An Analysis of Competition, Efficiency and Soundness in the South African Banking Sector

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Abstract

The main aim of this study was to investigate the relationship between competition and efficiency in the South African banking sector, then go further, and see how these variables affect bank soundness. Results show that the impact of competition on efficiency depends on the measure of competition used. When using the Lerner index there is a negative effect of competition on efficiency whilst the opposite is true when using the Boone indicator. In the case of bank soundness, our results are partly consistent with what other researchers have found. Thus, competition using the Boone indicator is negatively related to the Zscore implying that competition enhances bank soundness and these results support the Prudent and efficient management hypothesis

Keywords: Efficiency; Soundness; Competition and Banks
JEL: G2; D4

1 Introduction

Competition is the lifeblood of strong and effective markets, encourages firms to innovate, enhances productivity, and results in efficient allocation of resources. A competitive environment ensures that companies compete fairly and puts businesses under constant pressure to offer the best possible range of goods at the best possible prices. This makes competition the essential drive of productivity growth in any economy. In addition to improving quality, competition creates a wider choice for consumers and therefore by removing distortions to competition, we will reduce opportunities for corruption and rent seeking thus helping markets work better and maximizing economic benefits.

Industrial organization theory argues that the level of concentration in a market determines the degree of competition amongst firms. The Structure Conduct Performance (SCP) paradigm proposed by Bain (1951) argues that

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markets dominated by few large firms are less competitive than markets that are lowly concentrated. This implies that the higher the level of concentration in a market the lower the level of competition. However, the contestable market theory emphasize that a highly concentrated market can be highly competitive even if few firms dominate it (Baumol 1982). Thus, there is no strong theoretical support for the notion that in markets that are more concentrated, market power is higher and competition is lower. One undisputable fact however is that competition is important in enhancing efficient allocation of resources.

The theoretical literature is awash with a number of hypotheses that seek to explain the relationship between competition and efficiency (Hicks 1935; Demsetz 1973; Peltzman 1977; Liebenstein 1966). The quiet life hypothesis developed by Hicks (1935) argues that in highly concentrated markets, there is less pressure to compete, which results in reduced efforts by managers to operate efficiently. Thus increased market concentration weakens market competition and this affects productive efficiency. This hypothesis is synonymous with the competition efficiency hypothesis and argues that increases in competition precipitate increases in profit efficiency since banks are forced to engage in proper screening and monitoring of borrowers resulting in lower levels of non-performing loans (Williams, 2004, Schaeck and Cihak, 2008). Thus according to the quiet life hypothesis, increased competition improves efficiency implying that the relationship between these two variables is positive and runs from competition to efficiency. The efficient structure hypothesis proposed by Demsetz (1973) takes the argument further and argues that efficient banks will increase in market share and size at the expense of the inefficient banks, leading to higher market concentration. In this hypothesis, efficiency leads to higher concentration suggesting low levels of competition. The alternative to competition efficiency hypothesis is the competition inefficiency hypothesis that argues that competition leads to a decline in efficiency (Schaeck and Cihak, 2008). The argument is that higher competition is likely to be associated with unstable and shorter bank client relationships since clients tend to have a high propensity to switch to other service providers. This creates information asymmetry and require banks to spend more on screening and monitoring of borrowers. Banks in turn will likely reduce relationship-building programs and this affects the reusability and value of information. In this case, banks will incur greater expenses in keeping old and attracting new clients through investments into ATMs, new information systems and aggressive marketing (Schaeck and Cihak, 2008). In this case, competition reduces bank efficiency.

According to Simbanegavi et al (2015), a well-functioning banking sector contributes to economic growth via more efficient allocation of resources and risk diversification. The competitiveness and efficiency of the banking sector is critical to the wellbeing of the economy because it helps facilitate the efficient movement of funds from surplus to deficit units' thereby encouraging savings and optimal allocations of resources. A World Bank (2007) study also identified that lack of competition in banking is one of the aspects that is related to low efficiency of commercial banks in Africa. The study noted that interest rate spreads, profits and overhead costs are high in African banking compared to

other regions of the world. This competition efficiency nexus is of importance to South Africa given that the country's banking sector is dominated by four major banks that account for over 80% of total banking assets. Thus does this high level of concentration suggest low level of competition and hence inefficiency as per the quiet life hypothesis or the high levels of concentration in this market do not necessarily suggest lower levels of competition as per the contestable market theory. Given these conflicting theoretical positions, the objective of this study is to investigate empirically the nature of the relationship between competition and efficiency in the South African banking sector and look at how these variables ultimately affect bank soundness.

Although there are so many studies that have examined these relationships in the banking sector there is none on South Africa. Most of the studies on South Africa have looked at the competitive conditions in the banking sector, all finding that the sector is monopolistically competitive (Simbanegavi et al, 2015; Mlambo and Ncube,2011; Simatele, 2015) . If these competitive conditions are good, we expect to see an improvement in the level of efficiency and financial stability. No study has gone further to relate the competitive conditions to efficiency and soundness in the delivery of financial services in the sector. Our results show that the impact of competition on efficiency depends on the measure of competition used. When using the Lerner index there is a negative effect of competition on efficiency whilst the opposite is true when using the Boone indicator. In the case of bank soundness, the Boone indicator is negatively related to the Zscore implying that competition enhances bank soundness and these results support the Prudent and efficient management hypothesis.

This paper is organized as follows: The next section discusses some basic stylized facts about the South African banking sector whilst section two covers literature review followed by section three on methodology. Section four, covers results analysis and the last section then concludes the paper.

1.1 Some Stylized Facts About South African Banking

The South African banking system is well developed and effectively regulated, comprising a central bank, the South African Reserve Bank (SARB), few large, banks and investment institutions, and a number of smaller banks as well as lending and savings organisations (SARB, 2014). The banking sector is well developed and compares favourably with those of the developed world and ranked 11^{th} out of 138 countries in terms of financial market development in the Global Competitiveness survey. In terms of bank soundness, the country is ranked at number two out of 138 countries but ranked number 27 in terms of affordability of financial services. The financial sector together with real estate and business services for the past 10 years until 2016 has been contributing on average about 19% to GDP growing at 2.2% per year (Stats SA, 2017).

The banking sector is comprised of 64 institutions and close to half of these are foreign bank representatives with locally controlled banks constituting 16% of the total. The high number of players in the sector suggest an improved level of competitiveness in the market and this could be good for consumers. The

total banking assets have been increasing over the years, moving from 2.5 trillion rands in July 2008 to 5 trillion rands in the same month in 2017. Other banking depth indicators also show an improvement in financial deepening since year 2000. Bank deposits to GDP ratio increased from 50.1% in 2000 to 59.7% in 2015 and domestic credit to private sector as a percentage of GDP also increased to 147% from 130% for the same period. The same pattern is replicated when looking at broad money to GDP, which increased from 53% in 2000 to 74% in 2015 (see Table 2, below).

Banking structure indicators support some of the findings on competitiveness found by many researchers in the sector. The five banks concentration ratio calculated by the World Bank increased from 94.8% in 2000 to 98.99% in 2015 suggesting a heavily concentrated industry (See Gable 1 below). However, the intensity of competition is encouraging as the Panzar Rose H-statistic increased from 0.79 in 2010 to 0.86 in 2015 still supporting the generally held view that the sector is monopolistically competitive. The Lerner index moved from 0.22 in 2000 to 0.17 in 2010 whilst the Bonne indicator changed from -0.09 in 2000 to +0.03 in 2015 (See Table 1). The Lerner index suggest that there is some level of competitiveness in the banking sector but the Boone indicator suggest that the level of competitiveness is falling.

However looking at bank access and efficiency indicators calculated by the World Bank, bank-lending deposit spreads have been falling since 2000 and the same is true for bank non-interest income to total income. This could suggest that competitive conditions are intensifying or efficiency is improving resulting in banks reducing their prices. This trend is repeated even when looking at bank return on assets that have been falling since 2000. However, the bank Z-score values have been increasing supporting bank soundness and low risk profile of the sector. Finally in terms of access, the number of bank branches to 100 000 adults has been increasing gradually from 7.3 in 2005 to 10.5 in 2015 and ATMs per 100 000 adults also increased from 25.5 in 2005 to 69.3 in 2015 (see Table 1, below).

Given that the banking structure and efficiency indicators in Table 1 above point to improved levels of competition and efficiency, does this therefore suggest that there is a positive relationship between these two variables? Thus, given that Z-score values are increasing, does this mean competition or efficiency positively influence bank stability? These questions form the core objectives of this study.

2 Literature Review

A handful of studies have been done on the South African banking sector. These studies are of two strands: one strand looked at the competitive settings in the sector whilst another group analyzed efficiency conditions. Ncube (2009) used stochastic frontier analysis to calculate cost and profit efficiency of four large and four small banks in South Africa for the period 2000 to 2005. His results show that banks are generally 85% cost efficient with Investec being the most efficient

bank whilst Standard bank was the least. Profit efficiency levels were relatively lower at 55% for the banking sector with the most profit efficient banks being Capitec and standard bank with Nedbank and Absa being the least. Using the Krusral-Wallis ANOVA tests, he found that there has been a significant change in cost efficiency between these periods but no change in profit efficiency. A study by Erasmus and Makina (2014) analysed technical efficiency in the South African banking sector using the five largest banks. They used standard and alternative approaches to Data envelope analysis (DEA) and for the period before and after the financial crisis, that is 2006 to 2012. Their results show that Barclays bank and Nedbank were the most technically efficient banks using the two approaches and they conclude that the global financial crisis did not have a significant impact on the technical efficiency of the major banks in South Africa. The results found by Erasmus and Makina (2014) were contrary to those obtained by Maredza and Ikhide (2013). Using data for four largest commercial banks for the period 2000 to 2010 and calculating total factor productivity or efficiency using DEA's Hicks-Moorsteen index, Maredza and Ikhide (2013) found technical efficiency scores to have been affected by the financial crisis. Results from their stage two Tobit model showed that efficiency was 17% lower during the crisis compared to the pre-crisis period. Mlambo and Ncube (2011) carried out another study on South African banks where they analysed the evolution of competition and efficiency of 26 banks between the periods 1999 to 2008. Using DEA for measuring technical, allocative and cost efficiency and the Panzar Rose model for estimating competitive conditions, they found that even though the number of efficient banks was falling, average efficiency was increasing and the banking industry was monopolistic in nature. This study is an extension of what Mlambo and Ncube (2011) did and extends the analysis further by looking at the impact of competition and efficiency on bank soundness. Simbanegavi et al (2015) also tested for competition in the South African banking sector employing the Panzar Rose and the Bresnahan models and using a dataset of 14 banks over the period 1998 to 2008. They found the banking sector to be monopolistic in nature using the Panzar Rose model but could not reject the null hypothesis for perfect competition using the alternative Bresnahan approach. They conclude that these findings suggest that even though the banking sector is highly concentrated this has not affected competition in the sector. It appears that studies that have analysed the competitiveness of the South African banking sector using the Panzar Rose methodology arrive at the same conclusion. Simatele (2015) also used a time varying Panzar Rose methodology to examine the relationship between bank structure and competition in South Africa for the period 1997 to 2014. Using a dataset of 35 banks, she also found the sector to be monopolistically competitive confirming the results found by Mlambo and Ncube (2011) as well as Simbanegavi et al (2015).

In Africa, a number of studies have also investigated the relationship between competition and efficiency using various competition and efficiency measurement techniques and finding mixed results. A study that employed Data envelope analysis (DEA) done on Ghana by Alhassan and Ohene-Asare (2016) found competition to improve cost efficiency supporting the quiet life hypoth-

esis and similar results were found for the Middle East North Africa (MENA) region by Apergis and Polemis, (2016), concluding that increases in competition do not precede increases in cost efficiency. However Saka et al (2012) also using Data envelope analysis found that in Ghana competition improves technical efficiency supporting the efficient structure hypothesis. Their results were partly supported by Bucks and Mathisen (2005) who found that banks in Ghana behaved in non-competitive manner and this may not be good for financial intermediation efficiency. Sarpong-Kumankoma et al (2017) also looked at competition and bank efficiency in SSA, employing Stochastic Frontier Analysis (SFA) finding results inconsistent with the quiet life hypothesis. They found that increase in market power leads to greater bank cost efficiency, but the effect is weaker with higher levels of financial freedom. In the case of stability, Amidu and Wolfe (2013) analysed competition and stability in 55 emerging market countries of which 22 were from Africa including South Africa. Their core finding was that competition increases stability as diversification across and within both interest and non-interest income generating activities of banks increases. Their results show a positive and significant relationship between competition and stability supporting the competition stability view. Another study was done by Hope et al (2013) using ten African countries and they found that there is a robust positive relationship between market power and financial stability. This result suggests that there is a trade-off between bank competition and financial sector stability in these African countries, as per the competition-fragility view.

Studies on the relationship between competition and efficiency in the banking sector in non-African countries also abound. Most of these studies use granger causality tests to analyse the relationship between competition and efficiency. They only differ in the way they measure efficiency, one group of this literature uses Data Envelope Analysis (DEA) whilst another employ Stochastic Frontier Models (SFA). They all measure competition using non-structural measures like Panzar Rose H-statistics, Lerner index and the Boone indicator. Regardless of the efficiency technique used, there is no consensus on the nature of relationship between efficiency and competition. Rahim (2016) using Malaysian commercial banking sector found the same relationship as Schaeck and Cihak (2008) who used European and US banks. Rahim found a positive effect of competition on technical efficiency whilst Schaeck and Cihak found competition to be positively related to both profit and cost efficiency. Schaeck and Cihak (2008) also found that increased competition increases bank soundness via the efficiency channel. Casu and Girardone (2009) using banks from selected EU countries for the period 2000-2005 found a negative relationship between market power and efficiency and the same results were obtained by Fernandez de Guevara (2007) also using EU data for the period 1993-2002. The latter rejected the quiet life hypothesis in the same manner Podpiera et al (2007) rejected it using Czech Republic data for the period 1994-2005.

Using Stochastic Frontier Analysis, Fungacova et al (2013) studied whether bank competition is detrimental to efficiency in China using data for the period 2002-2011. Their finding is inconsistent with the "quiet life" hypothesis that market power has a negative impact on cost efficiency. Maudos and Solis

(2009) perform a similar analysis for Mexican banks by considering separately the Lerner index for deposits and loans. While they observe a negative link between competition and efficiency on the deposit market, they find an opposite result for the loan market. All these studies show that the relationship between competition and efficiency is not clear-cut and thus varies from one country to another.

3 Methodology

The approach followed in this paper is divided into three parts. We first measure the level of competition using the Lerner index and the Boone indicator, and after that we compute various efficiency scores (technical, cost and profit). Lastly, we then compute bank soundness using the Z-scores and non-performing loans.

3.1 Measuring Bank Competition

There are a number of techniques developed to measure competition in any industry. These measures are grouped into structural and non-structural and the former are based on the Structure Conduct Performance (SCP) paradigm developed by Mason (1939) and Bain (1951). The SCP model explains the aspects of conduct and performance of firms in terms of the structural characteristics of the markets in which they operate and argues that the more concentrated an industry is, the easier it is for firms to operate in an uncompetitive manner (Leon 2014). Structural measures include the number of firms, the concentration ratios, Herfindahl Hirschman index (HHI)[1]. The first generation of non-structural measures include the Lerner index developed in 1934 and the conjectural variation models like the Panzar Rose H statistic developed in 1987, Bresnahan-Lau test in 1982 and the Boone Indicator in 2008.

In this study since we are using bank level data, we use a measure of market power which is calculated at bank level like the Lerner index. This index captures the divergence between product prices and marginal cost of production. The price and marginal cost are equal in perfect competition but diverge in less competitive markets.

$$L_{it} = \frac{p_{it} - mc_{it}}{p_{it}} \tag{1}$$

where p_{it} is the output price of bank i at time t and is defined as total revenue[2] divided by total assets. Marginal cost is calculated by differentiating the translog cost function with one output (total assets) by output. This index ranges between zero and one, and a bigger wedge between price and marginal cost suggest greater market power. We can alternatively present this as follows so that it becomes clear how this index is calculated.

[1] For more information on these structural and non structural measures and their shortcomings see a paper by Leon (2014)

[2] Total revenue is equal to total interest and non-interest income

$L_{it} = \frac{P(Q) - C'_{q_i}(q_i, \omega_i)}{P(Q)}$, where q_i is the quantity produced by firm i, Q is total quantity and P(Q) is the market price. $C(q_i\, \omega_i)$ is the total costs of firm i and ω_i is the vector of the prices of inputs used. The differential of total costs with respect to q_i gives us marginal cost.

We follow the approach adopted by Fungacova et al (2013) by formulating a translog cost function where output is measured using total assets or loans and three input prices namely price of labour, price of borrowed funds and price of capital[3]. We also estimate one cost function for all the periods and symmetry and linear homogeneity restrictions in input prices are imposed. The translog cost function is specified as follows:

$$In\, TC_i = \beta_0 + \beta_1\, In\, q + \frac{1}{2}\beta_2 (In\, q)^2 + \sum_{j=1}^{3} \alpha_j In\, \omega_j + \sum_{j=1}^{3}\sum_{k=1}^{3} \alpha_{jk}\, In\, \omega_j\, In\, \omega_k + \sum_{j=1}^{3} \varphi_j\, In\, q\, In\, \omega_j + \varepsilon \tag{2}$$

where q is a measure of output and equal to total assets, ω is the price of inputs, with price of labour measured using the ratio of personnel expenses to total assets, the price of capital is ratio of other non-interest expenses to fixed assets and the price of borrowed funds is ratio of interest paid to total funding. Total cost is the sum of personnel expenses, other non-interest expenses and interest paid (Fungacova et al (2013). The coefficients of this cost function are used to compute marginal costs values as follows:

$$MC = \frac{TC}{q}\, (\beta_1 + \beta_2\, In\, q + \sum_{j=1}^{3} \varphi\, In\, \omega_j) \tag{3a}$$

Using marginal costs and price, we are able to calculate the Lerner index for each bank and for each year and thus obtain a direct bank level measure of competition. We also go further and use the adjusted Lerner index calculated as follows: $\frac{\mathrm{Pr}\, ofit + TC - MC*Q}{\mathrm{Pr}\, ofit + TC}$, where Q is total output. We also used the Boone indicator to measure market power and this index is argued to capture directly the relationship between competition and efficiency. The premise on which it

[3] This approach of determining inputs and outputs variables is based on the intermediation approach. In this approach banks are treated as collectors of funds, which are then intermediated to loans and other assets. The total balance of deposits and loans is used as a measure for outputs, while operating and interest costs are used to measure total costs. In the production approach a bank is viewed as a producer of deposits and loans using labour, capital and materials. The advocates of this approach use the number of accounts and loans outstanding as the bank's output (Zaim, 1995). Total costs include all operating costs incurred in the production of outputs. According to Kaparakis *et al* (1994), this approach seems more appropriate when the sample contains large banks, who fund a larger share of their assets from non-deposit sources. Berger & Humphrey (1997) suggest that the intermediation approach is best suited for analyzing firm level efficiency, while production approach is suited for measuring branch level efficiency, as at this level employees have little influence over funding and investment decisions (Ncube 2009).

is built is that more efficient banks attain better performance or higher profits and this outcome is increasing in the degree of competition (Schaeck and Cihak, 2008). It is modelled as a relationship between profits and marginal costs because an increase in costs reduces profits but in competitive markets the impact of changes in costs is huge since in this market inefficiency is heavily punished (Cummins et al, 2017). We construct this indicator from a regression model as follows:

$$\pi_{it} = \alpha + \beta \ln MC + \varepsilon_{it} \tag{3b}$$

Where π profit and MC is marginal costs. The parameter $\beta$is the Boone indicator and is expected to be negative showing that increases in competition raises profits of more efficient banks. We run this model for each year across all banks to estimate the Boone indicator parameter.

3.2 Measuring Efficiency in Banking

Efficiency measures used in banking analysis are varied. We have allocative efficiency, technical efficiency, cost efficiency and profit efficiency. Allocative efficiency is the extent to which resources are being allocated to the use with the highest expected value whilst a firm is technically efficient if it produces a given set of outputs using the smallest possible amount of inputs (Ncube 2009). A firm is also said to be cost efficient if it is both allocatively and technically efficient (Berger and Mester, 1997). Cost efficiency measures how close a bank is to its optimal cost when producing the same bundle of outputs (Fungacova et al, 2013). Profit efficiency measures how close a bank gets to the efficiency frontier, which denotes the maximum achievable profit, given a particular level of input and output prices (Berger and Mester, 1997). This profit measure takes into account performance from both the cost and revenue side of bank business and the argument is that profit efficiency is superior as it embraces cost efficiency (Schaeck and Cihak 2008).

In this study, we employ the stochastic frontier approach (SFA) to generate different efficiency scores (technical, cost and profit) for each bank in the sample during the period under analysis. We use the Battese and Coelli (1995) model that provides estimates of efficiency in a single-step in which bank effects are directly influenced by a number of variables and is assumed to be superior to a two-step procedure, in which the estimated efficiency scores obtained from the stochastic frontier are then regressed during a second step on a set of explanatory variables.

The Battese and Coelli (1995) model is expressed as follows:

$$Y_i \;=\; f\left(X_i\,;\,\beta\right)\;\exp\left(v_i \;-\; u_t\right) \tag{3}$$

Where $i$indicates firms, X is a set of inputs; β is a set of parameters, v_i is a two sided random error term assumed to be iid N(0, σ_v^2); u_i is a non-negative random variable representing inefficiency, independently distributed and truncated at zero $N(u_i;\sigma_u^2)$. The mean of this distribution is assumed to be a function of

a number of explanatory variables and given as $u_i = \delta_i Z_i$. This gives the following inefficiency term:

$$u_i = \delta Z_i + W_i \tag{4}$$

Where Z_i is a vector of variables that may affect firm efficiency, δ is also a vector of parameters to be estimated and W_i is a random variable defined by the truncation of the normal distribution with zero mean and constant variance (σ^2). In this case the point of truncation $-Z_i\delta$ is where $W_i > -Z_i\delta$. These assumptions are consistent with u_i being a non-negative truncation of the $N(Z_i\delta\,\sigma^2)$ distribution (Battese and Coelli, 1995).

The production function parameters β and the inefficiency coefficients δ_j are estimated using maximum likelihood techniques together with the following variance parameters:

$$\sigma_s^2 = \sigma_u^2 + \sigma_v^2 \text{ and } \gamma = {}^{\sigma_u^2}/_{\sigma_s^2} \tag{5}$$

Since technical efficiency is the ratio of observed production over the maximum possible technical output (a case of zero inefficiency), the efficiency measure TE of firm i in any period could be expressed as follows:

$$TE = \frac{f(X_i;\beta)\ \exp(v_i - u_i)}{f(X_i;\beta)\ \exp(v_i)} = \exp(-u_i) \tag{6}$$

The above efficiency scores will assume the value of one when the firm is fully efficient and less than one otherwise.

To estimate technical inefficiency scores we will use both a translog production function because of its flexible nature. The Stochastic frontier, translog production function to be estimated is specified as follows:

$$\begin{aligned}\ln Y_i = {} & \beta_0 + \beta_1 \ln L_i + \beta_2 \ln BF_i + \beta_3 \ln K_i + \beta_{11}(\ln L_i)^2 + \\ & \beta_{22}(\ln BF_i)^2 + \beta_{33}(\ln K_i)^2 + \beta_{12}(\ln L_i)(\ln BF_i) + \beta_{13}(\ln L_i) \\ & (\ln K_i) + \beta_{23}(\ln BF_i)(\ln K_i) + v_i - u_i\end{aligned} \tag{7}$$

Where K represents capital, L is labour and BF equals borrowed funds used in production. We assume a half-normal distribution for the inefficiency term. In the case of cost and profit efficiency, a translog function will be estimated as follows:

$$\ln C = f(w,z) + v_c - u_c \tag{8}$$

$$\ln(\pi + \theta) = f(w,\, z) + v_\pi - u_\pi \tag{9}$$

Where C is total cost and $w,$ and z are prices of inputs and output quantity respectively. π is profit and θ is a constant added to avoid taking the log of a negative number (in the case where profits are negative). v_i and u_i represent the white noise and the efficiency term respectively. We impose standard homogeneity conditions by scaling profits and cost functions with one of the input prices (borrowed funds).

The resulting efficiency effects are specified as follows:

$$u_i = \delta_0 + \delta_1 (Age) + \delta_2(Size) + \delta_3(Lerner) + \delta_4(Fowned) + W_i \quad (10)$$

Equation (4) and (5) will be estimated simultaneously using Frontier 4.1 model. The data used in this paper is sourced from BankScope and the South African Reserve Bank.

3.3 Measuring Bank Soundness

The standard approach used in the literature to measure soundness is to use the Zscore, calculated as follows:

$$Z = \frac{ROA + EAR}{\sigma ROA} \quad (11)$$

Where ROA is bank's return on assets, EAR is the equity to assets ratio whilst σROA is standard deviation of return on assets calculated over the sampling horizon. A higher Zscore implies a lower probability of insolvency (Schaeck and Cihak, 2008). We also alternatively measured soundness using non-performing loans.

3.4 Data

The bank level data used in this study was collected from BankScope and covers 17 local and international banks and spans the period 2004-2015. The sample size and period was influenced by the availability of comparable data on the variables of interest from BankScope. The sample included commercial banks, a mutual bank and an infrastructure bank. Our sample size is no different from the one used by Simbanegavi et al (2015) of 14 banks to ascertain the level of competition. The Bureau Van Dijk, which compiles Bankscope data, now publishes financial statements covering the past five years and this affected the inclusion of a number of banks in the study.

4 Results and Analysis

4.1 Descriptive or Stylized Facts About the Sampled Banks

The first part of this section computed competition and efficiency scores and a summary of these statistics is presented in tables 3,4 and 5 below. What is coming out clearly in these statistics is that efficiency levels are generally high above 80% and that these banks are more profit efficient than they are cost and technically efficient (see table 5). However, all these different measures of efficiency appear to have been decreasing over time, though the decline is marginal. There is also very little difference between the average efficiency levels of the big four banks and that of the 17 banks used in this study. This suggest that the computed efficiency scores are driven largely by the big four banks than

the other 13 small banks included in the sample. These results are similar to those found by Maredza and Ikhide (2013) using the four largest South African banks and technical efficiency scores of around 98%. Ncube (2009) using eight banks and Okeahalam (2006) using bank branches in all the nine South African provinces as well as Obeholzer and Westhuizen (2004) all found efficiency scores of 84%. Mlambo and Ncube (2012) using 25 banks found technical efficiency scores of around 67% and cost efficiency of 42%. The size of the sample and the sample period could be one of the reasons driving these differences in efficiency scores in these South African studies. In the case of competitiveness, the Lerner index show that competitiveness deteriorated between 2004 and 2007, improved during the periods 2008 to 2010 and 2014 to 2015. In the case of the Boone indicator, the more negative the value, the higher the degree of competition is, because the effect of reallocation is stronger. This indicator has consistently been more negative from 2011 until 2015, suggesting that competitive conditions improved during this period. In the case of competition, most studies on South Africa used country level indicators like the Panzar Rose (Mlambo and Ncube , 2011; Simatele, 2015, Simbanegavi etal, 2015) and the Bresnahan (Simbanegavi et al, 2015). However, statistics from Global Financial Development, (2017) show that using the Lerner index (period 2000-2010) suggest that there is some level of competitiveness in the banking sector but the Boone indicator (period 2000-2015) suggest that the level of competitiveness is falling.

The change in competitive conditions between 2004 and 2015 juxtaposed with the changes in efficiency levels over the same period show that the relationship between these two variables is not clear and is something that should be investigated using econometrics. We also went further and used descriptive statistics to explain how bank characteristics like age, size etc relate with bank efficiency and competitiveness. Table 5 shows that older and bigger banks (in terms of total assets) are less efficient than younger and smaller banks. Foreign owned banks are slightly more efficient than local banks. In terms of competition, banks whose total assets size is greater than R173100m have more market power than smaller banks and this is the case even when looking at locally owned banks. Banks older than the average age of 52 years appear to have less market power than younger banks[4].

The correlation matrix (see Table 10 appendix) also adds some insights into how these variables move together. The size and age variables appear to move negatively with all efficiency variables and this is the case with the competition indicators like the Lerner index. The Zscore, which is our measure of bank soundness, is positively correlated with efficiency variables suggesting prima facie that efficiency may be good for bank soundness.

[4] We used the bank size mean and bank age mean to divide the banks into small and large as well as older and younger respectively. The mean size using total assets was R173100m and the mean age was 52 years. There are no studies on South Africa that looked at these bank level characteristics to compare with.

4.2 Analysis of Regression Results

The first model looked at the relationship between technical efficiency and different indicators of competitiveness (see Table 6 above). We also included bank specific variables like age, size measured using total assets and a foreign ownership dummy. These results partly confirm what is presented under descriptive statistics above (Table 5) that larger banks are less efficient than smaller banks. Bank size has a consistently negative but significant relationship with technical efficiency. This this could be explained by the fact that small banks have to be very innovative in order to survive and be able to attract clients by offering products or financial services at prices below what big banks are charging. This probably explains why even though the South African banking sector is dominated by few large banks, this has never stopped new entrants into the sector. These results are contrary to what was found by Hauner and Peiris (2005) in Uganda, Ataullah et al. (2004) and Chen et al. (2005) but in line with what Isik and Hassan, (2003), Girardone et al., (2004) and Weill, (2004). Bank age also appears to have a negative and significant relationship with technical efficiency. Thus, older banks are less technically efficient than younger banks. In a highly concentrated banking environment like the one in South Africa, new banks can only enter and survive longer if they innovate or offer products that are not offered by the existing banks and if they offer the same products at lower prices. Albert (2015) however, found that age has a positive effect on efficiency using Egyptian banks whilst Karim et al (2010) found age to be positive and insignificant when related to efficiency and stability in Malaysia and Singapore. Being foreign owned does not appear to be important in enhancing technical efficiency in South Africa. This could be explained by the fact that foreign technologies have to be adapted to local conditions before they can be successfully implemented. Thus, you need to fully understand the local consumer market first before you can introduce new financial products or technologies. Foreign financial innovations or technologies may not be successful locally unless adapted to local conditions. This result however is not consistent with what Hauner and Peiris (2008) found in Uganda where efficiency was found to increase with foreign ownership. Karim et al (2010) found foreign ownership to be negative and insignificant when related to efficiency in Malaysia and Singapore.

To analyse the relationship between competition and efficiency, we used the Lerner index and the Boone indicator. Using the Lerner index, the results show a negative and significant relationship between these variables supporting the efficient structure hypothesis. This result is similar to that found by Casu and Girardone (2009) using EU banks. The Boone indicator and adjusted Lerner results however support the quiet life hypothesis and show a positive relationship between technical efficiency and competition. We also used the Generalised Methods of Moments model and the Instrumental variable technique to take care of possible endogeneity problems in the model. This is because the quiet life model hypothesize that competition increases efficiency whilst the competition-inefficient model assume that competition reduces efficiency. Results do not change much and still show a negative relationship between competition and

efficiency and the same pattern with other bank characteristics.

We followed the same approach as the one used in analysing technical efficiency in Table 6 above in analysing the determinants of cost and profit efficiency in the South African banking sector. The results (see Table 7, below) are generally similar to what we found under technical efficiency. Foreign ownership, bank size and bank age are all negatively related to cost and profit efficiency except that age is no longer statistically significant. The Lerner and adjusted Lerner indices are all significant and negatively related to these two efficiency variables whilst the Boone indicator still show a positive relationship. Thus using the Lerner indices, these results support the competition inefficiency hypothesis whilst the Boone indicator is in support of the quiet life hypothesis or the competition efficiency hypothesis. The relationship between competition and profit efficiency using the Boone indicator also support what Schaeck and Cihak (2008) refer to as the Competition-efficiency hypothesis, which is adapted from the efficient structure hypothesis proposed by Demesetz (1973). Under the competition-efficiency hypothesis, increases in competition precipitates increases in profit efficiency. On the contrary, the results using the Lerner index support the alternative, which they called the competition inefficiency hypothesis. In this case, competition leads to a decline in bank efficiency.

On Table 9 appendix, we also estimated a model using competition indicators as dependent variables. The results generally confirm what we found above that there is a negative relationship between competition and efficiency using the Lerner indices but a positive relationship using the Boone indicator. Thus, the Lerner index results support the efficient structure hypothesis that efficient banks reduces bank competition.

4.3 Competitions, Efficiency and Bank Soundness

The final section of this paper looks at the impact of competition and efficiency on bank soundness. We measure bank soundness here using Zscores. The objective is to find out which bank level characteristics affect bank stability. Schaeck and Cihak (2008) argue that the popularity of the Zscore as a measure of bank soundness stems from that fact that it combines bank's capital and profits with the risk they face in a way that is grounded in theory. The Zscore is inversely related to the probability of a financial institutions insolvency and the higher is this value, the lower the probability of insolvency. The other advantage with this measure is that it is easy to compute because it only require each bank's accounting information compared to market based measures such as distance to default. The impact of competition indicators is mixed. The Lerner indices show a positive and significant relationship with bank soundness whilst the impact using the Boone indicator is negative though insignificant. What is however coming out clearly in these results is that efficiency indicators have a positive and significant effect on bank soundness. This result support what is referred to in the Literature as the "prudent and efficient management hypothesis" (Petersen and Rajan, 1995; Schaeck and Cihak, 2008; Koetter and Porath, 2007). The argument is that more efficient banks have lower risks and are sounder

than their less efficient counterparts. The negative value of the Boone indicator and the positive value of the Lerner index support this hypothesis in this South African banking sample. Schaeck and Cihak (2008) using Europe and United States data as well as Cummins et al (2017) using European life insurance markets found similar results. Thus, an increase in the Lerner index signals a fall in the level of competition and since we found a negative relationship between competition and efficiency then this means increase in efficiency increases bank soundness. The negative and significant effect of the adjusted Lerner index supports the presence of what Scaheck and Cihak (2008) refer to as the "Poor and inefficient management hypothesis". In this hypothesis, competition adversely influences bank efficiency resulting in a negative effect on bank soundness. Thus if bank efficiency declines, these banks will do whatever it takes to retain old clients and attract new customers and by so doing may end up not employing sophisticated credit scoring systems and may also lack skills in assessing the value of collateral. This may result in a high proportion of non-performing loans and this negatively affect bank soundness (Schaeck and Cihak, 2008). Using non-performing loans (see Table 11 appendix) all competition and efficiency indicators show negative effect on stability partly supporting some of the results found using the Zscore values.

Bank age and foreign ownership variables are negatively related to Zscore but the effect is insignificant. However, in the case of bank size, there is a positive relationship and this is significant. This suggest that bigger banks have a lower probability of insolvency than smaller banks. Karim et al (2010) however, found age to be positive and foreign ownership to be negatively related to financial stability in Malaysia and Singapore. We also introduce two macroeconomic variables and they appear to carry expected signs. Inflation has a negative effect on the Zscore whilst GDP per capita carries a positive sign.

5 Conclusions

The main aim of this study was to investigate the relationship between competition and efficiency in the South African banking sector, then go further, and see how these variables affect bank soundness. Results show that the impact of competition on efficiency depends on the measure of competition used. When using the Lerner index there is a negative effect of competition on efficiency whilst the opposite is true when using the Boone indicator. Results also show that bank size measured using total assets is significantly negatively related to efficiency. In the case of bank soundness, our results are partly consistent with what other researchers (Schaeck and Cihak, 2008, Cummins et al, 2017) have found. Thus, competition using the Boone indicator is negatively related to the Zscore implying that competition enhances bank soundness and these results support the Prudent and efficient management hypothesis. This is also the case when using the Lerner index. Other macroeconomic variables used in the study also show consistent results. These results mean that the relationship between competition and efficiency in the South African banking sector supports the efficient

structure hypothesis and the competition inefficiency hypothesis when using the Lerner index but when using the Boone indicator results confirm the competition efficiency hypothesis or the quiet life hypothesis. Since the relationship between competition and bank soundness is generally unambiguous, there is therefore need for the regulatory authorities to weed out anti-competitive practices or barriers to entry into the banking sector. They should also ensure that the big four banks do not abuse their market dominance but contestable market conditions are promoted. For future research, it would be informative to examine non-linearities between competition and soundness to ascertain whether there is an inflection point as found by Fernandez and Grza-Garcia(2015), Berger et al (2009), Tabak et al(2012) and Fu et al (2014).

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Table 1: Main Banking Indicators

INDICATOR	2000	2005	2010	2015
BANKING STRUCTURE				
5 Bank concentration ratio (%)	94.84	99.46	99.3	98.99
H-Statistics	-	-	0.79	0.86
Lerner index	0.22	0.14	0.17	-
Boone indicator	-0.09	-0.18	-0.16	0.03
EFFICIENCY				
Bank lending deposit spread	5.3	4.58	3.37	3.26
Bank non-interest income to total income	31.87	48.89	47.37	5.51
Bank return on assets	1.59	1.55	0.95	0.92
Bank return on equity	9.46	27.39	14.35	15.05
Bank Z-score	21.27	12.28	13.02	13.93
ACCESS				
Bank branches per 100 000 adults	-	7.27	10.03	10.5
ATMs per 100 000 adults	-	25.53	56.83	69.28

Source: Global Financial Development 2017, South African Reserve Bank, 2017

Table 2: Financial Market Indicators

INDICATOR	2000	2005	2010	2015
Bank deposits to GDP (%)	50.14	52.19	59.16	59.71
Bank credit to Bank deposits (%)	129.62	122.75	121.30	111.00
Stock market capitalization to GDP (%)	160.55	194.61	247.77	245.42
Remittance inflows to GDP (%)	0.24	0.24	0.29	0.26
Liquid liabilities to GDP (%)	52.7	40.6	41.4	42.2
Private credit to GDP (%)	127.04	127.86	146.17	146.23
Domestic credit to private sector to GDP (%)	130.3	138.2	149.0	147.4
Broad money to GDP (%)	52.7	67.0	75.8	73.5

Source: Global Financial Development 2017, South African Reserve Bank

Table 3: Summary of statistics for all Banks

Variables	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Technical efficiency	91.28	91.19	91.06	90.87	90.66	90.53	90.43	90.33	90.18	90.09	89.88	89.82
Profit efficiency	97.40	97.42	97.33	97.22	97.09	96.91	96.87	96.60	96.59	96.71	96.37	96.32
Cost efficiency	90.87	90.78	90.74	90.71	90.74	90.51	90.28	90.07	89.92	89.92	89.66	89.64
Lerner index	0.095	0.122	0.137	0.147	0.121	0.113	0.107	0.127	0.160	0.167	0.166	0.121
Adjusted Lerner index	-0.055	0.094	0.116	0.117	0.079	0.044	0.041	0.067	0.077	-0.023	-1.171	-4.533
Boone indicator	-0.358	-1.007	-0.893	-1.141	-1.409	-0.757	-1.357	-0.976	-1.639	-2.065	-2.878	-4.814
Zscore	4.602	5.158	5.113	5.123	5.052	5.135	5.162	5.096	5.274	5.350	4.960	5.018

Source: Author's own calculation

Table 4: Summary of statistics for Big Four Banks (Standard Bank, Nedbank, ABSA/Barclays and FNB)

Variables	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Technical efficiency	87.24	87.11	86.88	86.71	86.53	86.59	86.53	86.45	86.38	86.31	86.22	86.11
Profit efficiency	94.96	94.81	94.67	94.68	94.71	94.71	94.51	94.38	94.30	94.19	94.15	94.08
Cost efficiency	87.51	87.31	87.14	87.08	87.02	87.01	86.79	86.66	86.58	86.47	86.42	86.33
Lerner index	0.129	0.133	0.175	0.174	0.157	0.161	0.177	0.187	0.223	0.236	0.230	0.118
Adjusted Lerner index	0.088	0.119	0.144	0.129	0.089	0.048	0.085	0.134	0.148	0.162	0.168	0.169
Boone indicator	-0.358	-1.007	-0.893	-1.141	-1.409	-0.758	-1.357	-0.976	-1.639	-1.065	-2.878	-4.813

Source: Author's own calculation

Table 5: Firm characteristics, efficiency and competition

	Size<173100	Size>173100	Age<52	Age>52	Foreign owned	Not Foreign owned	Average All Banks	Average Big 4 Banks
Technical efficiency	91.99	86.74	91.04	89.62	91.47	90.14	90.53	86.59
Profit efficiency	97.94	94.58	97.29	96.25	97.45	96.72	96.93	94.51
Cost efficiency	91.60	86.99	90.74	89.57	91.16	89.98	90.33	86.86
Lerner index	0.115	0.177	0.152	0.095	0.052	0.165	0.132	0.175
Adjusted Lerner index	-0.607	0.123	-0.647	0.032	0.015	-0.577	-0.405	0.124
Boone indicator	-1.586	-1.666	-1.608	-1.608	-1.629	-1.599	-1.608	-1.608
Zscore	5.192	4.813	5.196	4.89	5.112	5.076	5.087	4.802

Source: Author's own calculation

Table 6: Efficiency results

Dependent variable: Technical Efficiency	**(1)**	**(2)**	**(3)**	**(4)**	**GMM (5)**	**Instrumental Variable**
Foreign ownership	-0.018	-0.023	-0.040			-0.025
	(0.174)	(0.176)	(0.177)			(0.053)
Bank size	-0.787***	0.759***	-0.784***	-0.761***	-0.329***	-0.969***
	(0.027)	(0.029)	(0.027)	(0.029)	(0.047)	(0.010)
Bank age	-0.278***	-0.271***	-0.301***	-0.344***	-0.158*	-0.049**
	(0.069)	(0.071)	(0.069)	(0.074)	(0.094)	(0.024)
Lerner index	-0.451***				-0.232	-0.271**
	(0.131)				(0.176)	(0.126)
Boone		0.036***				
		(0.013)				
Adjusted Lerner index			0.005**			
			(0.002)			
Lerner index_1				-0.388***		
				(0.140)		
Tech efficiency_1					0.568***	
					(0.097)	
Tech efficiency_2					-0.031	
					(0.069)	
Time variable	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**200**	**200**	**200**	**184**	**151**	**184**
Number of Banks	**17**	**17**	**17**	**17**	**17**	**17**

Notes: The standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Cost and Profit efficiency determinants

Dependent variable	**Cost Efficiency**				**Profit efficiency**			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Foreign ownership	-0.171	-0.198	-0.213		-0.061	-0.066	-0.038	
	(0.344)	(0.358)	(0.361)		(0.149)	(0.151)	(0.146)	
Bank size	-0.719***	-0.676***	-0.709***	-0.714***	-0.558***	-0.591***	-0.602***	-0.582***
	(0.053)	(0.058)	(0.056)	(0.055)	(0.026)	(0.025)	(0.024)	(0.025)
Bank age	0.057	0.022	-0.051	-0.094	-0.014	-0.012	-0.022	-0.026
	(0.136)	(0.144)	(0.142)	(0.140)	(0.064)	(0.065)	(0.061)	(0.065)
Lerner index	-1.137***					-0.329**		
	(0.257)					(0.130)		
Boone indicator		0.051*			0.038***			
		(0.027)			(0.012)			
Adjusted Lerner index			-0.003				-0.709***	
			(0.005)				(0.162)	
Lerner Index_1				-0.807***				-0.394***
				(0.265)				(0.121)
Time variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	**200**	**200**	**200**	**200**	**184**	**184**	**184**	**170**
Number of banks	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**

***Notes*:** The standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Z-score results

Dependent variable: Log Zscore	**(1)**	**(2)**	**(3)**	**(4)**
Foreign ownership	-0.018	-0.084	-0.078	0.151
	(0.174)	(0.837)	(0.841)	(0.830)
Bank size	1.267***	0.7580**	0.716***	-0.687**
	(0.351)	(0.283)	(0.181)	(0.300)
Bank age	-0.329	- 0.537	-0.653**	-0.487
	(0.374)	(0.357)	(0.330)	(0.349)
Lerner index	1.500**			
	(0.722)			
Boone		-0.00009		
		(0.069)		
Adjusted Lerner index			1.880***	-0.573
			(0.311)	(0.979)
Technical efficiency	1.229***			-0.388
	(0.409)			(0.140)
Cost efficiency			0.515***	0.404*
			(0.175)	(0.209)
Profit efficiency		0.735*		0.125
		(0.437)		(0.513)
Inflation	-0.876*	-0.358	-0.468*	- 0.536****
	(0.410)	(0.291)	(0.210)	(0.087)
GDP per capita	1.354	0.986*	1.348	0.684***
	(0.985)	(0.436)	(0.876)	(0.045)
Time variable	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	
Observations	**207**	**204**	**207**	**204**
Number of Banks	**17**	**17**	**17**	**17**

***Notes*:** The standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX SECTION

Table 9: Competition results

Dependent variable:	Lerner	Boone	Adjusted Lerner
Foreign ownership	0.023	-0.311	0.687
	(0.085)	(0.950)	(5.403)
Bank size	-0.137***	0.348	4.204**
	(0.035)	(0.394)	(1.940)
Bank age	0.083**	-0.873**	-1.111
	(0.038)	(0.424)	(2.240)
Technical efficiency	-0.114**	0.274	6.958***
	(0.045)	(0.507)	(2.514)
Cost Efficiency	-0.060***	0.136	-2.169*
	(0.022)	(0.251)	(1.253)
Profit Efficiency	0.027	1.200	
	(0.054)	(0.601)**	
Time variable	Yes	Yes	Yes
Constant	Yes	Yes	Yes
Observations	**184**	**184**	**200**
Number of Banks	**17**	**17**	**17**

***Notes*:** The standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10 Correlation Matrix

	Fowned	ROA	Profit	Equity/assets	Age	Size	Lerner	AdjLerner	Z-score	TEfficiency	CEfficiency	PEfficiency
FOwned	1.000											
ROA	-0.220	1.000										
Profit	-0.078	-0.199	1.000									
Equity/Assets	-0.309	0.701	-0.338	1.000								
Age	-0.337	-0.292	0.605	-0.401	1.000							
Size	-0.085	-0.235	0.962	-0.365	0.603	1.000						
Lerner	-0.256	0.445	0.173	0.365	-0.097	0.143	1.000					
AdjLerner	-0.203	0.463	0.217	0.386	-0.129	0.158	0.829	1.000				
Z-score	0.044	-0.044	-0.129	0.035	-0.128	-0.138	-0.006	0.062	1.000			
TEfficiency	0.205	0.287	-0.837	0.395	-0.507	-0.869	-0.232	-0.202	0.140	1.000		
CEfficiency	0.215	0.149	-0.834	0.271	-0.475	-0.866	-0.345	-0.315	0.128	0.976	1.000	
PEfficiency	0.190	0.229	-0.832	0.331	-0.481	-0.863	-0.271	-0.243	0.137	0.989	0.986	1.000

Source: Author's own calculation using BankScope data. Fowned is foreign ownership; TEfficiency is technical efficiency, CEfficiency is cost efficiency and PEfficiency is profit efficiency

Table 11: Bank stability results using Non-performing loans (NPL)

Dependent variable: NPL	**(1)**	**(2)**	**(3)**	**(4)**
Foreign ownership	0.010	-0.024	-0.107	0.024
	(0.527)	(0.501)	(0.508)	(0.542)
Bank size	-0.049	0.224	0.398**	0.551***
	(0.195)	(0.181)	(0.172)	(0.084)
Bank age	-0.115	-0.296	-0.397*	0.097
	(0.217)	(0.210)	(0.216)	(0.214)
Lerner index	-2.199***			-1.855***
	(0.408)			(0.407)
Boone			-0.051	
			(0.042)	
Adjusted Lerner		-1.441**		
		(0.589)		
Technical efficiency	-0.762***			
	(0.225)			
Cost efficiency			-0.075	
			(0.118)	
Profit efficiency		-0.705***		
		(0.268)		
Constant	75.043***	72.263***	42.673	-0.405
	(22.346)	(27.585)	(27.159)	(0.593)
Observations	200	200	184	200

***Notes*:** The standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1