

Testing for Competition in the South African Banking Sector*

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November 4, 2009

Abstract

This paper seeks to determine the level of competition in the South African banking sector. This is done by using two non-structural methods of measurement, namely the Panzar and Rosse approach and the Bresnahan model. These two methods have been used in a wide range of papers, on varying countries, and seem to be generally accepted as an accurate measure of the level of competition in the banking sector. The results of both of these non-structural models has shown that the South African banking sector faces a high level of monopolistic competition, even characteristics of perfect competition. This level of competition was tested during the period 1998 to 2007 for the Panzar and Rosse approach and from 1992 to 2008 for the Bresnahan model. This result supports other non-structural studies on the South African banking sector.

1 Introduction

A competitive banking sector is important for the proper functioning of the economy. Indeed, the banking sector is the cornerstone of any properly functioning modern economy. At a micro level, banks, just like any other firms,

*The views expressed herein are solely those of the authors – they do not reflect the views of the authors' respective institutions.

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sell products to consumers - hence we need to worry about efficiency implications if the banking sector is not competitive. However, banks are much more important than this at a macro level. Firstly, banks advance credit or loans to both firms and consumers and thus an uncompetitive banking sector will lead to an underprovision of such credit or loans (Claessens & Laeven, 2005). This may negatively impact the overall economic performance of the country. Secondly, banks act as the primary conduit of monetary policy. To this regard, a low level of competition in the banking sector may hamper the effectiveness of monetary policy as banks may not respond appropriately to monetary tightening and or easing (Van Leuvensteijn et al. 2008).¹

It is for these and other reasons that the issue of determining the level of competition in the banking sector has been a topic of interest to academics, policy makers as well as the general public. Despite the importance of such competition research, there has historically been very few studies of the level of competition in the South African banking sector. Looking at prior structural studies of the South African banking sector, authors such as Falkena *et al.* (2004) and Okeahalam (2001) have generally concluded that the sector is highly concentrated. This high level of concentration is due to a few large banks dominating the market. It is traditionally believed that a high level of concentration shows that the banking sector is suffering from a low level of competition – the so-called structure-conduct performance paradigm. This paper is an attempt at a comprehensive study of the nature of competition in the South African banking sector.

Many authors² have given much criticism to using structural methods when measuring competition in the banking sector. This paper therefore focusses on non-structural forms of measurement which takes into account that banks behave differently depending on the market structure in which they operate (Baumol, 1982). Two models were used in this study to ensure that the results of one model were not inaccurate due to data or model

¹Indeed, Kot (2004), in his study of the interest rate pass-through in the new EU-member states finds that increases in the degree of competition in the banking sector coincides with faster transmission of the monetary policy impulses to the consumer credit prices.

²Including Demsetz (1973); Berger (1995); and Mullineux & Sinclair (2000).

issues. The non-structural models used are the Panzar and Rosse (1987) approach and the Bresnahan (1982) model. The results of both of the non-structural models in this paper have found that the South African banking sector has a relatively high level of competition - even when compared to similar developing countries. Another non-structural study by Claessens & Laeven (2003) has also found that the South African banking sector faces a high level of competition.

This paper is organised as follows: Section 2 discusses the various theories and methods used to measure competition and give an overview of the South African banking sector. Section 3 discusses the Panzar and Rosse approach in detail while section 4 provides the analysis and results of the Bresnahan methodology. Section 5 compares the results of the two models while section 5.2 makes a comparison between the results of this paper to outcomes found in comparable developing countries. Finally, section 6 concludes the paper.

2 Literature Review

2.1 Banking Competition Theory

There have traditionally been two main methods for determining the level of competition in the banking sector, namely tests on structural and non-structural characteristics of banks.

The structural tests focus on characteristics such as the level of concentration in the industry, the number of banks, market share, etc (Bain, 1951). There are two main structural theories, the structure-conduct-performance (SCP) framework and the efficiency hypothesis (EH) (Bikker & Haaf, 2001). The SCP framework says that in highly concentrated markets, banks use market power to increase profits through higher loan prices and lower deposits rates - leading to a low level of competition (Bain, 1951). This is the most commonly used structural test for competition.

There are many criticisms to the SCP framework. One theoretical criticism was originally put forth by Demsetz (1973) and later by Berger (1995).

They believe that the larger market shares which lead to a high level of concentration, may be as a result of better efficiency and lower costs rather than a low level of competition. Other arguments against the use of concentration as a measure of the level of competition include the theory introduced by Mullineux & Sinclair (2000). They argue that although higher concentration may lead to higher prices, and as a result lower demand, it does not necessarily result in higher profits for a highly concentrated banking sector. Indeed, the modern (New Empirical Industrial Organization (NEIO)) view is that both industry structure and industry performance are endogenous – being driven by some other factors. As Schmalensee (1989) puts it, “..except in textbook competitive markets, derived market structure is clearly affected by market conduct in the long run” (p. 954). The NEIO thus does not assume a causal relationship between market structure and performance, but rather, the approach tests competition and the use of market power (Bikker and Haaf (2002b: 21; Bresnahan (1989)).

The most commonly used non-structural models in banking sector studies are the Panzar and Rosse approach (Panzar & Rosse, 1977; Rosse & Panzar, 1987) and the Bresnahan model³ (Bresnahan, 1982).⁴ These models recognise that banks behave differently depending on the market structures in which they operate (Baumol, 1982). They also do not ignore the relationship between market contestability and revenue behaviour at the firm level, which the structural methods do (Perera *et al.*, 2006).

2.2 Overview of the South African Banking Sector

In the recent Banking Enquiry carried out by the Enquiry Panel of the Competition Commission (Jali *et al.*, 2008), it was concluded that the South African banks were not acting as a cartel.⁵ Despite this, the panel also believes that the cost and trouble involved for customers to switch banks

³ Added to by Lau (1982).

⁴The third model, the Iwata model (Iwata, 1974), is less utilised due to its rigid data requirements (Perera *et al.*, 2006). The Bresnahan model is an improved version of the Iwata model and has been used in numerous studies.

⁵This conclusion is arrived at based on qualitative (as opposed to quantitative) analyses of the banking sector.

weakens the competitive effect of price differences between banks. They stated that this “allows supra-competitive pricing to be maintained.” (Jali *et al.*, 2008. p.28). The Competition Commission’s Enquiry Panel therefore suggests that although there is competition in the banking sector, there is still need for intervention in certain aspects of the banks’ conduct. They recommend that banks should have to ensure greater transparency and disclose product and pricing information; reduce search costs and improve comparability between products; and reduce the actual cost of switching and assist consumers in doing so. This would result in greater ease for customers to switch between banks and prevent them from being *locked in* once they have joined a bank. The panel believes that this will in turn raise the level of competition in the banking sector. There is no guarantee of this improvement in competition though. Increasing the market transparency on the products and prices offered by banks may actually help facilitate collusion in the market (See for instance Tirole, 1988).⁶

Table 1 below shows how important the South African banking sector is to the economy.

TABLE 1 - Key Banking Values as a Percentage of GDP

	2003	2004	2005	2006	2007
Total Deposits ^a	72%	74%	80%	88%	93%
Loans to Public Sector ^a	6%	5%	5%	4%	3%
Loans to Private Sector ^a	58%	61%	67%	76%	81%

^a As a percentage of GDP.

Source??

The table illustrates that banks in South Africa play an important role as major lenders, especially to the private sector. They also receive a huge

⁶ A case where increased market transparency was harmful to competition is the famous case in Danish Cement industry whereby the competition authority decided to intervene to enhance the competition by requiring a daily price list (for two grades of ready-mixed concrete) to be revealed but this had an adverse effect on the competition and rather encouraged collusion. The requirement to publish a price list resulted in substantially reduced price dispersion and average prices of reported grades increased by 15–20 percent within one year (Albaek, Mollegard and Overgaard, 2003).

amount of deposits. They therefore play an important part towards the facilitation of the credit process.

In the banking sector, the measure of market share can be approximately calculated by the bank's total assets or total deposits as a percentage of industry totals. It can be seen in Tables 2 and 3 below that the total deposits and total assets in 2007 are dominated by the four main banks, Standard Bank, Firststrand, Nedbank and ABSA. These four banks therefore hold a large majority of the market share, in excess of 90%. This high market share should potentially allow them to partake in collusive practices, raising their lending rate and lowering their deposit rate.

TABLE 2 - Market Share by Deposits

<i>Bank</i>	<i>Total Deposits (R million)</i>	<i>% of Industry Deposits</i>
Standard Bank	705,843	36%
Firststrand	416,507	21%
Nedbank	384,541	19%
ABSA	368,545	19%
Other Banks	96,242	5%

TABLE 3 - Market Share by Total Assets

<i>Bank</i>	<i>Total Assets (R million)</i>	<i>% of Industry Assets</i>
Standard Bank	1,175,409	36%
Firststrand	717,257	22%
Nedbank	483,609	14%
ABSA	640,608	19%
Other Banks	290,227	9%

The South African banking sector has a total of 22 registered banks including locally owned banks, foreign owned banks and mutual banks (Reserve Bank, 2008a; 2008b; 2008c). It can be seen that the majority of the banks hold a very small portion of the market share. The South African banking sector can therefore be characterised as highly concentrated (Okeahalam, 2001).

2.3 Prior South African Banking Competition Research

Okeahalam (2001) attempts to measure the level of competition in the South African banking sector by means of analysing the concentration in the industry. Okeahalam (2001) follows the structure-conduct-performance (SCP) framework⁷ and concludes that the South African banking sector is highly concentrated - which normally leads to a high likelihood that there will be a collusive oligopoly in the industry.

Another study of the concentration in the South African banking sector was carried out by Falkena *et al.* (2004) as part of a Task Group Report for The National Treasury and the South African Reserve Bank. They used various methods including the Herfindahl-Hirschman Index to determine the concentration in the sector. They concluded that there was in fact high concentration in the South African banking sector, but that “The high cost and lack of access to banking services for small and micro-enterprises may have more to do with a number of structural factors than [to]⁸ the level of competition in banking.” (Falkena *et al.*, 2004. p.151).

Darji (2009) uses the Panzar and Rosse approach to test for competition in the South African banking sector using data for the period 2001 to 2006. She finds evidence of monopolistic competition. Claessens & Laeven (2003) use the Panzar and Rosse approach to measure the level of competition in the banking sector of fifty countries across the world for the period 1994 to 2001. The South African banking sector was included in their study. They found that the South African banking sector faces a high level of competition, which supports the results found in this paper.

This paper adds to the studies by Darji (2009) and Claessens & Laeven (2003) by testing the level of competition using the Panzar and Rosse approach for a longer period (1998 to 2007), as well as using a second model, the Bresnahan model.

⁷See also Burger & Hannan (1989) and Okeahalam (1998).

⁸Error in paper Falkena *et al.* (2004).

3 The Panzar and Rosse Approach

3.1 Methodology

3.1.1 The Theoretical Model

The first approach we use for measuring competition in the South African banking sector is the Panzar and Rosse Approach - Rosse and Panzar (1977) and Panzar and Rosse (1987). This approach measures competition on panel data by comparing the properties of each bank's reduced form revenue equation across time. Two of the important assumptions underpinning this model are (i) that banks operate in their long run equilibrium and (ii) that all banks hold a homogeneous cost structure.⁹

This model measures the level of competition by establishing how each of the individual banks' revenues react to proportionate changes in input prices. If the banks act as monopolies or at least in a monopolistic manner, and they face positive marginal costs, they will produce where demand is elastic. An increase in input prices will increase marginal costs, causing equilibrium output to decrease and equilibrium price to increase. Given that their elasticity of demand is greater than unity, the increase in prices will result in a reduction in the total revenue of the banks. This reduction in revenue reveals that banks are acting in an anticompetitive manner.

In a perfectly competitive environment however, an increase in input prices leads to a rise in both marginal and average costs, with no change in the optimal output for the individual banks.¹⁰ Theoretically, some banks should exit the market, allowing the demand faced by the remaining banks to increase. This should result in a proportionate increase in prices and revenues. The percentage increase in revenues should be exactly equal to the percentage increase in marginal costs in the case of a perfectly competitive market (Bikker & Haaf, 2002). Should the industry environment be that of monopolistic competition, the revenue will still increase by the same

⁹However, the long run equilibrium hypothesis is not a prerequisite when testing for monopoly (Panzar and Rosse (1987: 446)).

¹⁰This hinges on the assumptions of linear homogeneity of the cost function and long run equilibrium.

mechanism as in perfect competition, but by not as much as the marginal cost. The more competitive the market, the more the revenues will increase as a result of an in increased input prices.

By maximising profits at both the individual bank and industry level, the equilibrium output and equilibrium number of banks can be found. At the bank level, marginal revenues must equal marginal costs in order to maximise each bank's individual profits, therefore

$$R'_i(x_i, n, z_i) - C'_i(x_i, w_i, t_i) = 0,$$

where R'_i and C'_i are the marginal revenue and marginal cost of bank i respectively. The marginal revenue of bank i is a function of their output (x_i) and a vector of variables that shift their revenue function exogenously (z_i), as well as the number of banks (n). The marginal cost of bank i is a function of their output, a vector of m factor input prices faced by the bank (w_i), and a vector of variables that shift their cost function exogenously (t_i).

Furthermore, in order to determine the optimal number of banks¹¹, the zero profit constraint must also hold at the industry level. Therefore

$$R_i^*(x^*, n^*, z) - C_i^*(x^*, w, t) = 0,$$

where the superscript * denotes equilibrium values.

Panzar and Rosse have defined an H -statistic as the sum of the elasticity of the banks' revenue with respect to a change in each of m factor input prices. The H -statistic is therefore

$$H = \sum_{k=1}^m \left[\frac{\delta R_i^*}{\delta w_{k_i}} \cdot \frac{w_{k_i}}{R_i^*} \right],$$

where R_i^* is the equilibrium revenue for bank i and w_{k_i} is the input price of factor k for bank i .

The H -statistic derived by Panzar and Rosse is positively related to the

¹¹If this condition does not hold at the industry level, banks will realise potential profits (losses) and enter (leave) the market until the equilibrium number of banks is obtained. This zero profit constraint holds at this equilibrium.

level of competition in the banking sector. The testable hypotheses of the theory are provided in Table 4 below.

TABLE 4 - The Panzar-Rosse H -Statistic Outcomes

<i>Estimated H</i>	<i>Competitive Environment/Equilibrium</i>
$H \leq 0$	Monopoly/Colluding Oligopoly - Each bank operates under monopoly profit maximising conditions. H is a decreasing function of the perceived demand elasticity.
$0 < H < 1$	Monopolistic Competition - Free entry but where banks operate with some excess capacity. H is an increasing function of the perceived demand elasticity.
$H = 1$	Perfect Competition - Free entry with full capacity utilisation.

3.1.2 The Empirical Model

The theoretical model described above has been interpreted by many authors in different ways. This paper will follow the methodology by Bikker and Haaf (2002). They have stated their reduced form revenue equation as

$$\begin{aligned} \ln INTR = & \alpha + (\beta \ln AFR + \gamma \ln PPE + \delta \ln PCE) + \zeta \ln BSF \\ & + \eta \ln OI + e, \end{aligned} \quad (1)$$

where $INTR$ is the ratio of total interest revenue to the total balance sheet; AFR is the ratio of annual interest expenses to total balance sheet; PPE is the ratio of personnel/staff expenses to total balance sheet; PCE is the ratio of physical capital expenditure and other expenses to fixed assets; BSF are Bank Specific Factors¹²; OI is the ratio of other income to the total balance sheet; and e is the stochastic error term.

Given this structure of the reduced form revenue equation, the H statistic can be represented as $\beta + \gamma + \delta$.

¹²Listed and explained in Section 3.2.

3.1.3 Data

All of the data are available from individual banks' annual reports and financial statements. A list of registered banks in South Africa was obtained from the South African Reserve Bank website. These registered banks include locally controlled banks (Reserve Bank, 2008a); foreign controlled banks (Reserve Bank, 2008b); and mutual banks (Reserve Bank, 2008c). Of these 22 registered banks, a number of them are in the process of liquidation. Others are not listed on the JSE Securities Exchange, making attainment of the key variables difficult. Of the registered banks included in this study, some of the years annual reports and financial statements are not available or do not disclose all of the key variables. Some of the banks therefore have missing years in the dataset used - reducing the number of observations. Furthermore, few of the observations have negative ratios, resulting in an undefined value when the natural log of that ratio is taken. This further reduces the number of observations. Given that this is panel data, the few missing observations do not significantly impact the results of this model.

The annual reports and financial statements were obtained from McGregor BFA. The dataset was made up of data from fourteen banks over the period 1998 to 2007. With missing data from some banks in some of the time periods, the panel regression includes 108 observations. We conduct the P-R test on small, large and all banks to account for any possible heteroskedasticity.

The BSF variable includes all bank specific exogenous factors. These bank specific factors are other explanatory variables that reflect differences in risks, costs, size and structure of banks (Bikker & Haaf, 2002). In this study we use two bank specific (exogenous) ratios: Equity to Total Assets (BSF-EQ) and Loans to Total Assets (BSF-LO).¹³ The inclusion of the non-performing loans ratio reduces the sample size to half. It was decided that the benefit of this gain in a control variable does not outweigh the loss of power of the model. This variable was therefore excluded from the

¹³Bikker and Haaf (2001) used, in addition to the risk component, the differences in deposit mix control and the divergent correspondent activities control. However, due to the unavailability of data, these variables cannot be computed for South Africa.

regression.¹⁴

3.2 Empirical Results

The output of the model is shown in Table 5 below:

Table 5: Regression output for the Panzar-Rosse methodology

Variable	all banks		large banks		small banks	
	coeff	t-value	coeff	t-value	coeff	t-value
Average Funding Rate	0.2512***	3.30	0.7059***	21.37	0.1814*	1.73
Price of Personnel Expenses	0.5723***	4.54	0.2748***	3.69	0.4967***	2.98
Price of Capital Expenditure	-0.0760*	-1.67	-0.0135	-1.13	-0.0986	-1.53
Other Income	-0.1032	-0.82	0.0146	-0.32	-0.0807	-0.46
Bank Specific Factors - Equity	0.0912	0.69	0.0934*	1.71	0.0162	0.09
Bank Specific Factors - Loans	-0.0351	-0.68	0.0106	0.51	-0.0330	-0.48
Constant	0.3610	0.64	1.0042***	5.14	-0.2651	-0.33
	$R^2 = 0.7395$		$R^2 = 0.9833$		$R^2 = 0.7377$	
	$H = 0.7475$		$H = 0.9672$		$H = 0.5795$	

*** Significant at the 1% level
* Significant at the 10% level

The models are adequately explained, with R^2 values ranging from 0.7377 to 0.9833. This shows that the exclusion of the other control variables has not affected the models significantly.

Summing the three key coefficients in regression 1 gives an H -statistic of 0.7475 for all banks, an H -statistic of 0.9672 for the four large banks and an H -statistic of 0.5795 for small banks. For large banks and for all banks, the null hypothesis that the H -statistic is equal to 1 cannot be rejected at the 95%, or even at the 90% confidence interval¹⁵. This means that the H -statistic is not statistically different from 1. Again, for the large banks

¹⁴The inclusion of so few controls does not seem to be a problem as can be seen in the outputs in Appendix 1 of Bikker & Haaf's 2002 paper. For many of the countries in their study there are very few bank specific factors included in the regression.

¹⁵This method of determining whether H is statistically equal to 0 or 1 was used by Bikker & Haaf (2002).

and for all banks, the null hypothesis that $H = 0$ is rejected at the 99% confidence interval showing H to be statistically different from 0. A further test to determine whether H is statistically equal to 0 or to 1 is by means of a Wald test¹⁶. Firstly, with a null hypothesis $H_0 : \beta_{AFR} + \gamma_{PPE} + \delta_{PCE} = 0$, the χ^2 statistic is equal to 46.88. The null can therefore be rejected at the 5% significance level and it can be concluded that the sum of the three coefficients (i.e H) is not statistically equal to 0. Secondly, the null hypothesis $H_0 : \beta_{AFR} + \gamma_{PPE} + \delta_{PCE} = 1$ has a corresponding χ^2 value of 1.11. The null therefore cannot be rejected at the 5% significant level and the H -statistic is therefore statistically equal to 1.

For small banks, the H -statistic is 0.5795. Conducting the same tests of significance as above, it was found that the null hypothesis that this H is statistically equal to 1 is rejected, even at the 90% confidence interval. This shows that this H -statistic is statistically different from 1. Similarly, the null hypothesis that the H-statistic for small bank is equal to zero is rejected with much confidence.

The result of this application of the Panzar and Rosse approach reveals that, with regard to interest income, the South African banking sector is highly competitive - even facing the characteristics of a perfectly competitive industry. The results are even more astounding when we separate the small and the large banks. It is found that large banks operate under conditions consistent with perfect competition, with an H statistic of 0.9672. On the contrary, small banks exhibit an H- statistic of 0.5795 – consistent with monopolistic competition. Thus, whereas small banks exhibit some market power, large banks appear to have market power in the interest income market.

These findings suggest that small banks face less competition in the interest income market. One possible explanation for this finding is that either small banks mainly operate in geographically segmented markets or they tend to serve niche markets. This would allow them to exercise market power. On the contrary, the four large banks operate in the national (and

¹⁶This second method of determining whether H is statistically equal to 0 or 1 was used by Murjan & Ruza (2002) and Perera *et.al* (2006).

even international) market. As a result they tend to compete aggressively against one another.¹⁷ Indeed, anecdotal evidence points to significant competition (both price and non-price competition (e.g., mortgages, advertising) among the large banks.

4 The Bresnahan Model

4.1 Methodology

4.1.1 The Theoretical Model

The second model that is used to measure competition in the South African banking sector is the Bresnahan Model (Bresnahan (1982)). This is a non-structural test for the degree of competitiveness, such that this model can be used even when there is no cost or profit data available. This can be done by using industry aggregate data to measure this competition.

The idea behind this model is to see how price and quantity react to changes in exogenous variables - revealing the degree of market power of the average bank, and hence the level of competition in the banking industry.

The profit function for the average bank takes the form of

$$\Pi_i = px_i - c_i(x_i, EX_S) - F_i,$$

where Π_i is profit; x_i is the quantity of output of the bank; p is the output price; c_i are the variable costs; and F_i are the fixed costs faced by bank i . The variable costs are a function of the output of the bank, as well as the exogenous variables that affect marginal costs, but not the industry demand function (EX_S).

¹⁷This analysis focuses on the interest income market. It is possible that banks may compete aggressively in the interest income segment while colluding in the non-interest income market – a scenario termed semicollusion. Indeed, one of the major concerns of the Competition Commission of South Africa is that banks appear to be fleecing consumers in respect of bank charges and other non-interest charges. In the sphere of non-interest charges, the large banks appear to possess significant market power owing to the high switching costs associated with banking services in South Africa.

The inverse of the demand function faced by the banks is

$$p = f(X, EX_D) = f(x_1 + x_2 + \dots + x_n, EX_D),$$

such that prices are a function of exogenous variables that affect the industry demand but not the marginal cost (EX_D) and each of the n bank's outputs.

The first order conditions for profit maximisation of bank i is

$$\frac{d\Pi_i}{dx_i} = p + f'(X, EX_D) \frac{dX}{dx_i} x_i - c'(x_i, EX_S) = 0.$$

Summing over all banks gives

$$p + f'(X, EX_D) \frac{dX}{dx_i} \frac{1}{n} X - c'(x_i, EX_S) = 0,$$

such that

$$p = -\lambda f'(X, EX_D) X + c'(x_i, EX_S), \quad (2)$$

where λ is the measure of the level of competition in the banking sector and is equal to

$$\lambda = \frac{dX}{dx_i} \frac{1}{n} = \left(1 + \frac{d \sum_{j \neq i} x_j}{dx_i} \right) \frac{1}{n}.$$

λ is therefore a “function of the conjectural variation¹⁸ of the average firm in the market” (Bikker & Haaf, 2001). In a perfectly competitive industry, an increase in the output of bank i should result in a decrease of all other banks' outputs totalling the same magnitude as the initial increase in bank i 's output. Thus $\lambda = \left(1 + \frac{d \sum_{j \neq i} x_j}{dx_i} \right) \frac{1}{n} = (1 - 1) \frac{1}{n} = 0$, irrespective of the number of banks, n . If there is perfect collusion in the industry, an increase in bank i 's output will result in an equal increase in the output of all the other banks in the industry. This means that $\frac{d \sum_{j \neq i} x_j}{dx_i} = \frac{X - x_i}{x_i}$ and as a result $\lambda = \frac{X}{x_i n} = 1$. For a single monopolist, there are no other banks in the industry. Bank i can therefore not anticipate any change in output, as a reaction to the change in its output, by any other bank. This results in

¹⁸Conjectural variation is the change in output of the other banks, anticipated by bank i as a response to an initial change in its own output.

$\frac{d\sum_{j \neq i} x_j}{dx_i} = 0$. Therefore $\lambda = \frac{1}{n}$ where $n = 1$, from which $\lambda = 1$. Under the usual assumptions, these are the two extreme values of λ corresponding to opposite levels of competition in the industry. The conduct parameter λ is restricted between 0 and 1, and is proportional to the level of competition in the industry.

4.1.2 The Empirical Model

Bikker and Haaf (2001) apply the Bresnahan model to measure competition in the European banking market. They equate the following demand and supply equations for the deposits market such that λ can be found,

$$DEP = \alpha_0 + \alpha_1 r_{dep} + \alpha_2 EX_D + \alpha_3 EX_D r_{dep} + \epsilon, \quad (3)$$

where DEP is the real value of total deposits in the industry; r_{dep} is the market deposit rate; EX_D are the exogenous variables that affect industry demand for deposits, but not the marginal costs - including disposable income, unemployment, number of bank branches and interest rates for alternative investments (the money market rate and the government bond rate); and ϵ is the error term. The interaction terms $\alpha_3 EX_D r_{dep}$ are included to ensure the identifiability of the conduct parameter, λ . Without the interaction terms, one cannot distinguish competition from monopoly (Bresnahan 1982: 152-153).

On the supply side, Bikker and Haaf postulate the following marginal cost function:¹⁹

$$MC_i = \beta_0 + \beta_1 DEP_i + \beta_2 EX_{S_i} + v_i, \quad (4)$$

where MC_i is the marginal cost for each bank; EX_{S_i} are the exogenous variables that influence the supply of deposits, including the cost of input factors for the production of deposits - wages; and v_i is the error term.

¹⁹There is no requirement that the "true" marginal cost be linear. We can view (4) as a linear approximation of the marginal cost function.

Rearranging the demand function yields,

$$r_{dep} = \frac{1}{\alpha_1 + \alpha_3 EX_D} [DEP - \alpha_0 - \alpha_2 EX_D - \epsilon]. \quad (5)$$

The total revenue for each bank can be obtained by multiplying the above rearranged demand equation by bank i 's total deposits, DEP_i ,

$$TR_i = \frac{1}{\alpha_1 + \alpha_3 EX_D} [DEP - \alpha_0 - \alpha_2 EX_D - \epsilon] DEP_i. \quad (6)$$

Differentiating this total revenue with respect to bank i 's deposits will give the bank's marginal revenue,

$$\begin{aligned} MR_i &= \frac{dTR_i}{dDEP_i} = \frac{1}{\alpha_1 + \alpha_3 EX_D} [DEP - \alpha_0 - \alpha_2 EX_D - \epsilon] \\ &\quad + \frac{1}{\alpha_1 + \alpha_3 EX_D} \frac{dDEP}{dDEP_i} DEP_i \\ &= r_{dep} + \frac{\lambda n}{\alpha_1 + \alpha_3 EX_D} DEP_i. \end{aligned} \quad (7)$$

Equating the marginal revenue and marginal cost of each bank to obtain the market equilibrium,

$$r_{dep} + \frac{\lambda n}{\alpha_1 + \alpha_3 EX_D} DEP_i = \beta_0 + \beta_1 DEP_i + \beta_2 EX_{S_i} + v_i. \quad (8)$$

Rearranging and averaging to obtain the supply of deposit facilities by the banks yields:

$$r_{dep} = -\lambda \frac{DEP}{\alpha_1 + \alpha_3 EX_D} + \beta_0 + \beta_1 DEP + \beta_3 EX_S + v. \quad (9)$$

In order to find the λ statistic, two regressions need to be run. Firstly the demand equation, equation (3) must be estimated in order to find the α_1 and α_3 coefficients. These coefficients are then used to create the conduct variable $DEP/(\alpha_1 + \alpha_3 EX_D)$ which gives the $-\lambda$ coefficient in equation (9).²⁰ We thus have a simultaneous equation system and because of the possible

²⁰Identification of λ requires that both $\alpha_1 \neq 0$ and $\alpha_3 \neq 0$ holds.

endogeneity problem, equations (3) and (9) are estimated simultaneously to identify λ .

4.1.3 The λ Statistic

This coefficient λ is the value that determines the level of competition in the banking sector - with an opposite interpretation to the H statistic in the Panzar and Rosse approach.

TABLE 8 - The Bresnahan λ Statistic Outcomes

<i>Estimated λ</i>	<i>Competitive Environment/Equilibrium</i>
$\lambda = 1$	Monopoly/Colluding Oligopoly - Each bank operates under monopoly profit maximising conditions. H is a decreasing function of the perceived demand elasticity.
$0 < \lambda < 1$	Monopolistic Competition - Free entry but where banks operate with some excess capacity. H is an increasing function of the perceived demand elasticity.
$\lambda = 0$	Perfect Competition - Free entry with full capacity utilisation.

The estimated equations are:

$$dep = a_0 + a_1 dep_1 + a_2 r_{dep} + a_3 gdp + a_4 inf + a_5 r_{dep} inf + a_6 r_{dep} gdp + \epsilon, \quad (10)$$

$$r_{dep} = -\lambda dep / (a_2 + a_5 inf + a_6 gdp) + b_0 + b_1 dep + \beta_2 wage + b_4 inf + b_5 mm_r + v, \quad (11)$$

where dep is the volume of (current) deposits, dep_1 is the volume of deposits lagged one period, r_{dep} is the deposit rate, gdp is the real gross domestic product, inf is the inflation rate, $r_{dep} inf$ and $r_{dep} gdp$ are interaction terms; $wage$ is the average wage and mm_r is the money-market rate. The variable, $dep / (a_2 + a_5 inf + a_6 gdp)$ is the conduct variable and its coefficient, $-\lambda$, is the parameter of interest. That is, λ is a measure of the degree of

competition in the banking sector. The parameters ϵ and v are the respective error terms.

4.1.4 Data

The data required for the Bresnahan model are all macroeconomic (industry level) time series variables. Macroeconomic data is generally easier to obtain than microeconomic data. This is one of the benefits of using the Bresnahan model versus models that use bank specific data such as the Panzar and Rosse approach. In the case of a developing country such as South Africa however, this data is not always readily available. For example, there is not sufficient data to enable us to test competition for the loans market. Hence we restrict our study to the deposits market.

Unfortunately historical unemployment data is not readily available for South Africa. The longest range was available from the International Monetary Fund's International Financial Statistics (IFS) database which contained quarterly data from Q1 of 1992 until present. This dataset has a two year gap from Q1 of 1998 until Q4 of 1999. This has therefore restricted the study to 57 periods. Most of the remaining variables were also obtained from the IFS database. The *wage* variable was obtained from the Inet Bridge database as the total pay per worker at constant 2000 prices. Disposable income data was only available annually from the South African Reserve Bank database. Imputing quarterly values would result in inaccurate data, therefore a proxy for the disposable income was used. The best proxy would be the Gross Domestic Product (GDP) at constant 2000 prices. This is because the disposable income is calculated from the GDP by subtracting aggregate taxes from this value.²¹ There was insufficient time series data on the number of bank branches, therefore this variable was excluded from this study.

²¹Bikker & Haaf (2002) also used GDP as a proxy for disposable income.

4.2 Empirical Results

The volume of deposits is determined by the price of deposits (the deposit rate) and exogenous variables such as GDP, government bill rate, the money market rate and inflation (3). The volume of deposits at time t is also determined by the volume of deposits at time $t - 1$ (i.e., lagged deposits). The coefficient on the deposit rate should be positive since a higher return on deposits makes deposits more attractive. The money market rate and the government debt rate, being prices of substitutes, should have negative coefficients as the opportunity cost of holding money in deposits increases with the price of the substitute. GDP proxies for income and the coefficient on GDP is expected to be positive – reflecting a positive relationship between income and propensity to save.

The supply equation (9) determines the price of deposits (deposit rate) as a function of the volume of deposits, the wage rate, output (deposits) times the first derivative of the demand function and exogenous variables such as inflation and the money market rate. We expect a negative relationship between the volume of deposits and the deposit rate, as banks will pay a lower rate on deposits the more deposits they already have attracted. The coefficient of wages of bank employees should be negative since higher input prices has a negative impact on the deposit rate. The coefficient of inflation should be positive as higher inflation requires a higher deposit rate to fully compensate depositors for the real losses. Finally, the coefficient on 'deposits times the inverse of the first derivative of the demand function' is the parameter of interest in this exercise. It gives a measure of competition on the deposit market.

The regression outputs for equations (10) and (11) are reported in the table below. We report results for OLS, 2SLS and 3SLS. Given that the deposit rate (an endogenous variable in the supply equation) appears as a regressor in the demand equation (10) and likewise the volume of deposits (endogenous) appear as a regressor in the supply equation, we have a (possible) simultaneity problem. In this case, estimating by OLS may result in inconsistent and or inefficient estimates for at least two reasons: First,

one or more of the endogenous variables may be correlated with the error term and second, the error terms may themselves be correlated. We ran some endogeneity tests – specifically the Hausman test and the Durbin-Wu-Hausman test. The test results suggest no endogeneity. However, the identification conditions for the conduct parameter ($a_5 \neq 0$ and/ or $a_6 \neq 0$) are only marginally met. The joint test of $a_5 = a_6 = 0$ cannot be rejected at the 10% level. However, individual tests show that $a_5 = 0$ is rejected at the 10% level (but not at the 5% level) while $a_6 = 0$ cannot be rejected at the 10% level. Given these weak identification results and our intuition on the equilibrium relationship between demand and supply, we proceeded to estimate the demand and supply equations using 2SLS and 3SLS.

The results are reported in Tables 7 and 8 below. It is apparent from Table 7 below that there are some efficiency gains in using 2SLS relative to OLS as can be seen in the improved significance of the identification conditions and a slight increase in the R^2 . Also, whereas four parameters are insignificant in the OLS regression, only one parameter – the government bill rate – is insignificant in the 2SLS regression. Table 7 also shows that there are some efficiency gains in using the 3SLS over the 2SLS method. The identification conditions are much more robust and all the parameters are statistically significant at the 5% level (with five of the eight estimated parameters significant at the 1% level).

Table 7: Empirical results for the demand equation

Variable	OLS		2SLS (GMM)		3SLS	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
lag dep	0.8398***	13.39	0.8428***	14.22	0.8242***	14.92
lag dep_rate	13360.01	1.52	17836.84*	2.00	20107.01**	2.46
GDP	0.2363**	2.56	0.2725***	3.06	0.3223***	3.95
inflation	4925.058	1.46	5341.323*	1.71	4323.016***	2.65
Gov_rate	2938.174	1.39	2615.434	1.47	6860.831**	2.39
r_linflation	-542.1487*	-1.80	-571.2859**	-2.08	-712.9774***	-2.83
r_1GDP	-0.0100	-1.18	-0.0143*	-1.72	-0.0163**	-2.15
constant	-263314.8***	2.43	-300772.7***	-2.93	-369212.8***	-3.92
	$R^2 = 0.9646$		$R^2 = 0.9653$		$R^2 = 0.9684$	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

The results of the demand equation estimations are largely as expected and the demand equation is well explained, with R^2 values above 96%. Higher deposit rate in last period is associated with higher current deposit volumes. This may be a consequence of consumers believing that the high deposit rate will be sustained (backward looking expectations). Similarly, higher GDP and higher inflation are associated with higher deposit volumes. If inflation increases the consumers' propensity to spend, then the direct effect of inflation on deposits is negative. However, if the deposit rate fully compensates for inflation, the effect of inflation on deposits can be positive due to money illusion (Bikker, 2003).²²

²²The government bill rate carries the wrong sign and is insignificant in the OLS and the 2SLS regressions.

Table 8: Empirical results for the supply equation

Variable	OLS		2SLS (GMM)		3SLS	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
conduct variable	-8.25e-06	-0.18	0.0002	0.65	0.0001	0.82
dep	1.42e-06	1.04	1.71e-06	1.23	1.65e-06	1.26
wage	-0.0384***	-3.03	-0.0408***	-3.55	-0.0400***	-3.32
inflation	0.0650**	2.50	0.0693**	2.20	0.0682***	2.62
mm_rate	0.8802***	33.67	0.8732***	39.35	0.8789***	34.77
constant	4.3237***	3.48	4.5409***	4.20	4.4256***	3.76
	$R^2 = 0.9705$		$R^2 = 0.9722$		$R^2 = 0.9720$	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

The supply equation is well explained, with R^2 values above 97%. Most of the coefficients of the supply equation carry the expected signs except for the coefficient on deposits which is positive but insignificant (even at the 10% level). Higher inflation is associated with a higher deposit rate. This is meant to compensate consumers for the loss in purchasing power. Also, higher money-market rates are associated with a higher deposit rate. This is intuitive. Investment in the money-market is an alternative to investment in bank deposits. consequently, the higher the price of a substitute (money-market rate), the higher the deposit rate would have to be in order for banks to retain deposits.

The parameter of interest in this exercise is the coefficient of the conduct variable, $-\lambda$. From the 2SLS, λ is equal to -0.0002 while from the 3SLS model, λ is equal to -0.0001. The value of λ is even smaller for the OLS model. With t-values below unit, this coefficient is statistically equal to zero in all three estimations. This insignificant coefficient means that $\lambda \approx 0$ and that according to the Bresnahan Model there is a very high level of competition, even evidence of perfect competition, in the South African Banking Sector.²³ In other words, the average bank does not seem to possess

²³This insignificant coefficient does not seem to be a problem as the output for the

and or exercise any market power in the market for deposits.

5 Comparison of the Results

5.1 P-R versus Bresnahan

The results found in section 3.2 and section 4.2 both support the conclusion that the South African banking sector faces a high level of competition. The Panzar and Rosse approach found H-statistics of 0.56 for small banks, 0.75 for all banks and 0.97 for large banks. Thus competition in the market for interest income ranges from monopolistic competition in respect of small banks to almost perfect competition in respect of the large banks. Further evidence of the high levels of competition in the South African banking sector is provided by the Bresnahan model – in which the conduct parameter is statistically equal to zero. Both of these outcomes lie on the extreme side of a purely competitive market according to the definitions of H and λ respectively.

With both models supporting each other with such parallel, it is unlikely that the results have been subjected to errors in the data or the models themselves.

5.2 Comparison with other Developing Countries

Many studies have been conducted using different methods to find the level of competition in the banking sector of numerous countries across the world. The main two approaches used are the two methods applied in this paper, the Panzar and Rosse approach and the Bresnahan model.

Perera *et al.* (2006) have used the Panzar and Rosse approach on some developing Asian countries including Bangladesh, India, Pakistan and Sri Lanka. Claessens & Laeven (2003) have conducted the Panzar and Rosse approach on fifty countries around the world, of which thirty one are developing countries. The results of the Panzar and Rosse H -statistics from the

Bresnahan model in Shaffer (1989) on the U.S banking sector, and the λ coefficients of all of the countries in Bikker & Haaf (2002) are also insignificant.

developing countries of these two papers are shown in table A in appendix i.

The countries that are most comparable to South Africa in terms of their level of development include Argentina, Brazil, India, Latvia and Lebanon. The H -statistics for these range between 0.64 and 0.83. These results show that the five countries all have a moderate to high level of competition in their respective banking sectors. The H -statistic for South Africa in this paper of 0.75 along with the H -statistic from Claessens & Laeven (2003) of 0.85 show that among these comparable developing countries, South Africa faces a relatively high level of competition.

6 Conclusion

With the great importance of the banking sector on the economic performance of any modern economy, it is imperative that this banking sector faces a reasonable level of competition. This will help improve the efficiency required to create a fully functional credit system as well as strengthen the effectiveness of monetary policy.

This paper has used two models to test for the level of competition in the South African banking sector. These two non-structural models have been used extensively in the literature and hold a high level of credibility in giving an accurate result for the level of competition.

The study of large banks supported this outcome showing very large H -statistics, while there were slightly lower H -statistics in the study of smaller banks. Each model under each group was well explained by its respective independent variables, and the overall banking sector shows a high level of competition in South Africa. This result is supported by other Panzar and Rosse studies on the South African banking sector²⁴. The high level of competition between the large four banks in South Africa is expected as they compete nationally for customers. The Bresnahan study in this paper revealed a λ statistic that corresponds to a high level of competition in the South African banking sector.

²⁴Claessens & Laeven (2003) and Darji (2009).

The analogous result of both the Panzar and Rosse and the Bresnahan models emphasises the high level of competition in the South African banking sector. This level of competition lies at the extreme of perfect competition in both of the models. The similar results between models removes some of the possibility of error in the data or the model.

The results of the models combined with support from other applications of these models, as well as the similar results for comparable developing countries, leads one to believe that it is rather unlikely that the South African banks are behaving in a collusive manner.

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²⁵[http://www2.resbank.co.za/BankSup/BankSup.nsf/\\$\\$ViewTemplate+for+Banks+-+Foreign+Controlled?OpenForm](http://www2.resbank.co.za/BankSup/BankSup.nsf/$$ViewTemplate+for+Banks+-+Foreign+Controlled?OpenForm)

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²⁷[http://www2.resbank.co.za/BankSup/BankSup.nsf/\\$\\$ViewTemplate+for+Mutual+-+Banks?OpenForm](http://www2.resbank.co.za/BankSup/BankSup.nsf/$$ViewTemplate+for+Mutual+-+Banks?OpenForm)

Appendices

Appendix i - List of H -statistics

Appendices

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TABLE A - H -statistics from Claessens & Laeven (2003)

<i>Country</i>	<i>H-statistic</i>	<i>Country</i>	<i>H-statistic</i>
Argentina	0.73	Malaysia	0.68
Bangladesh	0.69	Mexico	0.78
Brazil	0.83	Nigeria	0.67
Chile	0.66	Pakistan	0.48
Colombia	0.66	Panama	0.74
Costa Rica	0.92	Paraguay	0.60
Croatia	0.56	Peru	0.72
Dominican Republic	0.72	Philippines	0.66
Ecuador	0.68	Poland	0.77
Honduras	0.81	Russia	0.54
Hungary	0.75	South Africa	0.85
India^a	0.64	Sri Lanka ^a	0.71
Indonesia	0.62	Turkey	0.46
Kenya	0.58	Ukraine	0.68
Latvia	0.66	Venezuela	0.74
Lebanon	0.69		

^a H -statistics from Perera *et al.* (2006).