a currency unit. Moreover, deposits are regarded as an input that is used to produce other banking outputs. Under the intermediation framework, it is based on the assumption that the main objective of an authorised deposit-taking institution is to act as an intermediary between saver and borrowers in a bid to make a financial transaction (Seelanatha, 2007).

Figure 1. Production approach
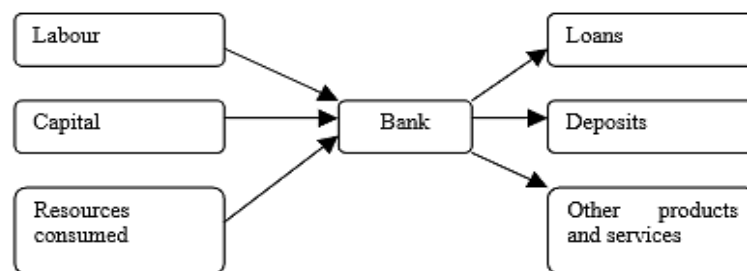
Source: Kirikal, 2005.

Figure 2. Intermediation approach

This research applies the intermediation approach which is in line with the majority of Australian financial institution studies (Abbott, Wu, & Wang, 2013; Worthington, 1999). For example, Favero and Papi (1995) argue that the intermediation approach is the most suitable for financial institutions, especially where the majority of banking activities involves the conversion of large deposits (funding purchased) from a bank converted into financial investments and loans. Golany and Storbeck's (1999) study concluded that under the production approach, deposits are included as outputs as it is part of the service that banks offer. Contrary to the production approach, findings suggested that deposits should be considered as an input. This is because deposits are used for making loans and investments with other inputs. The research also found that the intermediation approach provides more accurate data which decreases the potential quality problems of input-output data through the use of currency value. The production approach does not consider all banking costs as opposed to the intermediation approach which is more inclusive of the total banking costs. These costs are vital to take into account due to the expenses contributing to a significant portion of a bank's total cost. Hence, not including these expenses may provide inaccurate and misleading findings.

3.4. The study proposition

This research applies the DEA (non-parametric) approach to estimate MPI to analyse the impact of guarantee schemes on Australian financial institutions. The advantages of DEA were found in Berger and Humphrey' (1997) and Coelli et al. (2005a) studies which established two major benefits of production frontier analysis. Firstly, from a banking stance, by measuring relative productivity this particular analysis can identify the better performing firms from the underperforming firms. Secondly, management can distinguish specific areas of the firm that is performing better than other areas. Thus, the benefit of sifting through an intricate and complex structure of financial institutions is one of the main reasons as to why the researcher has adopted the DEA linear programming model to estimate MPI. For a detailed discussion of DEA refer to Lovell and Schmidt's (1988) and Färe, Grosskopf, Lindgren, and Roos's (1994a) studies. This study uses the combination of DEA and the MPI methods to provide the possible causes of productivity change in the financial institutions

through existing technology. It is to note that a major drawback of the MPI is the compulsory need to determine the distance function. This study uses the DEA linear programming method advocate by Färe et al. (1994a). Thus, this research use Data Envelopment Analysis computer program (DEAP) to compute Malmquist indices using DEA like methods (Coelli, Prasada, O'Donnell, & Battese, 2005a). DEAP method was suggested by Coelli (1998) and discussed later in this section. The use of the DEA model over various other models is due to its mathematical nature, DEA allows for the construction of a production frontier with a small sample (Seelanatha, 2007). Hence, this allows the researcher to apply the appropriate model to suit the objective of the study. DEA is used combining with MPI to give a more accurate result as MPI major disadvantage is the distance function requirement.

3.5. Malmquist productivity index (MPI)

There are a variety of options to measure productivity changes namely, the Fischer index (1992), the Tornqvist index (1936) and the Malmquist productivity index (1953). The study uses the DEA method to estimate an MPI which is in line with the previous studies. The DEA method has been commonly used as an efficient tool to measure the productivity and performance of financial institutions not only in Australia (Abbott, Wu, & Wang, 2013; Worthington, 1999) but internationally (Halkos & Salamouris, 2004; Kao & Liu, 2014; Kirikal, 2005; Xiang, Shamsuddin, & Worthington, 2013).

MPI can be separated into two sub-categories – technical efficiency and technical change. This decomposition allows for the causes of productivity change to be identified. In deference to the finance industry, the MPI also identifies if the financial institutions have improved their productivity. The findings can produce different results due to the oligopoly market where the big four banks have a substantial market share in the Australian market, in contrast to the smaller share that regional banks, credit unions, and building societies attribute. Färe et al. (1994a) have shown the simple ways to construct the MPI, and it is the preferred index over the three alternative options discussed in the literature review section which is aligned Grifell-Tatjé and Lovell (1995). Firstly, the researchers argue that the most advantageous attribute is the MPI does not require cost minimisation or profit maximisation to be assumed. Secondly, when inputs and outputs price information is distorted or unavailable the MPI is the

most suitable index to apply. Finally, when MPI is used in conjunction with panel data productivity changes can be separated into two sub-categories, e.g. technical efficiency change and technical change. Furthermore, two DEA models, the input orientated and output orientated DEA models can be applied to approximate efficiency values. In using the MPI, the

decomposition can be used to estimate technical efficiency and technical changes over the observation period. The definition of the output-orientated MPI was first presented by Färe et al. (1994a) and shown in Equation 1. The definition below can be used in multiple time-periods (*t* and (*t + 1*)) respectively:

$$M_I^{t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \left[\frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)} \times \frac{D_I^{1+t}(y^{t+1}, x^{t+1})}{D_I^{1+t}(y^t, x^t)}\right]^{1/2} \tag{1}$$

where, *D* = Input distance function; *I* = Input orientation; *M* = Malmquist productivity index also defined as the productivity of the most recent production point of (*x^{t+1}*, *y^{t+1}*) and (*x^t*, *y^t*) using period *t + 1* technology and period *t* technology respectively.

The first ratio measures the productivity change from period *t* to a period (*t + 1*); *t* is used as the benchmark. Thus, the first ratio represents the period *t* MPI. This is in contrast with the second ratio, which represents the period (*t + 1*) MPI, using (*t + 1*) as the benchmark. Furthermore, if the value of *M* is greater than 1, this indicates productivity growth as opposed to the value of *M* less than 1, which signifies a decline in productivity growth. If the value of *M* equals 1, it remains constant and unchanging.

3.6. DEAP program

This study uses Data Envelopment Analysis program (DEAP) which is a DEA computer program developed by Coelli (1992) and further described in Coelli (1997). The program was written as a tool to conduct DEA to calculate efficiencies in production. DEAP program can take into account a variety of models. However, DEAP provides three principal options. Firstly, Färe et al. (1994a) research identifies standard CRS and VRS models DEA models which involve the calculation of technical and scale efficiencies. Secondly, the extension of the previously mentioned models which includes the calculation of cost and allocative efficiencies. Thirdly, Färe, Grosskopf, Norris, and Zhang (1994b) apply Malmquist DEA methods through observations of panel data of which is used to calculate indices of total productivity change, technical efficiency change, technical change, and scale efficiency change. From an empirical application, the research uses the DEAP computer program, by constructing

Malmquist indices which apply DEA-like methods (Coelli, 1998). The distance measures are calculated for each financial institution using the DEAP program.

4. DATA AND DESCRIPTIVE STATISTICS

This research uses the dataset from several financial institutions, includes big four banks, regional banks, credit unions and building societies for analysis. The study spans the period from 2005 till 2014. The main reason for selecting this study period is to analyse an eight-year dataset of the Australian financial institutions when the Australian financial institution went through a severe crisis and structural changes. The study then divided into three sub-periods. The Malmquist productivity indixes (MPI) results and per GFC period are from 2005-2006 (pre-GFC), the GFC is from 2007 till 2009 (During GFC) and from 2010 till 2014 in the post-GFC period. These sub-periods are analysed for financial institutions representing each category. This procedure ensures that the smaller institutions are also represented as MPI can differ from the larger institutions. Additionally, the study seeks to observe if the government guarantee scheme benefited these financial institutions individually or the Australian financial system as a whole.

The data collected for the big four banks and multiple regional Australian financial institutions is from DatAnalysis Premium database. The information gathered from this database provides explicit financial information of all Australian publicly listed companies from the year 1989 which is extracted from ASX announcements. The ratios obtained are respectively, Return on assets (ROA), Return on equity (ROE), Net interest margin (NIM), Spread, Non-interest income/Total income and Operating income/Total assets.

Table 1. Definitions of ratios

Notation	Variable Name	Description
ROA	Return on asset	the ratio of net income over total assets
ROE	Return on equity	the ratio of net income over total equity
NIM	Net interest margin	the ratio of net interest income to average earning assets. Net interest income is the difference in interest income and interest expense
SPREAD	Spread percentage	the ratio is the difference of interest earned and interest paid
NON-INT/TOT INCOME	Non-interest/Total income	the ratio of total non-interest income divided by total income for a given period
OP INCOME/TOTAL ASSET	Operating income/Total asset	the ratio of total operating income divided by total assets for a given period
GROSS DIVIDEND	Gross dividend yield	the ratio is the sum of all dividends received in a given period

Credit unions, regional banks, and building societies are privately owned financial institutions and are generally not publicly listed companies. It is

notable that these private institutions still follow onerous reporting requirements under the Corporations Act, through ASIC and APRA's

stringent guidelines. However, being a member-owned bank meant that the availability of the data has been scarce. Therefore, this study sources data by calculating variables, obtained from each financial institution's yearly annual report. However, due to the limited disclosure publicised by each respective institution, the dataset consists of 514 firm-year observations across 55 different Australian financial institutions.

There are two main reasons why the data from these smaller institutions' earlier years have not been publicly disclosed. Firstly, there is a lack of incentive to produce up-to-date databases, as these firms are generally small in size and obtain a minimal share in the market. Secondly, the GFC resulted in a large number of building societies and credit unions to merge into what is known as mutual banks. Therefore, data for earlier years has not been publically disclosed. The dataset attaining a larger observation group representing four different types of financial institutions in the banking sector gives a wider understanding of deposit insurance. For example, building societies and credit unions industries have lost a substantial part in the industry market share to competitors.

4.1. Descriptive statistics

Table 2 illustrates the descriptive statistics from all financial institutions. It can be seen that most of the variables are positively skewed, aside from the negatively skewed spread variable. For example, the mean (median) value of the variables is ROA 0.6100 (0.6000), ROE 7.9338 (4.5931), NIM 2.6457 (2.4580), NON-INT 18.5613 (13.5300) and OP INCOME 7.7770 (7.4850). This means that the majority of the banks in the dataset have a value larger than the mean. Furthermore, the observation made from the comparison of the mean and standard deviation values suggests that there are no extreme outliers.

Table 2. Ratio of all institutions combined

	(Obs)	Mean	Min	Max	Median	Std dev.	Skewness
ROA	514	0.6100	-0.4500	2.1700	0.6000	0.3098	0.4923
ROE	514	7.9338	-7.0900	21.7700	7.4100	4.5931	0.4996
NIM	466	2.6457	0.9700	5.7500	2.4850	0.7945	1.0243
SPREAD	60	1.6907	0.9000	2.3900	1.7200	0.3690	-0.3633
NON-INT	514	18.5613	0.3200	81.8400	13.5300	16.0031	1.6669
OP INCOME	514	3.6665	0.9700	15.1900	3.0400	1.6909	2.8134
GROSS DIV	60	7.7770	5.9700	11.4200	7.4850	1.3209	0.9823

Although the dataset represents the symmetrical distribution, the largest difference in the dataset (mean and median) is shown in the non-interest/total income data. This can be argued due to the existence of an oligopoly market that the big four banks hold, in that the big four banks have substantial market share in the industry. This means these institutions can earn a greater amount from non-interest income through deposit and transaction account fees, and from annual and monthly fees. The presence of an oligopoly market means the smaller institutions (regional banks, credit unions, and building societies) do not have a substantial market share and struggle to compete against the major four banks.

Further, due to this steep competition and the inability to remain profitable and competitive, the building society and credit union industry have dramatically reduced in numbers. For example, the building society industry has dropped to just 6 institutions and most institutions merge into mutual banks in a bid to improve profitability. Table 3 breaks down into each banking sector, therefore, decreases sample size. The market size and power of the big four banks in contrast to its competitors is evident from this table. In contrast to the discussion in Table 1, the big four banks' ROA and ROE values are now negatively skewed. This suggests the mean value of the big four banks ROA (0.9307) and ROE (15.5712) is below the median (0.9800, 15.6750) value. Regional banks and credit unions also show a similar trend in the analysis. In contrast, building societies are still positively skewed like the previous table (Table 1).

It is to note that the big four banks' ROA is higher compared to the other banking sectors. It is due to better performance and attributing a large asset base. It can be argued that the big four banks' dominant market share, the smaller institutions are unable to compete. All institutions ROA dropped in the period after 2007-2009 due to the GFC. As mentioned above, the non-interest/total income variable was shown to be the main difference between mean and median. This is further justified in Table 2, which observed that the big four banks' mean is at 45.19, with a median of 43.81. This is compared to regional banks (17.30, 16.03), credit unions (10.72, 11.02) and building societies (5.25, 5.24).

Finally, in Tables A1 and A2 (refer to Appendix) gives a breakdown of ROA and ROE variable for each category of institution per three-year period. Both variables demonstrate that all four institutions show a similar trend. The onset of the GFC period 2007-2009 shows a decrease in the mean of all banks, continuing into the post-GFC period, 2009-2011. The only differing factor is that the big four banks have shown improvements in the recent period of 2012-2014, in terms of both ROA and ROE has increased. Although both variables only marginally increase, it is noteworthy that the big four are only banks that are improving. On the contrary, regional banks, credit unions, and building societies are continuing to decrease due to the consequences of the increase in competition and further exits out of the industry.

Table 3. Data sample

	Mean	Min	Max	Median	Std dev.	Skewness
Panel A - Big four banks						
ROA	0.9307	0.5800	1.2100	0.9800	0.1503	-0.6847
ROE	15.5712	9.9700	21.7700	15.6750	2.8969	-0.0927
NIM	2.2777	1.8800	2.8400	2.2450	0.2494	0.4545
SPREAD	1.6907	0.9000	2.3900	1.7200	0.3690	-0.3633
NON-INT	45.1987	25.2400	71.6000	43.8100	9.9179	0.5359
OP INCOME	3.1080	1.9800	5.4900	3.0400	0.6859	1.1933
GROSS DIV	7.7770	5.9700	11.4200	7.4850	1.3209	0.9823
Panel B - Regional banks						
ROA	0.6076	1.1100	0.0500	0.6100	0.2110	-0.2249
ROE	7.8085	13.8400	0.4100	7.8100	2.7827	-0.3114
NIM	2.3139	3.8300	0.9700	2.3550	0.6073	0.0295
NON INT	17.3083	81.8400	11.2600	12.9900	16.0306	2.9325
OP INCOME	3.2672	15.1900	0.9700	2.9900	1.9795	4.4178
Panel C - Credit unions						
ROA	0.4207	1.0300	-0.4500	0.4050	0.2401	-0.0971
ROE	4.5143	10.6100	-7.0900	4.2750	2.7340	-0.2832
NIM	2.8516	5.2700	1.5700	2.6700	0.7789	0.9455
NON-INT	10.7246	22.3300	0.3200	11.0200	4.7729	-0.0221
OP INCOME	3.5486	6.6500	1.6800	3.4850	0.9843	0.6812
Panel D - Building societies						
ROA	0.5040	0.7900	0.2400	0.5000	0.1382	0.2474
ROE	7.4576	11.4300	4.4100	7.0100	1.9159	0.4805
NIM	2.1544	2.5500	1.4800	2.1150	0.2739	-0.4651
NON-INT	5.2543	6.5300	3.7200	5.2400	0.9652	-0.2546
OP INCOME	2.4368	2.9500	1.7200	2.4800	0.3605	-0.4208

4.2. Data analysis

In using MPI with DEA, it allows the breakdown of the causes of productivity and efficiency change over time. Technical change and technical efficiency change indices determine productivity improvements, whilst scale efficiency and pure technical efficiency indices determine overall efficiency change (Abbott, Wu, & Wang, 2013). The definition of these indices is presented in Table 4 below.

Table 4. Definition of MPI components

Notation	Variable name	Description
effch	Technical efficiency change	Technical efficiency change is the productivity growth change from efficiency improvement from the better use of available technology.
techch	Technical change	Technical change is the change where there is an increase in total outputs per unit of total factor input.
pech	Pure technical change	Pure technical change is the change between the firm's ratio of output to input compared to the ratio achieved by the best practice firm. Achieved through managerial factors and not scale efficiency factors.
sech	Scale efficiency change	Scale efficiency change is the change to a technologically optimum scale, thus scale efficiency change is the improvement in the scale of operations of a firm (Coelli et al., 2005a, 2005b).
tfpch	Total factor productivity	Total factor productivity is made up of the above four definitions and represents overall total factor productivity.

4.3. Malmquist productivity index (MPI) results

Table 5 illustrates the MPI mean for the total banking sector representing the four different sectors of Australian banks, which are: the big four banks, regional banks, credit unions, and building societies. It is noteworthy that constant returns to scale were used over the variables return to scale in this study, as articulated in the research methodology section.

Table 5. MPI mean for the total banking sector

	effch	techch	pech	sech	tfpch
mean	0.981	0.979	0.975	1.006	0.960

It is to note that data of the earlier years have not been publicly disclosed by institutions. Therefore, MPI was conducted for a comparable period between each banking sector from 2009-2014. The total sample size was 23 financial institutions and consisted of: the big 4 banks, 6 regional banks, 3 building societies, and 10 credit unions. At a glance, MPI results for the financial institutions representing the Australian banking sector shows that the value of MPI for the majority of the variables is below one. *Sech* is the only variable showing a marginal increase of 0.6%. It can be seen that the decreases in the mean value of *effch* (0.981), *techch* (0.979), *pech* (0.975) variables. These MPI results suggest that the government guaranteed scheme did not show major improvements over the sample period 2009-2014.

4.3.1. Sub sector

The MPI results above suggest that the government guaranteed scheme did not improve efficiency and productivity gains with the banking sector as a whole. Therefore, MPI is conducted into sub-sectors to observe if there are any changes. Table 6 below presents the mean difference for individual banking sectors.

Table 6. MPI mean differences for sub-sectors

	Time period	effch	techch	pech	sech	tfpch
Big 4	(2000-2014)	0.992	1.005	0.992	0.999	0.996
Regional banks	(2011-2014)	1.012	0.981	1.010	1.002	0.993
Credit unions	(2011-2014)	0.950	0.978	0.962	0.988	0.929
Building societies	(2009-2014)	0.998	1.028	1.000	0.998	1.026

The sample size consists of the big four banks, 16 Regional banks, 25 Credit unions, and 3 Building societies. It can be seen that from Table 6 results that a majority of the MPI values are below 1, thus indicating that efficiency has not improved. The largest increase can be seen for building societies of 2.8% in techch and the only banking sector that increases tfpch of 2.6%. The big four banks show an increase of 0.5%. Overall, regional banks and building societies have benefited the most for all banking sectors. Regional banks show small increases in *effch* (1.2%), *pech* (1%) and *sech* (0.2%). It is to note that whilst there are increases, they are marginal and not particularly significant.

4.3.2. Sub periods analysis

MPI was further conducted for the banking sector representing each sub-periods. The pre-GFC period from 2005-2007, during the GFC period from 2007-2009, and 2010-2014 represents the post-GFC period.

4.3.3. Pre-GFC (2005-2006)

The sample size consists of the big four banks, six regional banks, and two credit unions. Due to the unavailability of the data, the researcher was not able to obtain prior years' data for building societies. Therefore, MPI has been conducted for the other three banking sectors for the period of pre-GFC from 2005 to 2006. MPI results suggest that all three banking sectors increase in *techch*. The largest increase is 19.7% by the credit unions. Overall, *tfpch* observed in the six regional banks showed an increase of 12.3%. The big 4 banks increase 10.7% and credit unions increase by 9.3% during the GFC 2007-2009.

Table 7. MPI mean differences between banking sectors pre-GFC

	effch	techch	pech	sech	tfpch
Big 4	1.024	1.081	1.028	0.996	1.107
Regional banks	0.999	1.125	1.005	0.994	1.123
Credit unions	0.913	1.197	1.000	0.913	1.093

Table 8 illustrates MPI mean differences between banking sectors during the GFC. MPI results show that during the GFC most banking sectors underperformed for our sample industry. However, slight increases of 1.5% (*effch*) and 2.2% (*pech*) can be seen for Regional banks. The only other sector showing an increase is credit unions *sech* of 2.3%. Overall, all banking sectors were inefficient in *tfpch*.

Table 8. MPI mean differences between banking sectors during GFC

	effch	techch	pech	sech	tfpch
Big 4	0.986	0.889	1.000	0.986	0.877
Regional banks	1.015	0.857	1.022	0.993	0.870
Credit unions	0.930	0.900	0.909	1.023	0.837
Building societies	1.000	0.964	1.000	1.000	0.964

4.3.4. Post-GFC 2010-2014

The post-GFC MPI indicates that the banking sector with the most improvements is the credit unions with increases in all variables. Overall '*tfpch*' increase by 5.6%. The big four is the only other sector who improved with an increase of 3.6%.

Table 9. MPI mean differences between banking sectors post-GFC

	effch	techch	pech	sech	tfpch
Big 4	0.987	1.050	0.973	1.014	1.036
Regional banks	0.934	1.029	1.000	0.934	0.962
Credit unions	1.053	1.003	1.008	1.045	1.056
Building societies	0.971	1.023	0.992	0.979	0.994

5. CONCLUSION

The findings from this research suggest that the guaranteed scheme may not be the solution for the big four banks. Firstly, the assumption may be due to the oligopoly in the Australian banking sector, the large market share that these big four banks attain are 'too big to fail'. Thus, the assumption made by depositors that deposits are automatically guaranteed. Secondly, prior to the GFC, the big four banks were not reliant on local deposits. It was only until after the GFC that the big four banks started sourcing this type of funding. Contrary to the other institutions in the banking sector has shown signs of improvement. There are notable improvements in regional banks, building societies, and credit unions. Therefore, if deposit insurance was to be implemented, MPI findings from this study suggest the adoption of a permanent deposit insurance scheme would not be beneficial for all Australian Financial Institutions. Further, this research tests the following four hypotheses.

The findings from this research suggest that deposit insurance did not improve the Australian

financial system as a whole. Therefore, *H1* has been rejected. The big four banks did not show signs of improvement as discussed above; and in contrast, the smaller banking sector showed an increasing inefficiency. We also find evidence that bank efficiency marginally increased for smaller to medium-sized institutions. Therefore, we accept *H2* and reject *H3*. The results support this hypothesis as the efficiency of the big four banks did not increase. This suggests that the introduction of government guarantee schemes did not improve the efficiency or productivity of the big four banks.

This study attempts to contribute to the literature of deposit insurance from an Australian stance, as presently very little research has been conducted in this area. The empirical findings from this research seek to convey the importance of deposit insurance schemes which may need further attention. Future researchers can reflect on this research to foresee benefits and challenges associated with deposit insurance, be aware of potential structural changes arising from it and assess for Australia to impose deposit insurance permanently. Findings from this research also suggest that there is a relationship between deposit insurance and Australian financial institutions.

Although we could not identify a strong relationship, these MPI findings should be a catalyst for future research. Especially, if the Australian government decides to implement the proposal of a permanent deposit insurance scheme as recommended by the Murray Financial Inquiry. If the recommendation is adopted, it will be interesting to investigate how country-level characteristics, such as political differences, affect the support for deposit insurance in the respective countries. Future research needs to explore what the optimal level of deposit insurance in Australia should be, the type of deposit insurance best suited for a country.

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APPENDIX

Table A1. Return on asset per three-year period

ROA	Mean	Min	Max	Median	Std dev.	Skewness
Panel A - Big four banks						
2014-2012	0.9100	0.5900	-1.1100	0.9700	0.1493	-0.9694
2011-2009	0.8183	0.5800	-1.0200	0.8550	0.1487	-0.3569
2008-2006	0.9117	0.6400	-1.0700	0.9450	0.1358	-0.8182
2005-2004	0.9958	0.7600	-1.2100	1.0200	0.1354	-0.1097
2002-2000	1.0175	0.8100	-1.1800	1.0150	0.0808	-0.8083
Panel B - Regional banks						
2014-2012	0.5808	1.0100	0.0700	0.5800	0.1777	-0.1963
2011-2009	0.6350	1.1100	0.0500	0.6400	0.2372	-0.3974
Panel C - Credit unions						
2014-2012	0.3667	1.0300	-0.2000	0.3500	0.2062	0.2235
2011-2009	0.4771	1.0100	-0.4500	0.5000	0.2593	-0.5216
Panel D-Building societies						
2014-2012	0.4756	0.6200	0.4000	0.4400	0.0707	1.1318
2011-2009	0.5244	0.7900	0.2400	0.5400	0.1682	-0.1262
2008-2006	0.5143	0.7800	0.2600	0.5300	0.1540	0.0021

Table A2. Return on equity per three-year period

ROE	Mean	Min	Max	Median	Std dev.	Skewness
Panel A - Big four banks						
2014-2012	14.8017	10.8300	17.9600	15.0100	2.0901	-0.2297
2011-2009	13.9258	9.9700	18.6000	14.8300	2.5430	-0.0110
2008-2006	17.7017	11.4400	21.7700	18.1150	3.0849	-0.5370
2005-2003	14.9450	10.0500	17.3400	15.6750	2.2339	-1.0770
2002-2000	16.4817	10.0600	19.6500	17.2500	2.7491	-1.1164
Panel B - Regional banks						
2014-2012	7.1631	11.5500	1.0600	7.2900	2.2899	-0.1931
2011-2009	8.4668	13.8400	0.4100	8.6600	3.0716	-0.6884
Panel C - Credit unions						
2014-2012	3.9017	9.4100	-2.4300	3.8400	2.2395	0.0435
2011-2009	5.1544	10.6100	-7.0900	5.4000	3.0403	-0.7378
Panel D-Building societies						
2014-2012	6.4489	8.1000	4.4100	6.5500	1.2607	-0.2934
2011-2009	7.3833	11.4300	4.7800	6.4700	1.9721	0.9086
2008-2006	8.8500	10.8800	6.2000	8.5700	1.6769	-0.3476