Competition & profit persistence in the South African Banking Sector

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Declaration

I, Katiso Letlaka, hereby declare that the compilation of this thesis is my own individual work and that it has not been submitted anywhere else. I have taken every reasonable step to acknowledge the contributions and efforts made by others by referencing the source of that literature. This thesis was compiled under the capable supervision of Professor Tendai Gwatidzo of the University of the Witwatersrand.

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Abstract

The objective of this paper is to determine the level of competition in the South African banking sector. This is achieved by answering two fundamental questions. Firstly, what is the level of competition in the South African banking sector? Secondly, is there profit persistence in this sector? We make use of panel data sourced from the Bankscope database. OLS, FE and GMM-SYS are used for estimation. Competition measures are split into two streams, the structural and the non-structural approaches. We follow the non-structural approach and outline two methods under this approach, namely the Lerner Index and the Boone Indicator. The innovation in this paper is bourne out of estimating the persistence of profits in the South African banking sector and then comparing the results with the already existing models in the literature. The main finding is that the South African banking sector exhibits low levels of competition. The 2008 financial crisis does not alter the main findings in any fundamental way. This supports the call for reform and better regulation in the South African banking sector.

KEYWORDS

Lerner Index, Boone Indicator, profit persistence, South African banking sector

JEL CLASSIFICATION

G21, C23, E52, F36, L16

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1. Introduction

1.1 Aim of the study

Competition is a fundamental concept of doing business in any sector of the economy across all economies of the world. It is a self-enforcing mechanism that ensures some semblance of parity is maintained in the course of conducting business. This is especially true in the financial sector, as this sector is the backbone of any economy. The banking sector in South Africa is dominated by the big four banks with these four banks enjoying over 80% (World Bank, 2018) of market share in the sector. This concentration does not in itself imply lack of competition but does warrant attention to be given to the concept of competition in the South African banking sector. The Banking sector is a very important sector in the economy as failures in this sector often have catastrophic consequences for the economy due to the negative spillover effects these failures have on other industries. The stability of the sector is of utmost importance to the relevant authorities as too much competition may lead to instability and too little competition may drive the price faced by the consumer up.

We hypothesize that there is a low level of competition in the South African banking sector thus prices are trending closer to a monopoly price. In this study we wish to answer two fundamental questions. Firstly, what is the level of competition in the South African banking sector? Secondly, is there profit persistence in this sector?

In answering these questions, we evaluate some of the currently available competition measures as well as introducing profit persistence as a measure of competition. There are two schools of thought that the current measures follow, a structural approach and a non-structural approach. Some of the leading literature in this area includes; Bain (2015), Demsetz (1973), Bresnahan (1982) and Boone (2008). The structural approach gives a measure of competition based on how the market is structured Leon (2015). It follows the Structure-Conduct-Performance (S-C-P) model which postulates that structure influences conduct of firms which in turn influences their performance. The S-C-P model posits that highly concentrated markets result in anti-competitive behaviour. Therefore, concentration is the central concept of the structural approach. The theoretical foundations of this approach have been criticized in literature[1]. The non-structural approach on the other hand provides a measure of competition

[1] See: Critique of structural approach in section 2.1.1.1

that is based on directly observing firm behaviour. This approach is more empirical in nature, which makes up for some of the shortcomings of the structural approach. We provide strengths and weaknesses of both approaches but focus on two of the non-structural measures. We pay extra attention to the static Lerner Index[2] and we also look at the dynamic Boone Indicator[3] in more detail in assessing the level of competition in the South African banking sector.

We tackle the question of profit persistence by following the First-order autoregressive model and unit root tests adopted in Bektas (2007). This helps us to arrive at a more robust estimate of competition in the South African banking sector. The use of the profit persistence model in the South African context is the main contribution of this paper. Efficiency is a very important consideration in the banking sector. The sector has undergone several changes over the past number of decades[4]. We have seen the sector open up to the foreign market and moves towards consolidation. Globalization has ensured that the product and geographical markets have been drastically altered over the same period. This has affected several parameters and more generally how business is being conducted in the banking sector. Operations, margins and ultimately profitability have been affected by all these changes. These parameters are our variables of interest when considering the persistence of profit. Static models only provide a part of the story about the level of competition. They don't capture the full picture as competition is a dynamic phenomenon[5]. The non-structural measures, especially the ones based on dynamic methodology like the "Boone Indicator" provide a better picture of the level of competition in this sector. Ultimately, we expect that the persistence of profits will provide a consolidated picture of the level of competition as this methodology captures the dynamic nature of the competition process. The persistence of profits could be an indication of a low level of competition or indeed some level of market power. Some factors that affect the persistence of profits include the high level of regulations which are often present in the banking sector. A competitive environment is characterized by the absence of barriers to entry, thus facilitating the convergence of prices down towards marginal costs and therefore leading to an increased competitive environment. Accordingly, the expectation is that there is high persistence in profits in this sector driven by the barriers to entry which emanate from the highly regulated environment in which banks operate.

[2] See: Berger et al, 2009; Fungacova et al, 2010; Fernandez de Guevara, 2005; Weill, 2013; Moyo, 2018
[3] See: Moyo, 2018; Schaeck & Cihak, 2014; Tan, 2017; Park, 2013 and Mamatzakis & Vu, 2018
[4] See: Simatele, 2015 & Wanke et al, 2017
[5] See: Leon,2015

1.2. Financial Crisis – Effects on South Africa

The period under review for this study is 2000 to 2015. We are particularly interested in the South African banking sector which is more connected to the global economy through the advent of globalization. The domestic sector is therefore affected by internal factors as well as external factors that occur outside the borders. One such factor was the 2008 financial crisis that sent shockwaves through the world economy.

The 2008 financial crisis had devastating effects on the world's financial system[6]. It plunged the top economies of the world into a recession which threatened to be sustained over a long period of time. Scholars argue that the crisis was caused by a burst in the housing bubble in the United States. Leading up to the crisis, the American economy experienced an environment of low lending rates which increased the demand for mortgages. Banks in the US therefore built up their balance sheets with these mortgages. This was prudent as long as these mortgages were backed by actual physical houses and for as long as house prices were rising. The US banks traded these mortgages in the secondary market as mortgage backed securities. "However, with the emergence of securitization, banks sold their mortgage assets to institutions that financed these purchases by issuing Mortgage-backed-securities (MBSs)" (Krankkala 2016). This practice exposed financial institutions across the world to this housing market and when the housing bubble burst in 2007 the underlying value of these securities declined therefore driving significant losses across global markets.

The South African banking market was largely insulated from these negative effects due to the highly regulated environment the local banks operate under. The sector was therefore not directly affected by the crisis as the local banks were prohibited from the participation in mortgage-backed-securities. However, the sector was not insulated from the indirect effect of the recession that followed the financial crisis. The decrease in demand and activity would have thus affected the behavior of banks and thus competition. The timing of the financial crisis influenced how we conducted the analysis for this study and ultimately how we reported the results.

[6] See: Krankkala 2016

1.3. Hypotheses

The South African banking sector is highly regulated and exhibits high levels of concentration thus we expect these factors to increase the barriers to entry and by extension lead to low levels of competition. We thus hypothesize that the South African banking sector is characterized by a low level of competition.

1.4. Historical Context of South African Banking Sector

Verhoef (2009) gives an account of the persistent nature of concentration in the South African banking system. This paper is concerned specifically with the period between 1970 and 2007. Verhoef (2009) does however provide historical context of this sector prior to 1970.

Post 1860, Imperial banks dominated the South African Banking landscape. The main banks in that period were The London and South Africa Bank, Standard Bank, Bank of Africa and National Bank. This domination endured despite local banks being permitted to enter the South African banking market earlier in that century. Local banks had entered this sector on the back of a growing agricultural sector. The local banks were driven out of the market by consecutive banking crises that were seen in the South African Banking sector in the latter part of the 19th century. Following the formation of the Union of South Africa in 1910, the South African banking sector started to experience an environment that encouraged concentration. First, the National Bank acquired the Natal Bank, the National Bank of the Orange Free State and the Bank of Africa while Standard Bank acquired the African Banking Corporation. Barclays Bank subsequently acquired the National Bank in 1926.

In 1910, four Imperial banks held almost 90% of the market share in the sector (Verhoef, 2009). These banks were Standard Bank, Bank of Africa, African Banking Corporation and the Netherland Bank. By 1970, this pattern had remained constant with Standard Bank, Barclays Bank, Netherlands Bank and Volkskas holding around 90% of total bank capital in the sector. These concentration patterns have persisted well into contemporary times with Standard Bank, Absa, First National Bank and Nedbank dominating the market share in the sector. This evolution highlights the fact that market share has been concentrated in the hands of a few banks since the 1800's all the way through to present day.

The concentration trends in the South African Banking sector generally track the concentration trends in global banking markets. International banking markets gravitated towards

concentration post the collapse of the fixed exchange rate regimes in the 1970s[7]. Increased export markets coupled with more flexible exchange rate regimes necessitated less government intervention and more deregulation in the international trade market. Deregulation led to a globalized world requiring financial institutions to play a bigger intermediation role as lenders and borrowers stretched beyond domestic borders. Banks started to set up offices in foreign markets, which led to increase in mergers and acquisitions (M&A) in the banking sector.

Carletti and Vives (2008) note that the banking sector has experienced high levels of consolidation over the past two decades. They point out that the number of M&A have increased in number and size in most European countries. This increase has resulted in high levels of concentration in the banking sectors of European countries. Fazio (2003) finds an increase in M&A activity in the banking sector, which ultimately leads to more concentration. Bank M&A accounted for 10.1% of total M&A activity and 18.2% of the value, in the USA, by the end of the 1990s (Fazio, 2003).

1.5. Overview of South African Banking Sector

Banks act as intermediaries between depositors and lenders. The provision of loans and deposits differentiates banks from other financial services institutions. Banks make their profits, inter alia, from the interest rate spread between the loan rate and the deposit rate. The second core function of a bank is to provide liquidity to its customers (Heffernan, 2005).

The South African banking sector is one of the more sophisticated banking sectors in the world. It is well developed and competes with banking sectors in developed countries. The global competitive index placed the sector in "12th position out of 140 countries surveyed" (Wanke et al ,2017). The banking sector currently has 19 domestic commercial banks, 15 local branches of foreign banks, 3 mutual banks and 3 cooperative banks (SARB Annual Report, 2017). Figure 1 displays the number of local and foreign banks for the period between 2006 and 2015. The South African Reserve Bank is the lender of last resort and the duty of being the regulatory and prudential authority over banks in the sector (Falkena et al, 2004).

[7] See: Verhoef, 2009

The South African banking sector is dominated by four big banks (Standard Bank, ABSA, Nedbank and FNB). This has been the case for at least the past two decades. Falkena et al (2004) find that the same banks are the largest banks measured by deposits.

Table 1: Number of registered banks (2006-2015)

Source: Wanke et al (2017); SARB Annual Report (2015)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Domestic Banks	19	19	19	18	17	17	17	17	17	17
Local Branches of foreign banks	14	14	14	13	13	12	14	14	14	15
Representative offices	43	46	43	42	41	43	41	43	40	40

The banking sector in South Africa is highly concentrated in these big four banks. This level of concentration has drawn the attention of policymakers who are interested in finding out what the effects of this high concentration are. The National Treasury and South African Reserve Bank jointly commissioned an enquiry into the phenomenon in the early 2000s. The commission produced a report in 2004 called "Competition in South African banking" which made a number of findings amongst which the South African banking sector exhibits an oligopolistic market structure with some indications of anti-competitive behavior (Falkena et al, 2004).

The Competition Commission commissioned its own enquiry which produced a report in 2008 which found that South African banks are not in a cartel but do exhibit levels of anti-competitive behaviour. Complex pricing structures were found to lock in clients to certain service providers resulting in maintained anti-competitiveness in the sector (Simatele, 2015).

Concentration decreased when foreign banks were allowed to enter the South African banking market (Simatele, 2015). Table 2 shows that foreign banks, as a percentage of total South African banks, increased from 13% to 24% between 2000 and 2013. This entry by foreign banks was largely driven by the regulation restructure post 1994 which brought about more liberal policies. Several small banks entered the market post 1994, with a number of them either exiting the market or being taken over by the larger, more established banks. "The sector has experienced rapid entry of banks into the industry post-apartheid between 1994 and 1999." Simatele (2015). Simatele (2015) goes on to say that "22 of these banks exited the industry between 1999 and 2003", citing liquidity issues. Foreign interest in local banks rose. Barclays

Bank PLC, a British bank, had a 62.32% shareholding in ABSA in 2013 before divesting in the bank in later years (Barclays Africa Group Limited Integrated Report, 2013).

Table 2: South African Banking Indicators (2004 – 2011)

	2004	2005	2006	2007	2008	2009	2010	2011
Foreign Banks/Total SA	17%	21%	22%	22%	23%	23%	24%	24%
Concentration ratio (CR3)	100%	79%	76%	77%	78%	76%	79%	78%
Regulatory Tier 1 Capital to RWA					11%	12%	12%	13%
ROE	31%	27%	25%	26%	20%	15%	14%	16%
Bank Lending Deposit Spread	5%	5%	4%	4%	4%	3%	3%	3%
Cost to Income Ratio	64%	64%	59%	55%	50%	52%	58%	58%
Deposits /GDP (%)	31%	27%	25%	26%	20%	15%	14%	16%
Credit to Private sector/GDP	57%	61%	69%	75%	79%	76%	72%	68%

Source: World Bank; Bank for International Settlements; International Monetary Fund: retrieved from FRED, Federal Reserve Bank of St. Louis

Table 2 displays some key indicators in the South African banking industry. An extended version of Table 2 is provided for in appendix D, Table 1. Table 2 shows that the concentration ratio was averaging around 79% for the period under review.

South Africa has been experiencing a sustained period of low economic growth post the 2008 financial crisis. This was largely driven by the depressed demand and declining commodity prices. The South African banking Sector is central to the South African economy. This is seen through the levels of credit that is provided to the private sector. Table 2 shows that banks are a major credit provider to the private sector. The South African banking sector plays a critical role in the domestic credit market (Simbanegavi et al, 2015). The credit to private sector as a percentage of GDP reached a high of 79% in 2008. Credit provision can boost economic growth by enhancing consumption and stimulating investments. The South African banking sector has remained profitable after the financial crisis.

The return on equity (ROE) was very high immediately before the crisis, reaching a high of 31% before tapering off to an average of 14% after the crisis (World Bank). The spread between the lending and deposit rate has gradually narrowed from 5% in 2000 to 3% in 2015. This has been driven partly by the increased operational costs that came with implementation of more stringent regulations in the industry after the crisis. The cost to income ratio, which is a measure of a bank's efficiency, initially declined prior to 2008 to a level of 50% before gradually rising to 57% in 2014. Deposits as a percentage of GDP increased leading up to 2008, as market

participants were bullish about the South African economy, before declining in the aftermath of the financial crisis.

The sector is highly regulated due to its importance in the South African economy. The objective of the regulation is partly to ensure there is stability in the sector and partly to foster more competitive conditions in the sector. Some of the key banking sector reforms that took place between the year 2000 and 2006 include; "In 2001 Basel 1 increased the minimum capital requirements that should be held by banks from 8% to 10%. The Financial Intelligence Centre Act was introduced, to verify customer identities, in 2003. The South African market was opened to foreign banks in 2005. The National Credit Act was introduced in 2006 to enable all South Africans to have access to credit at affordable rates." Kasekende et al (2009)

There are several statutes that govern the sector including the King report for corporate governance and Basel III which focuses on the capital requirements. Table 2 shows that the Tier 1 Regulatory capital as a ratio to risk weighted assets increase from 11% in 2008 to 13% in 2015. This means that banks have increased the amount of money they hold as regulatory capital over time. This would have increased the barriers to entry for potential entrants as well as squeeze banks who were operating on the margins.

The paper is structured as follows: Section 2 we present the literature review. Section 3 outlines the data and methodology where the model is initially derived followed by an overview of the data sample and variables. Section 4 presents the diagnostic tests and the results and analysis for all three models.

2. Literature Review

Banking and competition are topics that have captivated scholars for several decades[8]. The oligopoly nature of how banks present themselves is what has attracted researchers to this topic. Microeconomic theory involves the study of individuals' behaviour and small groupings such as family, government agencies and firms (Cooter & Ulen, 2016). It looks at dynamic optimization and decision-making of all these agents, which entails the allocation of finite resources to infinite needs. Microeconomic concepts include consumer theory, production choices of firms as well as welfare economics among others.

[8] See Bain (1951); Demsetz (1973); Bikker et al, (2006) for the leading literature in this area.

Welfare economics studies the organization of markets and how they achieve efficiencies (Cooter & Ulen, 2016). The concept of general equilibrium, a state in which all markets clear simultaneously, is highlighted. There are market failures that obstruct the attainment of this general equilibrium. The source of these market failures includes monopoly and market power, externalities, public goods and excessive asymmetric information (Cooter & Ulen, 2016). The study of banks and competition falls within microeconomic theory, under the concepts of welfare economics and firm production choices.

This topic has been covered extensively in various ways in the past. Most of the research covering the trade-off between competition and bank stability as well as competition and efficiencies (Xiaoqing et al, 2014; Schaeck & Cihak, 2014). There is a myriad of literature that covers the measurement of competition of banks within and across countries. The literature covers the structural and the non-structural approaches to banking sector competition in the South African context. The literature also indicates that there is room for profit persistence as a measurement of bank competition and as such is gaining traction internationally However, as far as I am aware, it has not been used to measure the extent of competition in the South African banking sector. The contribution of this paper is primarily borne from the use of profit persistence to measure the extent of bank competition in South Africa.

In this section we cover the structural approach, the non-structural approach as well as the persistence of profit framework. We give a brief background to all three concepts before expanding on all of them.

Competition measures are generally split into two streams, the structural and the non-structural approaches. In the structural approach, competition is based on how the market is structured and concentration is central to this methodology. It looks at issues such as level of concentration, the number of banks and market share amongst others. The two main theories under this approach is the Structure-Conduct-Performance (SCP) framework as well as the Efficiency Hypothesis. The SCP framework posits that the conduct and by extension, the performance of a firm are driven by the underlying structure. Under SCP concentration encourages collusion which leads to enhanced performance (Bikker and Haaf, 2002). Scholars have criticized the structural approach on the basis that concentration does not necessarily imply competition. The linkages between structure, conduct and performance have been called into question.

The source of concentration under SCP is market power and thus is anti-competitive (Bain, 1951) while efficient market theorists suggest that concentration emanates from firm efficiencies (Demsetz, 1973; Simrlock, 1985). Therefore, these competing theories lead to inconclusive outcomes about the drivers of concentration. These inconsistencies and contradictions ultimately lead to ambiguous interpretations of econometric results with each side being able to correctly provide evidence of their position on the source of concentration.

2.1. Theoretical Framework

2.1.1 Structural Measures

The structural approach seeks to describe conduct as well as performance based on the structure of the market in question. It can be broken down into two theories, the SCP framework and the Efficiency Hypothesis. The central concept in the structural approach is the level of concentration. SCP hypothesizes that the high levels of concentration influence banks to engage in collusive conduct with the aim of earning high profits (Bikker and Haaf, 2002). The latter theory suggests that concentration arises from efficient production by firms. The SCP framework "states that in highly concentrated markets, banks use their market power to increase lending rates and decrease deposit rates leading to low levels of competition." (Simbanegavi et al, 2015). The SCP framework therefore assumes structure is exogenously determined and the causal relationship flows in one direction from structure to conduct to performance. The Efficiency Hypothesis suggests a causal relation in the opposite direction from performance to structure. It suggests that a firm that creates efficiencies in the production process, which will reduce costs, will have the ability to drive out less efficient firms and thus increase the firm's market share.

Concentration plays a major role in the structural approach thus competition measures in this approach will be centered on the measurement of concentration. There are several concentration measures starting from the informal number of banks to the more formal concentration ratios through to the Herfindahl-Hirschman Index.

The number of banks is the easiest concentration measure to compute. However, this measure does not account for distribution of banks in the market and thus produces an unreliable measure of concentration. This measure thus does not feature much in literature. The

Concentration Ratio on the other hand is quoted in a lot of literature because of its arithmetic simplicity. This ratio measures the market share for a specified number of firms (k firms) in a sector. It is given by the below formula:

$$CR_k = \sum_{i=1}^{k} Si$$

Where Si = market share of i^{th} firm

k = number of firms specified

The concentration ratio ranges between zero and one with zero indicating no concentration and one indicating one firm with total market share. One weakness of this measure is that there is no scientific way of assigning k as k arbitrarily chosen. The measure also does not factor in firms that have been left out of calculation.

The Herfindahl-Hirschman Index (HHI)[9] is the concentration measure most widely used both in literature and by competition agencies. The HHI is a better measure than the CR_k measure because it accounts for all the firms in the market. The HHI captures the entire distribution of firm sizes in the market. It is a summation of the market share of all banks squared and takes the following form:

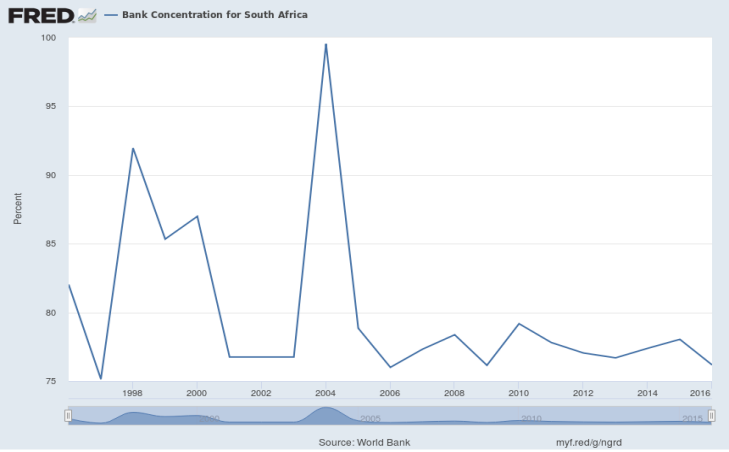
$$HHI = \sum_{i=1}^{N} S\,i^2$$

Where Si = market share of i^{th} firm

n = number of firms

[9] We follow the derivation as in Leon, F. (2015)

Figure 1: Bank Concentration for three largest banks in South Africa



Source: Federal Reserve Economic Data

2.1.1.1. Critique of Structural Approach

The advantages of the structural approach lie only in its computational simplicity and low data requirements. However, the approach is dominated by several shortcomings, which has led to several researchers to criticize the use of this approach. Molyneux (1999) suggests that concentration is becoming less relevant with regards to competition policy as the number and type of financial service providers increase.

Researchers' have critiqued the linkages between structure, conduct and performance. They argue that these relationships are not unidirectional. The Efficiency Hypothesis can lead performance to determine structure. This means concentration measures are not exogenous. The link between conduct and performance is said to be weak (Simbanegavi et al, 2015), thus the structural approach is criticized based on theoretical and empirical grounds.

2.1.2. Non-structural Approach

The non-structural approach was created to close the gaps, contradictions and inconsistencies found in the structural approach. The approach is located in the New Empirical Industrial Organization literature and evaluates the degree of competition without assuming a relationship between market structure and performance (Bikker and Haaf, 2002). This approach uses empirical data to draw conclusions about the level of competition. Inference about competition is made by directly observing the behaviour of firms. There are static measures as well as

dynamic measures in this approach. The non-structural measure includes, but is not limited to, the following measures; the Lerner-Index, the Panzar and Rosse H-statistic, conjectural variation parameter and the Boone Indicator. The most widely used measures being the Lerner Index (Sanya and Gaertner, 2012; Weill 2013; Elzinga et al,2011) as well as the Panzar and Rosse H-statistic (Simbanegavi et al 2015; Weill 2013; Molyneux et al 1993; Apergis et al 2016).

This paper makes use of two of these methods in measuring the extent of competition in the South African banking sector. We use the static Lerner Index as well as the dynamic Boone Indicator.

2.1.2.1. Lerner Index

The Lerner Index captures the degree of market power possessed by a firm. It is a bank-specific measure that is calculated by taking the difference between price and marginal cost as a percentage of price. The index therefore ranges between 0 and 1. Where 0 represents perfect competition (price = marginal cost) and high values symbolize higher market power (Sanya and Gaertner, 2012). The Lerner Index is calculated as follows:

$$L_{it} = \frac{P(Q) - C'q_i(q_i\omega_i)}{P(Q)}$$

Where $P(Q)$ = market price

$C'q_i(q_i\omega_i)$ = marginal cost

Subscript i denotes bank i and subscript t denotes year t

The Lerner Index will thus be calculated for different banks in the sector over time. This will facilitate a comparative study of the degree of competition as well as provide a trend analysis over time. This will provide some insights into the evolution of the degree of competition over the period in question, especially because the data covers the pre and post 2008 financial crises period.

2.1.2.2. Boone Indicator

The Boone Indicator employed in this study is a bank level indicator that is premised on the efficient structure hypothesis highlighted in Boone (2008). The Boone indicator has several advantages over other measures of competition as it incorporates the theory of contestability which factors in barriers to entry in its computation (Boone, 2008). The Boone indicator is based on the notion that firms with lower marginal cost tend to obtain higher profits and market shares (Park, 2013). The lower costs are assumed to be driven by the firm's higher level of efficiencies. One weakness of the Boone indicator is that it does not control for other factors that drive profits. The Boone Indicator can have both positive and negative values, with negative values representing higher levels of competition (Tan, 2017).

Boone, 2008 specified the below model to measure market power.

$$ln\pi_{it} = \alpha + \beta_i lnMC_{it} + \varepsilon_{it}$$

where π_{it} = profit

MC_{it} = marginal costs

β_i = profit elasticity

The profit elasticity β gives the Boone indicator which captures the degree of market power. The profit elasticity β is expected to be negative because as marginal cost decreases, profits are expected to increase. The sign thus captures this negative relationship between profits and costs. The magnitude of the profit elasticity β is expected to be higher for higher levels of competition (Park, 2013). The computation of the marginal cost follows the method employed in several studies which makes use of the translog cost function of inputs and outputs.

2.1.3. Profit Persistence

Profit persistence literature is grounded in the work of Mueller (1977) and has been used to evaluate the dynamic nature of competition. Mueller (1977) viewed competition as a dynamic process, a tool that is used to transform resources into new products and production techniques. This method has largely been employed in the manufacturing sector but has recently started to

gain prominence in the banking industry. The intuition behind this method is based on the Schumpeterian perspective of the "process of creative destruction"[10]. Low levels of profit persistence reflect a high degree of competition. This is driven by competitors being able to imitate the activities that led a firm to earn higher profits thus driving the price back to marginal cost. The method is also underpinned by the theory of contestability which advocates for the free entry and exit of firms in an industry. This allows new firms to enter the market during periods of higher profitability resulting in the erosion of abnormal profits.

The model for the profit persistence is outlined below and expanded upon in the methodology section.

$$\pi_{i,t} = \alpha_i + \lambda_i \pi_{i,t-1} + \mu_{i,t}$$

Where $\pi_{i,t}$ = bank i's long run average normalized profit in time t

$\pi_{i,t-1}$ = bank i's long run average normalized profit in time t-1

λ_i = speed of adjustment / intensity of competition

2.2. Empirical Evidence

Bikker et al, (2006) show that large banks tend to control a greater market share. Therefore, economies with large banks tend to be characterized by high levels of concentration. South Africa is dominated by four big commercial banks (Standard Bank, First National Bank, ABSA and Nedbank), a couple of midsize banks and a myriad of smaller sized banks. The concentration levels in the South African banking sector confirm the findings of Bikker et al, (2006), as the big four banks have a collective market share of around 80% (World Bank, 2018).

The structural approach owes its origins to Bain (1951) who was a proponent of the structure conduct performance approach which evaluated the levels of competition based on the prevailing market structure. Concentration was a product of market power and thus increases in profits were a product of anti-competitive behaviour.

[10] See: Gaffard (2008)

Demsetz (1973) provided an alternative interpretation to the concept of concentration. He looked at the concentration- profitability relationship and concluded that efficiencies drive superior profits of large firms and not market power. These efficiencies ultimately lead these firms to accumulate market share which increases concentration. These ambiguities, contradictions and inconsistencies in interpretations propelled some scholars to discourage the use of the structural approaches.

Bikker and Haaf (2002) find that defining a market is a difficult exercise and therefore argue against structural measures of competition. Shaffer (1982) highlights the contestability theory which is not incorporated in the structural approach. He highlights the fact that potential entry constrains prices thus the contestability theory makes the dominance concentration argument irrelevant.

Researchers have resorted to using the non-structural approach to evaluate the levels of competition. These researchers include, but are not limited to; Weill (2013), Sanya and Gaertner (2012), Simbanegavi et al, (2015), Simatele (2015), Mlambo et al (2011). We briefly look at these studies in the following section.

Weill (2013) employs the Lerner Index as well as the Panzar and Rosse H-statistic to evaluate the evolution of bank level competition in all European Union countries in the 2000s. They find that competition has not increased under both measures in the period under review.

Sanya and Gaertner (2012) analyze the competitiveness of the banking system of 4 countries in the East African Community (EAC) using both the Lerner index as well as the Panzar and Rosse H-statistic for the period 2001-2008. They find low levels of competition due to socio economic factors such as levels of economic development and population sizes. The H-statistic shows that the EAC exhibits characteristics of monopolistic competition.

Simbanegavi et al (2015) were pre-occupied with testing for competition in the South African banking sector. They used two non-structural measures for period 1998 – 2008 to achieve their objective. The measures they use are the Panzar and Rosse model as well as the Bresnahan model. The Panzar and Rosse model measures competition by determining the impact on a bank's revenue from changes in the input prices. Noting that the input prices for banks include deposits, capital expenditure and wages, the Panzar and Rosse computes the elasticity of a bank's revenue to these input prices. The Bresnahan model measure competition by determining the degree of market power in the sector. The study makes use of financial statement data obtained from the South African Reserve Bank as well as macroeconomic data

obtained from the International Monetary Fund's International Financial Statistics (IFS). These models suggested that there is monopolistic competition in the South African banking sector. They find that the high concentration in the sector does not lead to low levels of competition. They do however acknowledge that the risk of anti-competitive behaviour remains high and thus close monitoring and other interventions are required in this sector.

Simatele (2015) looks at the relationship between bank structure, performance and the level of competition in the South African banking sector. He is interested in the period succeeding the financial consolidation that occurred in the sector post 1994. He makes used of a variation of the Panzar and Rosse model which accounts for different time periods. He also obtains results consistent with the monopolistic competition in the sector even though the concentration levels are high.

Mlambo et al (2011) uses a three-step approach in measuring the evolution of competition and efficiency in the South African banking sector. They use Data Envelope Analysis (DEA), the Panzar and Rosse model as well as a combination of the two models to estimate competition for period 1999 – 2008. They found that efficiency level had an upward trajectory in the period under review but were not convinced that optimal efficiency was obtained. They also find results consistent with monopolistic competition in this sector.

Our study also makes use of the profit persistence methodology to ascertain the degree of competition in the South African banking industry. There have been various studies conducted on the concept of profit persistence. However, none of these studies have been conducted in the South African market. We highlight studies conducted by the following scholars, Bektas (2007), Gugler and Peev (2018), Amidu and Harvey (2016), Berger et al (2000), below. We also highlight Makhaya & Nhdundu (2016) who look at barriers to entry in the South African Retail sector.

Bektas (2007) looks at profit persistence in the Turkish Banking system for period 1989 to 2003. They use first-order autoregressive methods to estimate the persistence of profits in line with what has been used in the literature. Their innovation arises from their application of these methods to a developing country. They regress industry average profits on individual bank profits lagged by one period to obtain the speed of adjustment parameter. The lower is the speed of adjustment the higher are the competitive forces in the sector. The study concludes that competition in the Turkish banking sector is moderately high.

Gugler and Peev (2018) evaluate the dynamics of bank profitability in 6 developed countries for the period 1993 to 2014. The period in question covers both the pre and post 2008 financial crises. Results show that there is a persistence in profits for all 6 countries for the period leading up to the financial crises. They find that banks with higher levels of capital ratios persistently make larger profits but find no evidence of a relationship between bank size and persistent profits. They find that the financial crises affected the American banks' profits more severely. However, it is the American banks that recovered their long run profits faster than the European banks.

Amidu and Harvey (2016) study the role played by earnings management in determining the persistence of profits in the African Banking sector. They make use of the Markov chain analysis as well as the autoregressive model to analyse the extent of profit persistence in the sector. They find that banks in the African Banking sector exhibit high levels of persistence as well as low speeds of adjustments.

Berger et al (2000) use profit persistence techniques to ascertain the reasons why profits are persistent in the US banking sector. They rank the banks in the sector into deciles and find that profit persistence in banks in the upper deciles has its source from market power in input markets derived from informational ambiguity. The profit persistence in banks in the lower deciles is driven by market power in output markets sourced from obstacles to product market competition. They find that regulatory geographical restrictions do not contribute a great deal to profit persistence.

Makhaya & Nhdundu (2016) conducted a case study assessing barriers to entry in the South African Retail Banking sector. They particularly focused on Capitec's experience as a new entrant in this sector at the turn of the century. This sector is highly regulated and the more prevalent regulatory bodies include the South African Reserve Bank, The Financial Intelligence Centre, the National Credit Regulator as well as the Financial Services Board. These regulations contribute to the high barriers to entry. This study finds that there are high barriers to entry in the South African banking sector. These barriers are driven by four fundamental areas.

Firstly, there are high initial costs needed to set up IT infrastructure and branch networks. Customers tend not to trust new entrants into this market thus switching costs are high. Third, the high regulations as well as the compliance costs to obtain a banking license increase the barriers to entry. Plugging into the payments system is another potential hindrance to entering

this market. The Capitec case study confirms these high barriers to entry in this sector. Capitec took a long time to establish themselves as a player in this market. It was assisted by legislation such as the National Credit Act, which provided certainty in the unsecured lending market. The study finds that the entry of Capitec led to some product price reduction underlining the importance of competition.

The contribution to literature will be bourne out of estimating the persistence of profits in the local banking market. Previous studies in the domestic market have emphasized the concentration ratios, the Lerner Index and the Panzar and Rosse model. Our study will estimate the Lerner Index, the Boone indicator and compare and contrast the results with those of the persistence of profits results in getting to a more robust level of competition in the South African banking industry.

3. Data & Methodology

The study aims to deduce the accurate measure of the level of the competition in the South African banking sector. To help us with this task we have decided to answer two questions in this study. Firstly, what is the level of competition in the South African banking sector? Secondly, is there profit persistence in this sector? On the back of the weaknesses of the structural approach, we will be focusing on the non-structural measures.

The study makes use of three models that assist in drawing inferences about the extent of competition in this sector. The first model is the static Lerner Index model, followed by the dynamic Boone Indicator. The third model is the persistence of profits model, which uses the theory of contestability to test the dynamics of the profits in this sector.

3.1. Models

3.1.1. Lerner Index

To estimate the Lerner Index we follow the approach employed by some World Bank researchers (Anzoategui et al, 2010; Demirguc-Kunt et al, 2010) as well as other researchers (Berger et al, 2009; Fungacova et al, 2010; Fernandez de Guevara, 2005; Weill, 2013; Moyo, 2018) amongst others. The Lerner Index is a direct measure of market power that measures the

divergence of a firm's price from its marginal cost. When the divergence is zero, the price is equal to marginal cost. This implies that there is perfect competition. When the price is greater than marginal cost, competition starts to be eroded and characteristics of market power begin to rise. The higher the value of the index the less competitive the sector is.

The Lerner index finds its theoretical basis in the oligopoly theory. In a Cournot setting where firms make decision about how much quantity to produce, the profit-maximizing problem of a firm is as follows:

$$\max[P(Q)q_i - C(q_i\omega_i)]$$

where q_i = quantity produced by the firms
(Q) = total quantity in the industry
$P(Q)$ = market price
$C(q_i\omega_i)$ = total cost of the firm
ω_i = prices of factors of production

The Lerner Index is given by:

$$L_i = \frac{P(Q) - C'q_i(q_i\omega_i)}{P(Q)}$$

where $C'q_i(q_i\omega_i)$ = marginal cost given by the change in cost with respect to quantity produced

Following the studies outlined above, total assets are used as proxy of output thus allowing us to calculate the price which takes total revenue divided by total assets. The marginal cost is calculated using the translog cost function with one output (total assets) and three inputs prices (personnel expense, interest expense, & operating expense). We follow all the studies by imposing symmetry and homogeneity restrictions in the input prices. The marginal cost is a derivative of the following translog cost function:

$$lnTC_{it} = \beta_0 + \beta_1 lnq_{it} + \frac{1}{2}\beta_2(lnq_{it})^2 + \sum_{j}^{3} \alpha_j \, ln\omega_{j,it} + \sum_{j=1}^{3} \sum_{k=1}^{3} \alpha_{jk} \, ln\omega_{j,it} ln\omega_{k,it} + \sum_{j=1}^{3} \phi_j \, lnq_{it} ln\omega_{j,it} + \varepsilon_{it}$$

Where subscript i denotes the individual bank and t denotes the year. TC represents the total cost, and q represent total assets. ω is a measure of input prices where ω_1 is personnel expenses,

ω_2 is interest expenses and ω_3 is operating expenses. The coefficients estimated from the translog function are then used to derive the marginal cost:

$$MC = \frac{TC}{q}(\beta_1 + \beta_2 lnq_{it} + \sum_{j=1}^{3} \phi_j \, ln\omega_{j,it})$$

Once we have the price and the marginal cost, the Lerner Index is computed for each bank and for each year to attain a direct measure of bank level competition (Moyo, 2018; Fungacova et al, 2010). The Lerner Index ranges from zero to one, where zero is perfect competition and as the index values approach one the greater is the firm market power.

3.1.2. Boone Index

We follow the Boone indicator derived by Boone (2008) implemented in the following studies (Moyo, 2018; Schaeck & Cihak, 2014; Tan, 2017; Park, 2013 and Mamatzakis & Vu, 2018). The Boone indicator has a number of advantages over the other competition measures. The indicator factors in the contestability theory and accounts for the aggressive interaction among participants (Mamatzakis & Vu, 2018). It makes no assumption about the market being in long run equilibrium nor are there any issues related to product substitutability that may exist with the other measures (Schaeck and Cihak, 2014).

The Boone Indicator is premised on the efficient market hypothesis and captures the relationship between profit and marginal cost (Moyo, 2018). Under this hypothesis the argument is that in competitive environments profits are reallocated to more efficient firms (indicated by lower marginal costs) from their less efficient counterparts. The model is characterized as follows:

$$ln\pi_{it} = \beta_a + \beta_i lnMC_{it} + \varepsilon_i$$

where π_{it} = profit

MC_{it} = costs

β_i = profit elasticity/Boone indicator

Where π_{it} is the bank i's profit in year t. MC_{it} is marginal cost obtained using the translog cost function outlined in the first model. The Boone Indicator is given by the β_i parameter (Boone 2008) which articulates the percentage change of a bank's profits to the percentage change in

the marginal costs. This relationship is expected to be negative because profits and marginal costs are negatively related. The magnitude of β is expected to be large the higher the level of competition. The Boone Indicator suggests that in a competitive environment, inefficient firms are punished more severely than less efficient firms. The Boone Indicator is calculated for each bank and for each period under review.

3.1.3. Profit Persistence

To test for profit persistence, we follow the approaches employed in the following studies: (Bektas, 2007; Goddard et al, 2011; Keil, 2018; Amidu & Harvey, 2016; Glen et al, 2001). These studies all follow the first order auto-regressive model to estimate profit persistence in firms. The model views competition as a dynamic process where entry and exit conditions influence profits in the long run (Amidu & Harvey, 2016). We follow Bektas (2007) in focusing on the first order auto-regressive model because lagged variables at higher orders are insignificant. We, however test this assertion by employing Keil (2018)'s second order auto-regressive model that accounts for non-monotonic convergence to the long run equilibrium.

The first order auto-regressive model is specified as follows:

$$\pi_{i,t} = \alpha_i + \lambda_i \pi_{i,t-1} + \mu_{i,t}$$

Where $\pi_{i,t}$ = bank i's long run average normalized profit in time t

$\pi_{i,t-1}$ = bank i's long run average normalized profit in time t-1

λ_i = speed of adjustment / intensity of competition

Industry average profit:

$$\pi_{i,t} = P_{i,t} - \bar{P}_t$$

$$where\ \bar{P}_t = \sum_{i=1}^{n} P_{i,t}/n$$

Where $P_{i,t}$ = bank i's profit in time t

$\bar{P}_t$ = average profit of banks in time t

Bank profits ($\pi_{i,t}$; $\pi_{i,t-1}$) used in the model are normalized by taking the difference between individual bank profit and the average profit rate of banks. This is done to smooth out and control for extensive fluctuations in the business cycle and macroeconomic factors. The model is a reduced form equation which allows us to capture competition determinants like potential threats to entry. It captures the dynamic relationship between the prior year normalized profit rate and the current year normalized profit rate.

The resultant coefficient (λ_i) predicts the degree of competition or the speed of adjustment of bank profits towards the average industry profit (Bektas, 2007). The speed of adjustment (λ_i) can also be interpreted as the consequence of the interaction of bank profit and possible entry threat. The speed of adjustment is expected to be low in environments where competition is high. A (λ_i) close to 1 implies a slow adjustment towards the average industry profit. However, a (λ_i) that is closer to zero indicates an environment that has no persistence of profits where prior year profits have little bearing on current year profits. When the $\lambda_i < 1$the long run profit level of bank i is given by the following:

$$\pi_{i,p} = \frac{\alpha_i}{(1 - \lambda_i)}$$

Glen et al (2001) uses the second order auto-regressive model to account for non-monotonic convergence long run profit. They suggest that convergence may be quicker when bank profits are far from equilibrium but slower when profits are closer to equilibrium. The second order autoregressive model is specified as follows:

$$\pi_{i,t} = \alpha_i + \lambda_{1i}\pi_{i,t-1} + \lambda_{2i}\pi_{i,t-2} + \mu_{i,t}$$

Where $\pi_{i,t-2}$ = bank i's long run average normalized profit in time t-2

λ_{2i} = non-monotonic speed of adjustment

The long run profit level of bank i is given by the following:

$$\pi_{i,p} = \frac{\alpha_i}{(1 - \lambda_{1i} - \lambda_{2i})}$$

3.2. Estimation technique

We make use of the Generalized Method of Moments (GMM) estimation technique to estimate our models. Tan, 2017; Goddard et al, 2011; Amidu & Harvey, 2016 use GMM to reduce potential bias and to account for endogeneity, unobserved heterogeneity and correlation between regressors and lagged dependent variables. Arellano & Bond (1991) derived the GMM-DIFF estimator, which uses all available lagged values of dependent variable and regressors as instrumental variables. The GMM-DIFF is said to be inefficient due to weak instrumental variables. To combat this inefficiency, system GMM (GMM-SYS)[11], which includes lagged levels and lagged differences, is used. We make use of the Hansen (1982) test to test for the validity of the instruments as well as to test for over-identification restrictions. We employ both the Ordinary Least Squares and the panel Fixed Effects estimators as a means to compare our results. OLS[12] suffers from endogeneity with panel data thus produces inconsistent results. FE[13] corrects for the unobserved, individual specific fixed effects but suffers from Nickell bias in dynamic panel estimation. GMM-SYS is ultimately a superior estimation technique to both OLS and FE. The latter two estimation techniques have been provided for comparison of the results.

Testing for a unit root is pivotal to our analysis as it eliminates the spurious regression problem. We use the Fisher type test that is based on the Augmented Dickey-Fuller (ADF) to test for existence of a unit root. The null hypothesis (H_0) is that "All panels contain a unit root" and the alternative hypothesis (H_0) is that "At least one panel is stationary". The Fisher type test allows for unit root testing for unbalanced short panel data. It allows for the incorporation of drift and trend in the data as well as the removal of cross-sectional dependence across banks. An alternative unit root test is the Im, Pesaran, Shin (2003) (IPS) test which tests for cross-sectional dependence across banks. This test doesn't assume homogeneity in parameters and the null hypothesis is $H_0: \beta_i = 0$ and the alternative hypothesis $H_0: \beta_i < 0$. IPS is also based on the ADF statistic. However, IPS requires that there be a balanced panel. Maddala et al (1999) compared the Fisher test, the Levin-Lin (LL) test and the IPS test and found that the Fisher test was better than the IPS and the LL test. We therefore use the Fisher type test for this study

[11] See: Arellano & Bond (1991); Roodman (2009); Roodman (2009)

[12] See: Gujarati (2009); Woodridge (2001)
[13] See: Gujarati (2009); Woodridge (2001

based on the fact that we have an unbalanced short panel and on the findings of Maddala et al (1999)

3.3. Data

We make use of annual data collected from the Bankscope database to conduct this study. We particularly use the income statement and balance sheet data of various South African banks to obtain the variables required for this study. This data is similar to the data used in Moyo (2018). The differences arise in the 1 additional cross-sectional unit and the 4 additional time-series units. A detailed description is provided in Table 1 below. All our models make use of bank specific data in their estimation. The data covers 18 banks for a timespan of 2000 – 2015. The data thus represent a short panel because the cross-sectional units are greater than the time series units (N > T). The panel is unbalanced as there are some missing time series units for some of the banks.

Table 1: Variable Description

Lerner Index		
	Variable	**Description**
	$P(Q)$	Price represented by total revenue divided by total assets
	$C'q_i(q_i w_i)$	Marginal cost which is a derivative of the translog cost function
	Q	Output proxied by total assets
	w_1	Input price: personnel expense/total assets
	w_2	Input price: interest expense/total deposits
	w_3	Input price: operating expense/total assets
Dependent Variable	$lnTC_{it}$	Natural log of Total Costs
Independent Variable	lnq	Natural log of Total Assets
	$(ln\ q)^2$	Natural log of Total Assets squared
	$ln\omega_j$	Natural log of input prices
	$ln\omega_j ln\omega_k$	Interaction of Natural log of input prices
	$lnqln\omega_j$	Interaction of Natural log of Total Assets & Natural log of input price
Boone Indicator		
	Variable	**Description**
Dependent Variable	$ln\pi_i$	Natural log of Profit before tax
Independent Variable	$lnMC_i$	Natural log of marginal cost calculated using translog cost function

Profit Persistence		
	Variable	**Description**
Dependent Variable	$\pi_{i,t}$	This is the industry average profit obtained by taking the difference between individual bank profit and average annual profit
	$\bar{P}_t$	This is the average annual profit which is the sum of the individual bank profit divided by the number of banks
Independent Variable	$\pi_{i,t-1}$	This is the individual bank prior year profit before tax

3.4. Period of review

The period under review is from 2000 - 2015. This period is subject to the availability of data. In 2008, the world experienced a shock to the system through the global financial crisis. A background to this crisis has already been provided in earlier sections. This shock severely altered profits in most industries and thus requires to be factored into our analysis. We therefore will breakdown our period of analysis as follows to account for the financial crisis:

i) 2000 – 2008

ii) 2009 – 2015

iii) 2000 – 2015

4. Results and Analysis

Table 1 shows the descriptive statistics of the data. We included variables that were used in the estimation of the models. The number of observations range from 217 to 246. The standard deviations were relatively small except for one of the variables used in the study. The largest standard deviations were found under the Normalized Profit variable. This variable is the only variable which has not been logged. This variable is used to estimate profit persistence whilst the rest of the variables are pivotal in the estimation of the Lerner Index and the Boone Indicator.

Table 1: Descriptive Statistics for the Period 2000 – 2015 (Million South African Rands)

VARIABLES	N	mean	sd	min	max
Log Total Cost	225	7.20	2.54	3.18	11.29
Log Total Assets	232	9.44	2.67	5.41	14.06
Log Total Assets^2	232	48.08	26.67	14.61	98.84
Sum - Log Input costs (w)	210	-10.52	1.62	-13.79	-5.98
Sum Interaction (Log w)	210	18.48	5.30	3.28	28.63
Sum Interaction Log (TA & w)	210	-102.20	36.66	-165.80	-42.84
Log Profit	204	5.68	2.64	0.26	9.98
Log MC	210	-2.84	0.40	-3.54	-1.59
Normalized Profit	232	0.00	4,35	-12,224	16,579

4.1. Stationarity and Unit Root testing

The dataset exhibits characteristics of a short panel even though the data has 16 time periods. N, the number of banks, is 18 and T, the number of years, is 16. Therefore N>T, which indicates that we have a short panel. The most appropriate approach to test for stationarity for unbalanced panels is the Fisher type unit root test. The Fisher type test is based on the Augmented Dickey-Fuller (ADF) test for unit roots. The null hypothesis for this test is that "All panels contain unit roots" and the alternative hypothesis is "At least one panel is stationary" We conducted the Fisher type test and the results are outlined in Appendix A. The first table provides the results for the original bank level variables, whilst the second table provides the derived variables as per the methodology employed.

When we consider the original variables, the test shows that we reject the null hypothesis for the profit and Total cost variables when the drift term is included and therefore profit is stationary. Total Assets, personnel expenses as well as operating expenses reject the null hypothesis, and thus are all stationary, when the trend term is included. Total revenue, and Interest expense also reject the null hypothesis, and thus are all stationary, when the trend term is included as well as when cross-sectional dependence means have been removed. We cannot reject the null hypothesis for total deposits which means that this variable displays a level of non-stationarity. However, the total deposit variable is only used to scale down the interest expense variable and is not expected to fundamentally alter the results obtained.

4.2. Results: Lerner Index

We require two variables to compute the Lerner index, namely the price and marginal cost. We obtained the price by using the ratio of total revenue over total assets. This is because in banking literature total assets are used to measure output (Q) and total revenue is measured by multiplying price (P) by quantity (Q). Dividing total revenue by output will therefore yield price (P). In order to get the marginal cost, we used the translog cost function of inputs and outputs. We follow Weill (2013) who used the same approach. Output was proxied by total assets while the inputs were represented by interest expenses, personnel expenses and operational expenses. The total cost is given by the sum of all these inputs. The coefficients obtained in the regression were then used to compute the marginal cost. The regression results of the translog cost function are displayed in Table 2. We ran the regression using two different estimation techniques. These estimation techniques included the Ordinary Least Squares (OLS) estimation, as well as the Generalized method of moments (GMM) estimation. Both these methods were run using robust standard errors to obtain more efficient estimators. The OLS estimator was further clustered to obtain more accurate standard errors in order to reduce the chances of making a type 1 error.

Under OLS[14], there are four variables that are significant at the 1%, 5% and 10% levels of significance. However, it must be noted that the OLS estimator suffers from endogeneity and therefore produces biased and inconsistent estimations. This study makes use of OLS as a robustness check for the GMM estimator. The GMM-SYS estimator corrects for heterogeneity, endogeneity and serial correlation. GMM-SYS achieves this by creating instrumental variables for the equation in difference and the equation in levels. We collapsed the internal instruments which ensured that the number of instruments in our estimation was not greater than the number of banks. There were four variables that were significant at either the 1% or the 5% levels of significance. We performed the standard diagnostic tests for GMM-SYS. The AR(1) and AR(2) tests for the first order and second order serial autocorrelation yielded a p-value of 0.284 and 0.942 respectively. There is a certain level of first order serial correlation, which by itself does not invalidate our results. The important test is the second order serial correlation test, AR(2), which finds evidence of no serial correlation. We placed reliance on the translog cost function to calculate the marginal cost. The Hansen[15] test evaluates the validity of the overidentification

[14] Note: The Goodness of fit (R^2) for the OLS estimation is 99.6%.
[15] See Hansen (1982); Roodman (2009)

restrictions. The Hansen test value of 0.2425 showed that the instruments used in the estimation are valid.

The information above was used to derive the marginal cost. Table 1 in the appendix C shows the GMM-SYS marginal costs for the banks in the sample. The Lerner Index was then computed for each bank and for each time period where data was available. Appendix C also outlines the Lerner Index obtained from the OLS. Results for the GMM-SYS Lerner Index are provided for in Table 4 and discussed below. We first compute and discuss the average Lerner index that is broken down by bank as well as by year.

Table 2: Translog cost function regression

VARIABLES	OLS	GMM-SYS
Log Total Cost (lag)		0.360**
		(0.156)
Log Total Asset	0.779***	0.622***
	(0.071)	(0.183)
Log Total Assets Squared	-0.009***	-0.034
	(0.002)	(0.022)
Sum - Log Input costs (w)	-0.053	-0.369
	(0.144)	(0.311)
Sum Interaction (Log w)	-0.152***	-0.236**
	(0.047)	(0.107)
Sum Interaction Log (TA & w)	-0.027***	-0.031**
	(0.006)	(0.013)
Constant	-0.280	-2.316
	(0.765)	(1.429)
Observations	210	193
R-squared	0.99	
Number of ID	17	17
Banks	17	17
No. of instruments		17
AR1 p-value		0.284
AR2 p-value		0.942
Hansen p-value		0.1766

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 shows a breakdown of the average Lerner Index and the average profit by bank. The profit is measured in millions of South African Rands. From the results we note several

outcomes. Firstly, Standard Bank reflects the highest average profit for the period 2000 to 2015, followed by FNB, ABSA and Nedbank. This is as per our expectation. Using economies of scale and other advantages that come with size, the big four banks seem to be more profitable than the rest of the banks. In the discussions that follow, we focus on the GMM results.

The average Lerner Index ranges from 0.29 to 0.73. The average Lerner Index is however not lead by the big four banks. Instead, African Bank Investment Ltd has the highest average Lerner Index at 0.73. This means that on average African Bank Investment Ltd sets its price 73% higher than its marginal cost. This shows that this bank has a high degree of market power. They are followed by Real People Investment Holdings and Bidvest Bank with a Lerner Index of 0.67 and 0.60 respectively. The big four banks then take up the next 4 spots with values of the Lerner Index ranging from 0.52 to 0.59. Our results therefore show that these banks reflect the highest magnitudes of the Lerner Index.

The banks mentioned are all charging a price that is above marginal cost. As per the Lerner Index definition, this is indicative of these banks enjoying a certain level of market power. Surprisingly, three of the smaller banks seem to have more market power than initially hypothesized. These results are strange when viewed in the context of the big four banks enjoying a concentration ratio of around 80%. These results however, further corroborate the argument against concentration as a measure of competition. Sanya and Gaertner (2012) find that the dominance of the larger banks may lessen the extent of competition in the EAC countries.

African Bank collapsed from a rise in bad debt. African Bank provided unsecured loans to the market which led to the collapse when consumers were failing to meet their debt commitments due to sluggish economic conditions[16]. The unsecured debt offering explains the high Lerner Index. Real People Investment Holdings offer debt-linked products to small and micro-enterprise (SMME) and the bank "invests in non-performing consumer debt.[17]" These market segments attract higher risk and thus explains the premium that Real People Investment Holdings charges its customers. Bidvest Bank was formed on the back of the foreign exchange market segment which may explain the high Lerner Index.

[16] See: https://ewn.co.za/2015/03/03/African-Banks-lending-below-levels (accessed on the 13/03/2019, 21:05)
[17] See: https://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=42885434 (accessed on 13/03/2019, 20:35)

Figure 1 in appendix C provides a graphical representation of the average Lerner Index by bank. The banks are represented by bank ID between 1 and 18. The description of these ID's are provided for in appendix E. The figure depicts the average Lerner Index for both estimation techniques. The graph reflects that the average Lerner index follows the same pattern for both estimations. This provides a level of robustness for the results we obtained.

Table 3: Average Lerner Index and Average profit (by bank)

Bank	mean LI (GMM)	mean LI (OLS)	mean (Profit)
African Bank	0,726	0,534	-433.69
Real People Investment Holdings	0,665	0,466	67.64
Bidvest	0,603	0,404	256.65
FNB	0,591	0,252	8 058.84
ABSA	0,587	0,238	7 867.44
Nedbank	0,569	0,217	5 574.88
Standard Bank	0,517	0,109	10 304.38
Sasfin	0,511	0,276	88.39
Investec	0,494	0,153	1775.31
HBZ	0,493	0,292	17.21
Mercantile Bank	0,452	0,171	47.56
Habib Overseas Bank	0,438	0,232	44.39
Grinrod	0,422	0,170	59.56
Albaranka	0,372	0,105	25.60
GBS Mutual	0,314	0,070	6.03
South African Bank of Athens	0,307	0,012	-6.51
VBS Mutual	0,288	0,040	1.13
Infrastructure Finance Corporation	-	-	36.70

Source: Own calculation from Bankscope data

Table 4 provides a more detailed display of the Lerner Index. The Table displays the evolution of the Lerner index for each of the banks and for every time period where data was available. There are ten banks for which there are at least ten data points of the Lerner Index. The Lerner Index increased for seven out of these ten banks, suggesting that the South African banking industry became less competitive over the period under review. Three out of the top four banks experienced increase in the Lerner Index whilst Standard Bank faced a decrease over the same time period. Standard Bank were facing cost escalations leading up to 2010. Their cost to income ratio

Table 4: GMM: Lerner Index per bank per year

Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	LI by Bank
ABSA	0,55	0,55	0,56	0,55	0,57	0,57	0,59	0,60	0,59	0,60	0,60	0,61	0,62	0,62	0,61	0,61	0,06
African Bank	0,73	0,65	0,67	0,69	0,72	0,73	0,76	0,79	0,73	0,74	0,76	0,77	0,74	0,75	0,73	0,64	-0,09
Albaranka					0,33	0,33	0,35	0,41	0,41	0,36	0,35	0,37	0,39	0,39	0,41		0,09
Bidvest							0,53	0,59	0,60	0,62	0,54	0,65	0,66	0,62	0,62	0,60	0,07
FNB	0,54	0,54	0,55	0,56	0,58	0,56	0,59	0,59	0,60	0,58	0,60	0,61	0,62	0,63	0,64	0,65	0,11
GBS Mutual						0,31	0,33	0,34	0,35	0,32	0,27	0,27	0,29	0,31	0,32	0,33	0,02
Grinrod						0,40	0,35	0,47	0,39	0,41	0,48	0,41	0,42	0,44	0,44		-0,40
Habib						0,39	0,40	0,47	0,48	0,47	0,43	0,42	0,44	0,44	0,43		-0,39
HBZ			0,45	0,51	0,49	0,48	0,48	0,52	0,53	0,51	0,49	0,48	0,49	0,47	0,48		0,03
Investec	0,47	0,54	0,48	0,45	0,45	0,48	0,49	0,50	0,51	0,51	0,52	0,51	0,50	0,50	0,50	0,51	0,04
Mercantile Bank	0,42	0,28	0,41	0,26	0,27	0,38	0,46	0,52	0,55	0,55	0,50	0,56	0,54	0,52	0,51	0,51	0,09
Nedbank	0,64	0,51	0,49	0,50	0,52	0,56	0,57	0,58	0,57	0,58	0,58	0,59	0,60	0,61	0,60	0,59	-0,05
Realpepi														0,73	0,66	0,60	-0,13
Sabath	0,23	0,10	0,20	0,25	0,29	0,34	0,37	0,39	0,42	0,32	0,27	0,31	0,37	0,39	0,37		0,13
Sasfin							0,52	0,51	0,55	0,54	0,46	0,54	0,50	0,48	0,51	0,48	-0,04
Standard Bank	0,57	0,57	0,58	0,57	0,58	0,45	0,47	0,49	0,52	0,52	0,48	0,48	0,48	0,49	0,50		-0,07
VBS Mutual							0,29	0,29	0,34	0,35	0,26	0,21					-0,07

Source: Own calculation based on Bankscope data

was high (58.1%) which led to mass retrenchments of around two thousand employees in 2010[18]. This may have been one of the drivers for the downward pressure on Standard Bank's Lerner Index.

Weill (2013) obtain an average Lerner Index that ranges between 12.2% and 20.34% for the 27 European Union countries they analyse for the period 2002 to 2010. When Carbo et al (2009) break down their average Lerner Index by year and they obtain values for the index that range between 11% and 22% for the EU countries as well. Fungacova et al (2010) obtain an average Lerner Index of 21.4% for Russian banks in the periods they review.

We followed Weill (2013) and broke down the average Lerner Index by year, thus capturing the evolution of this index from the year 2000 to 2015. The results are presented in Table 5 below. Our results are comparable to the other studies highlighted above. We attain an average Lerner Index that ranges between 0.46 and 0.55 for the period 2000 to 2015. This gives us an average of 49.7% for the period under review.

If we compare this average Lerner Index to the average Lerner Index for developed countries, we find results that are consistent with previous studies that compared this index between developed and developing countries. We compare the average Lerner index for South African banks of 49.7% to the average Lerner index calculated by Weill (2013) for banks in the UK, Germany and France. We find that the average Lerner index for South African banks is consistently higher that of banks in developed countries.

We further analyse these results with respect to the 2008 financial crisis. The results reveal an average Lerner index that is trending downward during the period preceding the financial crises (2000 to 2008). We obtained the trend by comparing the average Lerner index per bank for the entire period to the average Lerner index per bank for the period 2000 to 2008. This is indicative of a period where banks in the South African banking industry were moving towards a relatively more competitive environment. The overview of the South African banking sector showed us that the foreign banks presence in South Africa increased from 13% in 2000 to 23% in 2008 and maintained this rate up to 2015. This reveals that there was a rapid increase in

[18] See: https://mg.co.za/article/2010-11-11-standard-bank-to-meet-some-union-demands-over-retrenchments (accessed on 02/03/2019, 10:20)

foreign bank entry before the financial crisis. This may have led to the relatively competitive environment that our results show.

Conducting the same exercise for the post-crisis period from 2009 to 2015 we find the opposite effect to the pre-crisis outcomes. This period is characterized by an upward trend of the average Lerner Index towards a less competitive banking environment. This period coincides with the period where the South African banking sector was experiencing a decline in the spread between loan and deposit rates, the cost to income ratio was on the rise and there was a squeeze on the return on equity. There may have been an incentive to increase prices which would have led to a larger Lerner Index. This dichotomous effect of the pre and post crisis average Lerner Index is confirmed by an average value of 0.49 for period 2000 to 2008 and 0.51 for the period 2009 to 2015. The difference between the two periods is however insignificant. Banks in the sector remained with high degree of market power.

When analyzing the effect between the big four banks against the rest of the banks in the sector, we found that the big four banks consistently have an average Lerner index that is higher than the index value for the rest of the banks. This pattern holds for the pre and post financial crisis period. This suggests that the big four banks are relatively less competitive than the rest of the banks in the sector. This may be driven by the boutique nature of clients of the some of the other banks. As outlined earlier, African Bank specialized in unsecured credit extension which was not prevalent with the big four banks.

Weill (2013) computes median values to account for outliers that may be present in the mean. He obtains results for the median Lerner Index that are similar to those of the average Lerner Index. We conducted the same exercise and obtain median values that range from 0.43 and 0.59. The median values are therefore similar to the mean values. We can therefore conclude that outliers do not distort the results we obtain using the mean Lerner Index.

Table 5: Average Lerner Index and Average profit by Year

Year	Mean LI (GMM)	Mean LI (OLS)	Mean (Profit)
2000	0,520	0,215	1 484.07
2001	0,468	0,122	924.28
2002	0,487	0,179	1 033.13
2003	0,484	0,164	1 298.65
2004	0,481	0,177	1 947.79
2005	0,462	0,175	1 689.21
2006	0,471	0,204	1 939.81
2007	0,505	0,242	2 356.67
2008	0,510	0,242	2 455.26
2009	0,499	0,224	1 776.87
2010	0,474	0,190	2 031.34
2011	0,487	0,209	2 670.93
2012	0,511	0,236	3 139.75
2013	0,524	0,255	2 405.10
2014	0,520	0,244	3 150.02
2015	0,554	0,270	5 011.70

Source: Own calculation from Bankscope data

Figure 2 in appendix C provides a graphical illustration of the average Lerner index broken down by year. The figure captures the OLS and the GMM estimation technique which reflect a similar pattern albeit differing in magnitude of the index. The graph provides a graphical depiction of the trends pre-2008 and post-2008.

4.3. Results: Boone Indicator

As explained in the methodology section, the Boone indicator is estimated based on the relationship between profits and the marginal cost. We estimated the Boone indicator using GMM-SYS as well as the panel data Fixed Effects estimator. As explained in the methodology section the Boone indicator is expected to be negative due to the inverse relationship between profits and costs. Higher negative values of this indicator are associated with higher levels of competition.

Table 6 provides the results for GMM-SYS Boone indicator for various periods. The table gives values for the entire period as well as the pre and post crisis estimates. Table 7 provides the Boone Indicator for the same periods using the panel Fixed Effects estimator. These results

are in line with the with the Boone indicator estimated in Park (2013). Park (2013) estimates Boone indicator values between -3.22 and 7.34 for banks in South Korea and China.

The Boone indicator for the period 2000 to 2015 is -1.87 using the GMM-SYS estimator. There is no second order autocorrelation and the chosen instruments satisfy the overidentification restrictions. The indicator is captured by the coefficient of the Log MC variable as outlined in the methodology. This coefficient is significant at the 5% level of significance. It reflects that a percentage increase in the marginal cost is associated with a 187% decrease in profits. This captures the negative relationship between profit and marginal costs. The -1.87 also captures the reallocation rate of profits from less efficient banks to their more efficient counterparts. The -1.87 is a relatively small value thus indicative that the banking sector in South Africa exhibits characteristics of low competition.

We estimated the Boone indicator for the pre and post financial crisis period and the results

Table 6: GMM-SYS Boone Indicator

VARIABLES	(2000 - 2015) System GMM	(2000 - 2008) System GMM	(2009 - 2015) System GMM
Log Profit (lag)	0.853***	0.759***	0.937***
	(0.081)	(0.176)	(0.026)
Log MC	-1.861**	-4.507**	-0.612**
	(0.851)	(1.553)	(0.213)
Constant	-4.434**	-11.355**	-1.379**
	(2.036)	(4.095)	(0.553)
Observations	168	60	92
Number of ID	17	16	16
Banks	17	16	16
No. of instruments	15	11	11
AR1 p-value	0.0614	0.094	0.054
AR2 p-value	0.633	0.907	0.138
Hansen p-value	0.353	0.118	0.414

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

are displayed in Table 6. The pre-financial crisis Boone indicator is -4.51. This value is significant at the 5% levels of significance. The period preceding the financial crisis has a high negative value which points to a banking environment that is relatively more competitive. The post-financial crisis Boone indicator is -0.61. A percentage increase in the marginal cost is

associated with 61% decrease in profits, at the 5% levels of significance. These results mirror the results we obtained for the Lerner Index for the same period. The Hansen test for overidentification restrictions showed that the instruments used are valid. There is however a certain level of second order autocorrelation in the 2009 – 2015 results which necessitates a robustness check.

Table 7: Fixed Effects Boone Indicator

VARIABLES	(2000 - 2015) Fixed Effects	(2000 - 2008) Fixed Effects	(2009 - 2015) Fixed Effects
Log MC	-1.818***	-1.042***	-2.513***
	(0.245)	(0.282)	(0.292)
Constant	0.862	3.229***	-0.071
	(0.636)	(0.719)	(0679)
Observations	185	93	76
Number of ID		0.192	0.509
R-squared	17	17	16
Bank FE	YES	YES	YES
N	185	93	76
r2	.	0.192	0.509
F	.	13.67	74.19
Rho	0.963	0.982	0.971
chi2	54.86	.	.

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We conducted a robustness check for the Boone Indicator using the Fixed Effects (Within Group) estimator for the same periods. The FE estimator provides estimators that are more consistent than OLS estimators as it accounts for the bank specific, unobserved, time invariant, heterogeneous fixed effect. The coefficient of interest under all three regressions is significant at the 1% level of significance. The overall Boone indicator under the FE[19] estimator is -1.8 which reflects a relatively moderate level of competition for the period under review. The pre-crisis Boone indicator is -1.04 whilst the post-crisis value is -2.51. These results refute the results attained under the GMM-SYS estimator. The Fixed Effects results reflect a less competitive environment before 2008 and relatively more competitive environment after the global financial crisis.

[19] Note: The Goodness of fit (R^2) for the FE estimation is 17%, 17% & 16% for the periods of estimation.

The Boone Indicator for the big four banks using the FE[20] estimator is -2.49. This value is negative and relatively high in magnitude indicating that there was a relatively high level of competition among the top 4 banks in the banking sector. This could symbolize that there is very little that differentiates these banks in the market. The Boone indicator for the other banks in the sector was -1.19. This value suggests a lower extent of competition among these banks.

Table 8: Boone Indicator Results for the Big four banks vs other banks

	(Big four banks)	(Other banks)
VARIABLES	FE_	FE_
Log MC	-2.486**	-1.189***
	(0.548)	(0.161)
Constant	2.450	1.163**
	(1.407)	(0.377)
Observations	60	109
R-squared	0.590	0.202
Number of Year	4	12
Bank FE	YES	YES
N	60	109
r2	0.590	0.202
F	20.54	54.49
Rho	0.184	0.935

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4. Results: Profit Persistence

In order to better understand the extent of competition in the South African banking sector, we also conducted further robustness checks using profit persistence. In the absence of competition, profits tend to persist for a long time as there are no serious rivals that compete with incumbent banks. Table 8 reports the GMM-SYS estimates for profit persistence. The table provides a breakdown of the speed of adjustment, which is captured by the coefficients of the normalized profit variable. The speed of adjustments has been computed for three

[20] Note: The Goodness of fit (R^2) for the FE estimation is 59% for the big four banks and 20.2% for the other banks.

different time periods, namely the period before and after the 2008 financial crisis as well as the entire period under review. The speed of adjustment is significant at the 1% level of significance for all the time periods. The second order serial correlation test and the Hansen test indicates that the estimation for the entire period has been correctly specified. The speed of adjustment for the entire period is 1.07. This indicates that the South African banking sector exhibited a high level of profit persistence in the period between 2000 and 2015. The speed of adjustment for the period preceding the financial crisis is 1.11, whilst the post financial crisis value is 1.06. This indicates that the financial crisis did not fundamentally alter the persistency of profit in this sector. However, it does show that the pre-crisis period was relatively less competitive than the post crisis period.

These results are in line with profit persistence expectations. Makhaya & Nhdundu (2016) find that the South African banking sector has got high barriers to entry, primarily driven by high set-up costs and heavy regulations. This tends to maintain the profit persistence indicated above. The fact that the banking sector is a heavily regulated sector also explains the persistence. Banks do not simply enter and exit as in other sectors such as the manufacturing sector. Another reason is that the demise of some banks in the sector may destabilize the entire sector, affecting the entire economy. This means the central bank, through its policies, may have to intervene to ensure the stability of the industry. This creates a moral hazard and can encourage banks to embark in riskier behavior thus enhancing profits. This again helps maintain the persistence of profits in the banking sector

The last column of Table 8 provides the results of the second order auto-regressive model in line with Glen et al (2001). The second order lag of normalized profit is insignificant. This result confirms that higher order lagged variables are immaterial and therefore the first order auto-regressive model is appropriate for computing the speed of adjustment. Secondly, the results suggest that there is a monotonic convergence to long run profit.

Running the same exercise using the Fixed effects[21] estimation we obtain opposing results, for the pre and post financial crisis period, to the GMM results. This was done as a robustness check for GMM estimations even though FE estimations are susceptible to Nickell bias. The GMM results are thus superior as they account for the dynamic nature of the first order auto-regressive model. The FE estimation results are displayed in table 9.

[21] Note: The Goodness of fit (R^2) for the FE estimation is between 57.8% & 73.3% for the periods of estimation.

The big four banks showed a speed of adjustment of 0.933 compared to a value of 1.08 for the other banks in the sector. The results are displayed under appendix F, Table 1. This revealed that the big four banks were relatively more competitive than the rest of the banks, even though all the banks were trending on the non-competitive end of the spectrum.

Table 8: GMM-SYS – Profit Persistence

VARIABLES	(2000-2015) System GMM	(2000-2008) System GMM	(2009-2015) System GMM	(AR (2)) System GMM
L1. Normalized Profit	1.067***	1.106***	1.056***	1.100***
	(0.034)	(0.081)	(0.025)	(0.062)
L2. Normalized Profit				-0.016
				(0.083)
Constant	2.670	91.726	-75.575	24.635
	(59.990)	(81.209)	(119.685)	(126.796)
Observations	214	79	117	196
Number of ID	18	18	18	18
Countries	18	18	18	18
No. of instruments	7	7	7	7
AR1 p-value	0.049	0.0201	0.0690	0.0613
AR2 p-value	0.851	0.0921	0.2396	0.6065
Hansen p-value	0.034	0.091	0.044	0.024

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10

Table 9: Fixed Effects – Profit Persistence

VARIABLES	(2000-2015) FE	(2000-2008) FE	(2009-2015) FE	(AR (2)) FE
L1. Normalized Profit	0.932***	0.839***	0.920***	0.987***
	(0.061)	(0.147)	(0.083)	(0.066)
L2. Normalized Profit				-0.066
				(0.114)
Constant	-4.504	202.137***	-142.734***	7.537
	(5.160)	(0.000)	(12.806)	(8.022)
Observations	214	79	117	196
R-squared	0.733	0.546	0.578	0.739
Number of ID	18	18	18	18
Bank FE	YES	YES	YES	YES
N	214	79	117	196
r2	0.733	0.546	0.578	0.739
F	235.1	32.43	124.2	232.4
Rho	0.218	0.328	0.274	0.252

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

We compare the results for the GMM-SYS estimator to allow for a more consistent assessment of the outcome. All three models reveal that the extent of competition in the South African banking sector is low. The average Lerner Index for the period is 0.497, which shows that banks in South Africa set their prices 49.7% above the marginal cost. This indicates that banks in the South African banking sector have a high degree of market power. The Boone indicator over the entire period is -1.86. This value is negative, which captures the inverse relationship between profit and the marginal cost. The magnitude of the Boone indicator is relatively small, which again shows that the level of competition in the South African banking sector is low.

The Boone Indicator has an added advantage of capturing the contestability in the sector, which in this case reveals that the barriers to entry are high. The profit persistence model is based on the Schumpeterian perspective of the "process of creative destruction"[22]. This perspective points out that innovations are rewarded with abnormal profits in the short-term. In the medium to long term the abnormal profits get eroded by imitations of that innovation. The persistence of profits is captured by the speed of adjustment which is 1.07 for the period under review. This result shows that abnormal profits are persistent in the South African banking sector. The slow speed of adjustment also indicates that the incumbent banks tend to deter potential entrants from the high barriers to entry that are present in the sector.

These results confirm our hypothesis that there is a low level of competition in the South African banking sector. The Lerner Index shows that banks in South Africa have a great deal of market power, whilst the slow speed of adjustment is an indication that there are high barriers to entry, which contribute to the low levels of competition.

The big four banks are shown to be less competitive than the other banks under the Lerner Index estimates. African Bank has the highest level of market power due to the unsecure loans they extend to their customers. However, the Boone Indicator and the profit persistent estimates shows that t the other banks are less competitive relative to the big four banks. This could be attributed to the riskier customer base of some of the other banks.

The 2008 financial crisis caused a shock to the world economy including the South African banking sector. The crisis caused a squeeze on profits and caused operational costs of banks to increase. Our finding shows that the financial crisis of 2008 did not fundamentally alter the

[22] See: Gaffard (2008)

extent of competition in the South African banking sector. However, the Lerner Index and the Boone Indicator shows that the South African banking sector was marginally more competitive before the crisis and became relatively less competitive after the crisis. Moreover, for the profit persistence model, the results move in the opposite direction to those found in the other two models. Conclusively the level of competition remained low before and after the 2008 financial crisis.

We have managed to run three models in determining the level of competition in the South African banking sector. The three models corroborate each other and find that there is low level of competition in the South African banking sector. The profit persistence results corroborate the results of the measures that are already being used in the South African context. Therefore, we can conclude that policies that are aimed at addressing low levels of competition in the sector are based on the correct premise.

This research can be extended to include a study of the banking sector in the South African Development Community (SADC) region. The studies that cover the trade-off between competition and bank stability as well as competition and efficiencies can make us of the profit persistence framework to measure competition.

6. Appendix

6.1. Appendix A

Table 1: Fisher type unit root test – Original variables

Variable	Inverse chi-squared Statistic prob	Inverse normal Statistic prob	Inverse logit Statistic prob	Modified inverse chi-squared Statistic prob
Profit	83.688***	-4.648***	-4.773***	5.620***
Total Assets	72.247***	-0.125	-1.532*	4.271***
Total Costs	62.932***	-2.562***	-2.675***	3.509***
Interest Expense	143.464***	-7.416***	-8.627***	12.665***
Personnel Expense	125.383***	-2.636***	-5.405***	10.534***
Operating Expense	85.663***	-0.481	-2.522***	5.853***
Total Revenue	84.928***	-3.063***	-3.893***	5.766***
Total Deposits	41.223*	-0.527	-0.615	1.449*

Note: level of significance dented as: *** $p<0.01$; ** $p<0.05$; * $p<0.1$

Table 2: Fisher type unit root test – Derived variables

Variable	Inverse chi-squared Statistic prob	Inverse normal Statistic prob	Inverse logit Statistic prob	Modified inverse chi-squared Statistic prob
Log Total Cost	196.133***	-5.058***	-10.431***	18.782***
Log Total Assets	83.278***	-4.488***	-4.542***	5.572***
Log Total Assets Squared	72.651***	-3.835***	-3.812**	4.319***
Sum (Log Input costs (w))	93.507***	-5.836***	-6.182***	7.688***
Sum Interaction (Log w)	83.081***	-5.393***	-5.458***	6.385***
Sum Interaction Log (TA & w)	82.022***	-4.889***	-5.176***	6.253***
Log Profit	101.531***	-6.614***	-7.002***	9.106***
Log marginal cost	75.154***	-5.043***	-4.908***	5.394***
Normalized Profit	52.155**	-1.950**	-1.938**	1.904**

Note: level of significance dented as: *** $p<0.01$; ** $p<0.05$; * $p<0.1$

6.2. Appendix B

Table 1: Correlation Matrix

	Profit	TA	TD	TR	TC	Interest	Personnel	Op exp	MC_GMM	LI_GMM	lnProfit	lnMC
Profit	1											
TA	0.961***	1										
TD	0.958***	0.996***	1									
TR	0.930***	0.965***	0.967***	1								
TC	0.506***	0.475***	0.484***	0.509***	1							
Interest	0.850***	0.920***	0.912***	0.959***	0.384***	1						
Personnel	0.972***	0.975***	0.979***	0.956***	0.577***	0.860***	1					
Op exp	0.951***	0.975***	0.975***	0.963***	0.539***	0.884***	0.986***	1				
MC_GMM	-0.473***	-0.503***	-0.507***	-0.473***	-0.248***	-0.445***	-0.479***	-0.473***	1			
LI_GMM	0.361***	0.317***	0.320***	0.391***	0.241***	0.317***	0.362***	0.371***	0.0598	1		
lnProfit	0.776***	0.782***	0.783***	0.811***	0.390***	0.781***	0.772***	0.783***	-0.402***	0.711***	1	
lnMC	-0.587***	-0.621***	-0.624***	-0.567***	-0.306***	-0.523***	-0.595***	-0.582***	0.963***	-0.00349	-0.494***	1
NormProfit	0.983***	0.948***	0.944***	0.929***	0.507***	0.862***	0.958***	0.947***	-0.440***	0.371***	0.788***	-0.548***

Source: Own calculation from

TA stand for total assets; TD stands for Total Deposits; TR stands for Total Revenue;

TC stands for Total cost; MC_GMM stands for the marginal cost computed using GMM;

LI_GMM stands for Lerner Index (GMM); NomrProfit stands for Normalized profits

***, ** and * stand for 1%, 5% and 10% levels of significance respectively.

6.3. Appendix C

Table 1: Marginal Cost per bank per year (GMM-SYS)

Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ABSA	0,07	0,06	0,06	0,06	0,05	0,04	0,04	0,04	0,05	0,05	0,04	0,03	0,03	0,03	0,03	0,03
African Bank	0,10	0,11	0,09	0,11	0,11	0,12	0,10	0,08	0,07	0,07	0,05	0,05	0,06	0,07	0,08	0,08
Albaranka					0,05	0,06	0,05	0,06	0,06	0,06	0,05	0,05	0,05	0,04	0,05	
Bidvest							0,20	0,17	0,12	0,12	0,07	0,09	0,08	0,08	0,08	0,06
FNB	0,06	0,05	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,05	0,04	0,04	0,04	0,03	0,03	0,03
GBS Mutual						0,07	0,07	0,07	0,08	0,09	0,07	0,07	0,06	0,06	0,06	0,06
Grinrod						0,06	0,06	0,08	0,09	0,07	0,06	0,06	0,04	0,03	0,04	
Habib						0,06	0,06	0,06	0,06	0,05	0,05	0,04	0,04	0,04	0,04	
HBZ			0,06	0,05	0,05	0,05	0,05	0,05	0,06	0,05	0,04	0,03	0,04	0,03	0,03	
IFC																
Investec	0,04	0,14	0,04	0,06	0,05	0,05	0,04	0,04	0,05	0,06	0,04	0,04	0,04	0,03	0,03	0,03
Mercantile Bank	0,09	0,11	0,13	0,11	0,08	0,07	0,06	0,07	0,06	0,06	0,05	0,05	0,05	0,05	0,05	0,06
Nedbank	0,05	0,06	0,05	0,06	0,04	0,04	0,04	0,05	0,05	0,05	0,04	0,04	0,04	0,03	0,04	0,03
Realpepi														0,12	0,13	0,15
Sabath	0,13	0,13	0,13	0,13	0,10	0,09	0,08	0,07	0,08	0,08	0,08	0,07	0,06	0,06	0,07	
Sasfin							0,11	0,10	0,11	0,13	0,12	0,10	0,07	0,07	0,08	0,07
Standard Bank	0,06	0,06	0,06	0,05	0,04	0,04	0,04	0,04	0,05	0,04	0,03	0,03	0,03	0,03	0,03	
VBS Mutual							0,08	0,08	0,09	0,10	0,08	0,08				

Table 2: OLS: Lerner Index per bank per year

Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	LI by Bank
ABSA	0,18	0,19	0,21	0,19	0,21	0,23	0,24	0,24	0,22	0,25	0,25	0,27	0,30	0,28	0,28	0,26	**0,24**
African Bank	0,57	0,44	0,46	0,49	0,53	0,54	0,59	0,64	0,55	0,55	0,56	0,57	0,56	0,57	0,53	0,39	**0,53**
Albaranka					0,07	0,06	0,09	0,16	0,16	0,08	0,06	0,09	0,12	0,11	0,14		**0,11**
Bidvest							0,31	0,40	0,40	0,42	0,32	0,47	0,48	0,43	0,42	0,39	**0,40**
FNB	0,19	0,19	0,20	0,22	0,26	0,20	0,25	0,24	0,25	0,22	0,25	0,26	0,30	0,32	0,33	0,34	**0,25**
GBS Mutual						0,08	0,10	0,11	0,12	0,08	0,01	0,01	0,04	0,06	0,07	0,09	**0,07**
Grinrod						0,17	0,10	0,25	0,12	0,15	0,25	0,14	0,16	0,18	0,17		**0,17**
Habib						0,18	0,19	0,28	0,29	0,28	0,21	0,21	0,23	0,23	0,21		**0,23**
HBZ			0,27	0,35	0,30	0,29	0,28	0,33	0,34	0,31	0,29	0,27	0,28	0,24	0,25		**0,29**
IFC																	
Investec	0,11	0,18	0,16	0,09	0,11	0,16	0,16	0,17	0,17	0,16	0,18	0,18	0,15	0,15	0,14	0,17	**0,15**
Mercantile Bank	0,12	-0,12	0,10	-0,11	-0,09	0,08	0,19	0,27	0,32	0,32	0,24	0,33	0,30	0,27	0,26	0,25	**0,17**
Nedbank	0,39	0,12	0,11	0,09	0,14	0,21	0,22	0,23	0,21	0,22	0,23	0,25	0,27	0,27	0,26	0,24	**0,22**
Realpepi														0,58	0,45	0,37	**0,47**
Sabath	-0,07	-0,27	-0,14	-0,07	-0,01	0,07	0,11	0,14	0,17	0,02	-0,05	0,00	0,09	0,12	0,08		**0,01**
Sasfin							0,36	0,29	0,34	0,31	0,19	0,31	0,25	0,22	0,26	0,21	**0,28**
Standard Bank	0,23	0,24	0,25	0,22	0,24	0.00	0,04	0,05	0,10	0,10	0,04	0,03	0,03	0,04	0,04		**0,11**
VBS Mutual							0,04	0,04	0,11	0,11	0,00	-0,06					**0,04**
LI by Year	**0,21**	**0,12**	**0,18**	**0,16**	**0,18**	**0,18**	**0,20**	**0,24**	**0,24**	**0,22**	**0,19**	**0,21**	**0,24**	**0,25**	**0,24**	**0,27**	**0,21**

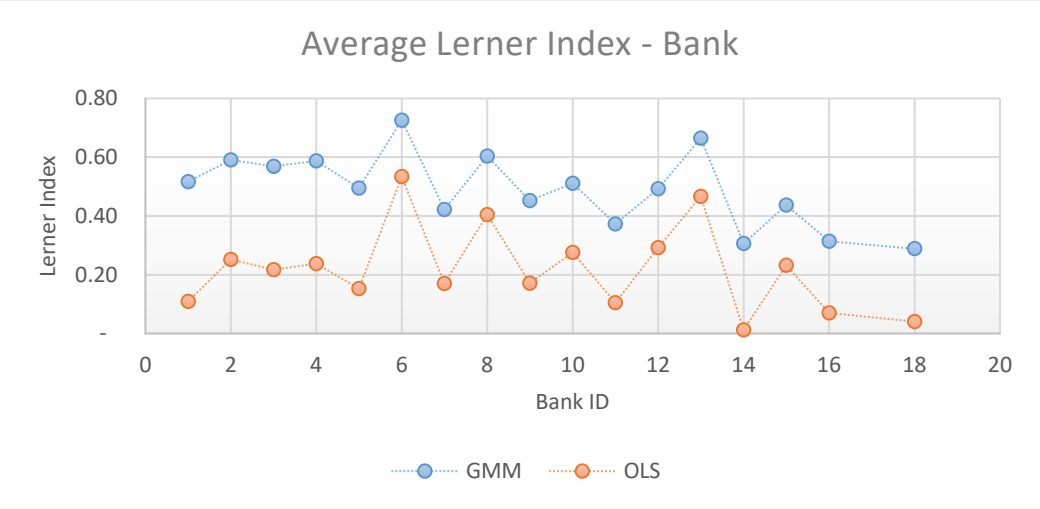
Table 3: Big four banks vs Other banks (Average Lerner Index)

Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Big four banks	0,57	0,54	0,55	0,55	0,56	0,54	0,55	0,56	0,57	0,57	0,57	0,57	0,58	0,59	0,59	0,62
Other Banks	0,46	0,39	0,44	0,43	0,42	0,43	0,44	0,48	0,49	0,48	0,44	0,46	0,49	0,50	0,50	0,53

Table 4: Median Lerner Index by Year

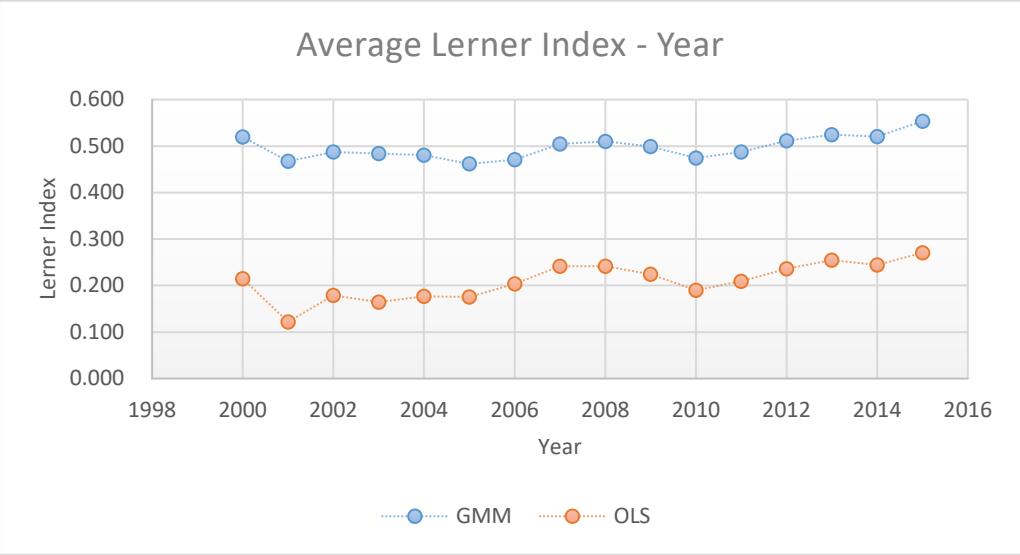
Bank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Median LI by Year	0,54	0,54	0,49	0,51	0,49	0,43	0,47	0,50	0,52	0,51	0,48	0,48	0,50	0,49	0,50	0,59

Figure 1: Graph - Average Lerner Index by Bank



Note: For each Bank ID, there is a corresponding Bank name. See Appendix E Table 1

Figure 2: Average Lerner Index for South African banks (2000 – 2015)



6.4. Appendix D

Table 1: South African Banking Indicators (2000 – 2015)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Foreign Banks/Total SA	13%	15%	16%	17%	17%	21%	22%	22%	23%	23%	24%	24%	24%	24%		
Concentration ratio (CR3)	87%	77%	77%	77%	100%	79%	76%	77%	78%	76%	79%	78%	77%	77%	77%	78%
Regulatory Tier 1 Capital to RWA									11%	12%	12%	13%	13%	14%	14%	13%
ROE	9%	6%	6%	1%	31%	27%	25%	26%	20%	15%	14%	16%	16%	11%	12%	15%
Bank Lending Deposit Spread	5%	4%	5%	5%	5%	5%	4%	4%	4%	3%	3%	3%	3%	3%	3%	3%
Cost to Income Ratio	52%	51%	59%	72%	64%	64%	59%	55%	50%	52%	58%	58%	55%	56%	57%	
Deposits /GDP	9%	6%	6%	1%	31%	27%	25%	26%	20%	15%	14%	16%	16%	11%	12%	15%
Credit to Private sector/GDP	59%	60%	57%	58%	57%	61%	69%	75%	79%	76%	72%	68%	69%	70%	70%	72%

Source: World Bank; Bank for International Settlements; International Monetary Fund: retrieved from FRED, Federal Reserve Bank of St. Louis

6.5. Appendix E

Table 1: Bank ID description

ID	Bank Name
1	Standard Bank
2	First National Bank (FNB)
3	Nedbank
4	Amalgamated Banks of South Africa (ABSA)
5	Investec
6	African Bank
7	Grinrod
8	Bidvest
9	Mercantile Bank
10	Sasfin
11	Albaranka
12	HBZ Bank Limited
13	Real People Investment Holdings
14	South African Bank of Athens
15	Habib Overseas Bank
16	GBS Mutual
17	Infrastructure Finance Corporation (IFC)
18	VBS Mutual Bank

6.6. Appendix F

Table 1: Profit Persistence Results for the Big four banks vs Other banks

VARIABLES	Big Four System GMM	Other Banks System GMM
Normalized Profit (Lag)	0.933***	1.081***
	(0.125)	(0.069)
Constant	997.843**	-63.555
	(295.476)	(172.827)
Observations	60	139
Number of ID	4	13
Banks	4	13
No. of instruments	4	4
AR1 p-value	0.1189	0.278
AR2 p-value	0.9106	0.913
Hansen p-value	0.143	0.006

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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