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Industry concentration and risk taking: Evidence from the South African banking sector.

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Abstract

The quest to gain market share within an industry is argued to drive Decision Making Units (DMUs) to accommodate more risk. The cross sectional variations in risk taking is believed to be influenced by the position of the DMU in the industry, with those on the lower end assuming more risk in order to gain market share. On the other hand, less competition among banks could result in higher interest rates being charged on business loans, which might raise the credit risk of borrowers as a result of moral hazard issues. The South African highly concentrated banking sector presents an opportunity to econometrically investigate such issues. Panel estimation techniques are employed on the South African banking sector unique data set. The model explores the relationship between the specified bank risk measure and bank market concentration measure, controlling for individual bank characteristics and the state of the economy. We find that smaller banks in South African concentrated banking sector are more exposed to credit risk than bigger banks. However, considering the interaction between size and concentration measure, bigger banks in highly concentrated industry are more likely to have high credit risk, in line with the concentration fragility hypothesis. Findings have implications for both policy and management of individual banks.

Keywords: Industry concentration; Bank risk-taking; Credit risk; South Africa

1. Introduction and background

The structure of the South African banking sector is unique- highly sophisticated financial sector and a highly concentrated banking sector. In the past years the sector leaders (big four[1]) have witnessed surmountable pressure from the previously smaller banks like Capitec. However, when asked his perception on losing market share to Capitec bank, Nedbank CEO (Mr Mike Brown) argued that focus should not be on increasing market share only, rather on the quality of business created (Lefifi, June 16, 2013). Such quest for increasing market share by smaller banks, and competition to maintaining high share among the 'big four' have had its share of scrutiny both in the academic and industry spheres (see for example, Okeahalam, 1998). Keely (1990) and Kouki and Al-Nasser (2014) agree that competition can be detrimental to the economy through erosion of franchise value, as well as incentivising banks to take more risk. On the contrary, Boyd, De Nicoló and Al Jalal, (2006) and Boyd and De Nicoló, (2005) argue that competition (less concentration) is good for financial stability. This implies that the effect of concentration on risk taking (stability versus fragility) is dependent on the specific sector and cannot easily be generalised to other economies.

On the other hand, Suarez (1994) showed that there is a trade-off between market power and solvency, implying that if the market power of the bank decreases, the incentive to engage in riskier policies increases significantly. Furthermore, Boyd and De Nicolo (2005)noted large literature that concludes that, when confronted with increased competition, banks rationally choose more risky portfolios. On the other hand,Verhoef (2009) argued that the persistent high degree of concentration inherent in the South African banking sector, is predominantly as a result of the risk related capital and liquid asset requirements enforced globally by partiesto the Basel Accords[2].

Given that the cross sectional variations in risk taking is believed to be influenced by the market share position of the decision making unit (DMU) in the industry, with those on the lower end assuming more risk in order to gain market share, it is necessary to test this in a compelling environment like the South African banking sector. Banks are exposed to credit risk through their income generating process of credit creation (see Kargi, 2011). The Basel Committee on

1 Alphabetically: Amalgamated Bank of South Africa-ABSA (Barclays Africa); First National Bank (FNB); Nedbank and Standard Bank of South Africa.

2 South Africa is one of the emerging and developing countries that keenly comply with the Basel Accords recommendations

Banking Supervision (2001) defined credit risk as the possibility of losing the outstanding loan partially or totally, due to credit events (default risk). It is imperative to note that, credit risk is an internal determinant of bank performance. The higher the exposure of a bank to credit risk, the higher the propensity of the bank to experience financial crisis and vice-versa.

The argument stems from the work of Boyd and De Nicolo (2005) who noted that less competition, which is expected to be a characteristic of highly concentrated sector, among banks could result in higher interest rates being charged on business loans that would raise the credit risk of borrowers as a result of moral hazard issues. Apparently, the increased default risk could result in an increase in problem loans (heightened loan loss provision could be witnessed) and thus greater bank instability. Contrary to this view, and showing lack of consensus in literature on this topic, Jimenez, et al. (2013) concluded that the underlying source of franchise value is typically assumed to be market power, and market concentration has been considered to promote banking stability.

Despite the plausibility of the link between market concentration and high risk appetite among entities, research in this area is very scant. Furthermore available literature has a number of limitations, for example focusing on developed economies, outside the financial crisis, having a multi-country analysis without controlling for different market structures (see for example, Cipollini & Fiordelisi, 2009). Given this background, this study attempts to overcome the limitations of existing studies and add to South African literature in a number of ways: considering an emerging economy, focusing on one country with its unique characteristics to avoid loss of information in generalisation and using panel data analysis techniques compared to cross-sectional analysis. In the context of South African banking sector, with high concentration rates, a system that proved resilience to the 2008/09 global financial crisis and a sophisticated financial market, we thus hypothesise that there is a statistically positive association between industry concentration and risk taking.

The rest of the paper is divided as follows. Section 2 presents the structure of the South African banking industry, followed by sections 3 and 4 which deal with the review of the theoretical literature and empirical literature, respectively. Section five covers methodology and data, while section six presents the empirical results and their discussion. Lastly section seven summarises and provides a conclusion to the study.

2. The structure of the South African banking industry

The South African banking sector is developed and well regulated. It compares favourably with those of industrialised countries. The industry is made up of 19 registered banks, 2 mutual banks, 13 local branches of foreign banks, and 43 foreign banks (Banking Association of South Africa (BASA), 2011).To date back to history briefly, Verhoef (2009) reports that the formal financial sector was historically dominated by an "oligopoly" of British-owned banks (Standard Bank and Barclays Bank, for example).. Whilst the micro-lending sector, offering mostly smaller and short-term loans, grew exponentially in the 1990s, run mostly by Afrikaans-speaking former civil servants, (examples of the consolidated versions of these are African Bank and Capitec) (James, 2014).

The South African banking-sector is dominated by the four largest banks, which contribute over 84 per cent to the balance-sheet size of the banking sector of 19 banks, explaining the current high concentration within the industry calculated using the Herfindahl-Hirschman Index (HHI). The higher the index, the lesser is the competition that exists in the market. An H-H index below 0.1 indicates that there is no concentration in an industry, while an HHI between 0.1 and 0.18 is an indication of moderate concentration. The South African Reserve Bank Annual Reports, from 1994 to 2011 shows that the South African banking sector HHI amounted to over 0.18 since 2004, and was never below 0.1 over the period under review. An HHI above 0.18 represents a highly concentrated industry that indicates the presence of oligopoly behaviour and this is the case of the South African banking sector.

Among the big four banks in South Africa, Standard bank is the largest bank in terms of assets, with a market share of 26 percent, followed by ABSA with 22 percent. FNB and Nedbank had a market share of about 19 percent and 18 percent respectively as of that date (BASA, 2011). The South African banking sector is thus unique, and therefore an interesting case for testing the effect of concentration on industry stability through determining link between concentration and risk taking.

3. Theoretical literature review

3.1 Conceptualising competition in the banking sector

The common measure of concentration which is also used by the South African Reserve Bank (SARB) for competition in the South African banking sector is the Herfindahl-Hirschman index (HHI) for concentration. Market concentration measures the extent to which market power is likely to be pronounced in a single supplier, or group of suppliers. Organisation of Economic Cooperation and Development (OECD) (2010) noted that measuring competition in financial markets is complex due to their peculiar features, such as switching costs. OECD then identifies three approaches that have been used to measure competition in the banking sector, as follows:

3.1.1 Structural measures of competition

The widely used measures in empirical work are concentration ratios, the number of banks and HHI. These measures originated in the structure-conduct-performance (SCP) paradigm linking the structure of a market to influences on firm behaviour and thus sector performance. See for example, Berger et al. (2004). One prediction of the SCP approach is that higher concentration would encourage collusion and reduce efficiency. The challenge however, is that there is no consensus on the best variable for measuring market structure in banking.

3.1.2 Measures of market contestability

This approach assesses competitive conditions in terms of contestability. Variables like regulatory indicators of entry requirements, the presence of foreign ownership, formal and informal entry barriers and activity restrictions measure the threat of entry in the sector and thus its contestability through the degree of entry and exit (see for example, Daude & Pascal 2015).

3.3.3 Direct measures of competition: the H-statistic

The third approach measures the intensity of competition directly, in the way prices or outputs respond to costs. Most recent studies of banking use the so-called H-statistic, based on the Panzar and Rosse methodology, which proxies the reaction of output to input prices (Panzar & Rosse, 1987). The H-statistic is calculated by summing the estimated elasticities of revenue to factor prices; a value of one indicating perfect competition, a value of zero (or less) indicates monopoly and intermediate values indicate the degree of monopolistic competition (Bikker & Haaf, 2002). Other studies (for example, Jimenez et al., 2013) use the Lerner index, which expresses market power as the difference between

the market price and the marginal cost divided by the output price. The index ranges from a high of 1 to a low of 0, with higher numbers implying greater market power.

Despite that theoretical foundation for direct measures is stronger than for structural measures, direct measures have drawbacks. For instance, the H-statistic imposes restrictive assumptions on banks' cost functions. Its conclusion that increases in input prices make total revenue and marginal costs not to move together in imperfectly competitive markets is only valid if the industry is in equilibrium, which in practice is very rarely the case. Its single measure neglects differences among banks like size (which is of great concern in South Africa), product or geographic differentiation. The Lerner index is a better way to distinguish among the different products, but it has the problem that it requires information on prices and marginal costs, which is very difficult to gather. For reasons highlighted here, we adopt the SCP approach and model HHI for the South African banking sector, with data available from the SARB annual reports.

3.2 Competition and risk-taking theory

Increased competition in the banking sector is typically seen as a threat to the solvency of financial institutions and the stability of the banking sector. The underlying idea is that when banks compete heavily in the deposit market, interest rates fall and the franchise value decreases (Marcus, 1984; Keeley, 1990). As banks have less to lose in the case of default, their incentives to take on extra risk increase. In an influential theoretical paper, Boyd and de Nicolo (2005) challenge the above view. They show that as competition declines, banks earn more rents in the loan markets by charging higher loan rates, which however, imply higher bankruptcy risk for borrowers. Then, within a moral hazard framework, borrowers optimally increase their own risk of failure, which naturally leads to financial instability. Other studies also emphasize the importance of the loan market, although they do so from a credit risk perspective. For instance, Gehrig (1998) showed that competition decreases screening efforts, thus worsening the quality of the loan portfolio.

On the other hand, the "franchise value" paradigm for bank risk-taking, both with and without government regulation, is well established in the banking literature. Simply stated, the idea is that banks limit their risk-taking in order to protect the quasi-monopoly rents granted by their government charters. Increased

competition would erode these rents and the value of the charters, which would likely lead to greater bank risk-taking and greater financial instability (Jimenez, Lopez, & Saurina, 2013).

One of the earliest papers in this literature was by Marcus (1984), who used a one-period model to show that franchise value declines as a bank engages in riskier policies. Chan et al. (1986) showed that increased competition erodes the surplus that banks can earn by identifying high-quality borrowers. The reduction in value leads banks to reduce their screening of potential borrowers and, thus, overall portfolio credit quality declines. Keeley (1990), following Furlong and Keeley (1989), used a state preference model with two periods to show explicitly that a decline in franchise value increases bank risk-taking. Besanko and Thakor (1993) showed that increased competition erodes informational rents originated from relationship banking and leads to greater risk-taking by banks.

In a context of asymmetric information, Marquez (2002) showed that an increase in the number of banks in a market disperses the borrower-specific information and results in both higher funding costs and greater access to credit for low-quality borrowers.

Using a dynamic optimization model with an infinite horizon, Suarez (1994) showed a trade-off between market power and solvency. If the market power of the bank decreases, the incentive to engage in riskier policies increases significantly. As the franchise value of the bank is a component of bankruptcy costs, it should encourage the bank to carry out prudent policies that increase the solvency of the bank. Matutes and Vives (1996, 2000) showed in a framework of imperfect competition (i.e., product differentiation) that higher market power reduces a bank's default probability.

Hellmann et al. (2000) showed in a dynamic model of moral hazard that competition can have a negative impact on prudent bank behaviour. Capital requirements are not sufficient to reduce the gambling incentives in the system, and deposit rate controls need to be added as an additional regulatory instrument. Building on that, Repullo (2004) used a dynamic model of imperfect banking competition to show that more competition (i.e., lower bank margins) leads to more risk-taking in the absence of regulation, risk-based capital requirements were found to effectively control the risk-shifting incentives in that model.

As an interesting alternative to the franchise value paradigm, Boyd and De Nicolo (BDN, 2005) developed a model, modifying one presented by Allen and Gale (2000), where an increase in bank market power both in the loan and de-

posit markets translates into higher loan rates charged to borrowers. In a moral hazard environment as per Stiglitz and Weiss (1981), entrepreneurs facing higher interest rates on their loans would choose to increase the risk of their investment projects, a practice that would lead to more problem loans and a higher bankruptcy risk for banks. They find a monotonic declining relationship between competition (measured as the number of banks lending in a market) and bank risk; that is, as the number of banks and competition increases, the level of bank risk would decline.

Martinez-Miera and Repullo (MMR) (2010) extend the BDN model by introducing imperfect correlation across borrowing firms. Under this assumption, two potentially countervailing effects of bank competition are introduced. As in the BDN model, the "risk-shifting" effect captures the result that more competition leads to lower loan rates, lower firm default probabilities, and improved bank risk measures. However, the lower rates should also reduce all firms' interest payments and thus overall bank revenues, which should lead to potentially greater bank risk and bank failures. This effect is defined as the "margin" effect by the authors.

In the MMR model, a U-shaped relationship between bank competition (measured as the number of banks) and the risk of bank failure is found to represent the net effect of these two forces. The risk shifting effect is shown to dominate in very concentrated markets, such that increased entry improves bank risk measures. In already competitive markets, the margin effect dominates such that further entry worsens bank risk. Thus, the lowest degrees of bank risk are obtained in loan markets with moderate levels of competition. The authors importantly found that the results hold whether the variable of interest is loan supply or pricing, thus expanding the set of circumstances under which the model applies.

4. Empirical literature

Jimenez et al. (2013) studied how competition affects bank risk-taking using data from the Spanish banking system. This was done to test the MMR model which postulates that a nonlinear relationship theoretically exists between bank competition and risk-taking in the loan market. After controlling for both the macroeconomic conditions and bank characteristics, they found evidence for non-linear relationship using standard measures of market concentration in the loan and deposit markets. Using the direct market power measures such as the Lerner indices, the empirical results where more supportive of the MMR

hypothesis. Though we do not intend to run a horse race of the models, we find this paper informative in modelling risk taking and concentration within the banking sector.

On the other hand, Levy Yeyati and Micco (2007) analysed concentration and foreign penetration in Latin American banking sectors with the main focus on the impact on competition and risk taking. They used the H-statistic as the measure of competitiveness. The results of the study revealed that bank risks increased as bank competition increased (low concentration) in eight Latin American countries. This implies that stiff competition, market contestability, increases risk taking and in line with our study this would mean low concentration high risk taking incentive. Given the high concentration with the banking sector, this could explain the resistance from financial crisis shown by the South African banks during the 2008/9 global financial crisis that paralyzed some economies.

In similar vein, Martins and Alencar (2010) investigated banking concentration, profitability and systematic risk; testing an indirect contagion approach. The findings of the study show evidence of the existence of an indirect contagion channel in Brazil. However the study found out that a more concentrated financial system is associated with an increase in potential of systematic risk among banks with similar characteristics. The South African banking system could bring forth interesting results given the level of concentration as well as uniqueness of the entities.

Agoraki et al. (2011) looked at the relationship between regulations, competition, and risk-taking in the Central and Eastern European banking sectors between 1994 and 2005. They found that market power is negatively linked with the risk taking behaviour of banks, whereas capital requirements and supervisory power are effective devices in monitoring risk-taking since they augment equity to capital ratios and decrease credit risk. Lastly, they found out that incentives and tools that improve market self-monitoring also encourage credit-risk reduction.

A positive effect of bank concentration on financial distress was found by Cipollini and Fiordelisi (2009) examining the impact of bank concentration on bank financial distress using a balanced panel of commercial banks in the EU-25 over a sample period running from 2003 to 2007. This is contrary to our hypothesis here. The shareholder value ratio which falls below the threshold of the empirical distribution of risk adjustment was used as a proxy for financial distress.

Kick and Prieto (2013) investigated the bank competition-stability in German over the period 1994 to 2010. In line with Agoraki et al. (2011), their findings using the Lerner Index to proxy the bank specific market power support the view that market power reduces bank's risk taking incentive. However, when considering competition through local market share using the Boone indicator, they found a strong support that increased competition lowers the riskiness of banks.

From theory and empirical studies two hypotheses stand out: concentration-stability and the concentration-fragility hypotheses. The former posits that in a highly concentrated market banks with greater market power may force the market to charge higher loan rates in order to yield higher profits. Such high profits have a positive marginal effect acting as buffer against loan losses thereby increasing the franchise value and reduce risk appetite of the individual bank. On the other hand, bank supervision and monitoring is easier in highly concentrated market as only a few large banks hold diversified and complex portfolios. South Africa has a highly concentrated sector and repelled the global financial crisis fairly well than many of its counterparts, so did Canada and Australia with concentrated financial systems credited for such outcomes (World Bank-2013). According to Bordo, Rockoff and Redish (1994) history show that the UK banking sector was highly concentrated between 1840 and 1940 and no major disruptions to the system were recorded.

On the contrary, concentration-fragility hypothesis argue that a highly concentrated market is prone to bank fragility. According to OECD (2011) the hard knock felt by highly concentrated banking systems of Switzerland and the Netherlands during the 2007-2009 global financial crisis era is testament to this hypothesis. Due to weak competition in a concentrated market, the large bank(s) exploit their monopoly (oligopoly) power and charge higher interest rates on loans which will increase moral hazard and adverse selection problems leading to greater default risk. This is in line with the null hypothesis the study seeks to test, rejecting the null would be in support of the concentration-stability hypothesis above.

As a result of this relativity of the effect of sector concentration on risk taking, there is no consensus in literature, and for South Africa, there are no known studies that have modelled this relationship. This study immensely contributes to literature by performing a focused test on the relationship between one of the key features of the South African banking sector, concentration, and bank risk taking.

5. Research methodology, data and empirical estimation techniques

The study sought to investigate the quantitative pressure of sector concentration on risk appetite of banks in South Africa. Based on availability of data, a sample of seven banks from the nineteen commercials banks in operation where considered over a three-and-half year period, forty months' observations for each bank between 2008 and 2011. The size of the sample is determined by availability of data, which is a serious constrain in South African banking sector research (see also Maredza & Ikhide, 2013; Mishi and Tsegaye, 2012). Bank specific data were sourced from the D900 returns for each bank to the central bank of South Africa. The data include time series and cross sectional data, therefore pooled into a panel data set and estimated using Panel Data regression techniques. The study uses panel data regression model in the analysis. The technique of panel data estimation takes care of the problem of heterogeneity in the seven banks selected for the study. Also, by combining time series of cross-section observation, panel data give more informative data, more variability, less co-linearity among the variables, more degree of freedom and more efficiency (Gujarati & Sangeetha, 2007). Bank sector concentration data was obtained from the South African Reserve Bank Quarterly Bulletins over the period of study

5.1 Model specification

To examine the hypothesis regarding the effect of banking sector concentration on bank risk taking, we estimate the general regression following (Jimenez, Lopez, & Saurina, 2

$$RISK_{it} = f(CONCENTATRION\ INDEX_{it}; MACROECO.CONDITIONS_{it}; BANK\ CONTROL\ VARS_{it} \quad 1$$

Our dependent variable measure of risk-taking is a bank's commercial non-performing loan (NPL) ratio, which is an ex-post measure of credit risk. Our main focus is on commercial credit risk. It is the primary driver of risk for most banks, although other risks obviously exist.

The concentration structure of the market is measured by the Herfindahl index, *(HHI)* which measures the size of firms in relation to the industry. It is an indicator of the amount of competition among firms. The index is defined as the sum of the squares of the market shares of the firms within the industry (Maudos & Guevara, 2008). The negative association between market concentration and bank risk taking has been established, among many others, by Matutes and Vives (1996) and Repullo (2004).

The banking sector does not exist in vacuum, macroeconomic policies and factors can influence their risk appetite and possibly influence the effect of concentration on risk taking. For macroeconomic factors we control for monetary policy, proxied by interest rate (ir) (repo rate in this case); while for bank specific characteristics we used size, total factor productivity efficiency scores (tfpe), exposure through capital market investments (expo). The econometric model estimated in STATA is stated as:

$$CR_{it}=\alpha+\beta_1 SIZE_{it}+\beta_2 TFPE_{it}+\ \beta_3 HHI_{it}+\beta_4 IR_t+\beta_5 SIZE_{it}*HHI_{it}+\beta_6 EXPO_{it}+\varepsilon_{it} \qquad 2$$

6. Empirical results and discussion

Panel estimations were conducted given the advantages that it allows the control for variables that cannot be observed or measured like differences in business practices across banks as well as variables such as monetary policy that change over time but not across entities. In essence individual heterogeneity can be controlled. Firstly by running a pooled Ordinary Least Squares (POLS) we obtained:

Table 1: Pooled ordinary least squares estimation results

Dep. Var: cr	**Coef.**	**Std. Err.**	**T**	**P> |t|**
Size	-510.9733	170.2346	-3.00	0.003
Tfpe	6.0385	6.1089	0.99	0.324
Hhi	-55914.3	16881.12	-3.31	0.001
Ir	1.814124	1.937	0.94	0.350
Size*hhi	2731.496	902.414	3.03	0.003
expo	-4.2037	3.404	-1.23	0.218
cons	10524.15	3173.114	3.32	0.001
Number of observations	280	Adj R-squared	0.0770	
Prob>F	0.0001			

From this analysis, size, industry concentration and interaction between the two are significant. With the latter positively related to credit risk. As size increases, credit risk exposure declines. This may be explained by availability of resources as cushion, diversification of income sources as most of the smaller banks concentrate on one business line. With concentration, as the industry become highly concentrated, risk taking declines in line with the findings of Levy and Micco (2007) Marquez (2002), Matutes and Vives (2000) arguing that with high competition (low concentration) borrow-specific information is dispersed

leading to higher funding costs and adverse selection problem, and thus greater default risk. In addition, this maybe because in such a sector, leaders are clearly known and acknowledged to the extent that fierce competition that expose entities to credit risk will be eliminated.

Interestingly, given the nature of our data we can control for individual specific effects by including dummies and compare the results with the simple POLS reported above.

Table 2: Least square dummy variable model (LSDV)

Dep. Var: cr	**Coef.**	**Std. Err.**	**t**	**P> |t|**
size	-680.9635	158.1448	-4.31	0.000
tfpe	16.26183	10.76656	1.51	0.132
hhi	-73138.73	15616.42	-4.68	0.000
Ir	1.855869	1.555303	1.19	0.234
Size*hhi	3341.823	829.4746	4.03	0.000
expo	22.65483	5.295059	4.28	0.000
Bank				
African Bank	-53.51501	11.68011	-4.58	0.000
Capitec	-113.6344	11.65964	-9.75	0.000
FNB	-19.27343	8.411619	-2.29	0.023
Investec	-54.62559	9.053473	-6.03	0.000
Nedbank	5.773038	5.789218	1.00	0.320
Sasfin	-172.2301	14.95252	-11.52	0.000
cons	14386.92	2944.518	4.89	0.000
Number of observations	280	Adj R-squared	0.4119	
Prob>F	0.0000			

Here the effects of explanatory variables are mediated by the differences across banks. Meaning by including dummy for each bank the pure effect of exogenous factors is estimated through controlling for the unobserved heterogeneity. Each dummy is absorbing the effects particular to each bank. The results in table 3 below justify the inclusion of dummy variable given the effect on the results, also revealed by an increase in the explanatory power of the models as shown by a sharp increase in r-squared (to over 43%) and adjusted r-squared (of 41%) from as low values as 10%.

TABLE 3: COMPARING POLS AND LSDV

Variable	**ols**	**ols_dum**
size	-510.97335**	-680.96354***
tfpe	6.0385072	16.261826
hhi	-55914.304**	-73138.727***
ir	1.8141244	1.8558691
Size*hhi	2731.4958**	3341.8227***
Expo	-4.2037228	22.654832***
Bank		
African Bank		-53.515011***
Capitec		-113.63436***
FNB		-19.273428*
Investec		-54.625591***
Nedbank		5.7730379
Sasfin		-172.23013***
_cons	10524.151**	14386.918***
N	280	280
legend: * p<0.05; ** p<0.01; *** p<0.001		

With specific reference to panel data, there are two key techniques available, fixed effects (FE) or random effects (RE) assumption, with the former used whenever the interest is in analysing the impact of variables that vary over time and the latter variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

Under fixed effect assumption the time-invariant characteristics are unique to the individual bank and should not be correlated with other individual characteristics. Each entity is different therefore the entity's error term and the constant should not be correlated with the others. If the error terms are correlated then FE is not suitable since inferences may not be correct and there is need to model that relationship probably using RE. This is determined through the Hausman test.

According to Green (2000), in order to choose between fixed or random effects a Hausman test is run with the null hypothesis that the preferred model

is random effects versus the alternative the fixed effects. Given that the test is significant, (Prob>Chi2= 0.0000) we reject the null and therefore estimate the model assuming fixed effects. Running the panel assuming fixed effects justified by the analysis above, we get the following results:

Table 4: fixed effects model

Dep. Var: cr	**Coef.**	**Std.Err.**	**t**	**P>|t|**
size	-680.9635	158.1448	-4.31	0.000
tfpe	16.26183	10.76656	1.51	0.132
hhi	-73138.73	15616.42	-4.68	0.000
ir	1.855869	1.555303	1.19	0.234
Size*hhi	3341.823	829.4746	4.03	0.000
expo	22.65483	5.295059	4.28	0.000
_cons	14328.7	2945.649	4.86	0.000
N	280			

With the Prob>F being less than 5%, our model fits well, as all the coefficients in the model are different from zero. Given the two-tail p-values: size, hhi, size*hhi and expo all have significant effect on credit risk. The same conclusions can be drawn from the t values at 95% confidence interval. Furthermore the intra-class correlation ('rho') tells us that 87% of the variance in credit risk is due to differences across panels.

Of the variables that have a significant effect on credit risk, size of each bank and our key variable level of concentration within the sector have a negative influence. This means that when we move from small banks, in terms of market share, to bigger banks, the extent of credit risk exposure declines. It implies that large banks better manage their operations and have lower credit risk. The results corroborate the works of Kick et al. (2013). This explains our assertion that smaller banks accumulate more risk through efforts to gain market share. For example, most of the smaller banks in South Africa have been observed as creating business through consolidating loans, and lending generously to attract more customers, the focus being on quantity rather that quality of clients,(Lelifi, 2013. The banks, especially Capitec and African bank have been asked to re-assess their lending criteria to avoid what has been referred to as 'reckless' lending, (Arde, 2013; Lelifi, 2013; Mittner, 2013). Such finding also corroborates the works of Agoraki et al. (2011) in Brazil, an emerging market as South Africa, with both belonging to the BRICS[3] group.

3 A group of emerging economies: Brazil, Russia, India, China and South Africa.

With regards to concentration measure, the more concentrated the sector becomes the lower the credit risk. This seeming paradox could be explained by the fact that, in a highly concentrated market, sector leaders are well known and acknowledged, limiting competition and hence risk taking activities. Relational lending, for example would be key to driving success through building customer franchise (franchise value paradigm). This is in line with the concentration-stability hypothesis. However, this contradicts with the findings in Cipollini and Fiordelisi (2009) who concluded on a positive effect of bank concentration on financial distress.

When size has been interacted by concentration measure (size*hhi) the effect becomes positive, implying that as size of banks increase, in an increasingly highly concentrated industry risk taking increase. Concentration, that is, having few very big banks controlling very few assets within the sector comes at a cost of increasing credit risk. This refutes the concentration-stability hypothesis upheld in Bordo et al. (1994) and World Bank (2013) and supports the concentration-fragility hypothesis as evidenced in Switzerland and Netherlands (OECD, 2011). Furthermore and Rath, Mishra and Al Yahyaei (2014) concluded that bigger banks in highly concentrated industry contribute to financial instability. For there to be acknowledged leaders in the market, high risky activities could have been undertaken, so as some banks grow to be sector leaders, thus at the same time increasing concentration within the sector, credit risk will be increasing.

On the other hand, when a bank is exposed to more risk through its investments (expo variable), there is a tendency of accumulating more credit risk. Assumedly caught in "sunk-cost fallacy" the bank's management believes further exposure will help recoup losses. Furthermore, weak competition from the minor entities create an opportunity for the bigger banks to exploit the market by charging higher interest rates on loans which will expose them to greater default risk and adverse selection in a manner depicted in Stiglitz and Weiss (1981) model. The results imply that the process of having a concentrated market results in incurring high credit risk of which greater credit risk exposure may destabilise a sector. However, once industry leaders are clearly established, accumulation of risk declines. There should be close monitoring of how bank business is conducted as smaller banks seem inclined to unseating bigger banks, albeit at a cost of engaging in risky activities. The National credit regulator should have a closer monitoring to ensure reckless landing is curtailed.

On the other hand, for robustness check we looked at the effect of including the dummy. According to Hamilton (2006), although the demean data (*areg*

command) output is less informative than the regression one, nonetheless *areg* has the advantage of speeding up exploratory working, providing quick feedback whether a dummy variable approach is worthwhile. Here, as shown in Table 6 below, the test is significant, also indicating the dummy variable controlled is worthwhile.

Table 5: areg estimations: Linear regression, absorbing indicators

Dep. Var cr	**Coef.**	**Std. Err.**	**t**	**P>|t|**
size	-680.9635	158.1448	-4.31	0.000
tfpe	16.26183	10.76656	1.51	0.132
hhi	-73138.73	15616.42	-4.68	0.000
ir	1.855869	1.555303	1.19	0.234
Size*hhi	3341.823	829.4746	4.03	0.000
expo	22.65483	5.295059	4.28	0.000
_cons	14328.7	2945.649	4.86	0.000
bank	F(6, 267) = 26.911 0.000			

Finally we econometrically compare our models to see the power of each and as a robustness check mechanism to ensure that the results we presented from the chosen model can be used to draw policy conclusion.

Table 7: Comparing fixed effect assumption, ols and areg

Variable	**Fixed**	**Ols**	**areg**
Size	-680.96354***	-510.97335**	-680.96354***
Tfpe	16.261826	6.0385072	16.261826
Hhi	-73138.727***	-55914.304**	-73138.727***
Ir	1.8558691	1.8141244	1.8558691
Size*hhi	3341.8227***	2731.4958**	3341.8227***
Expo	22.654832***	-4.2037228	22.654832***
_cons	14328.703***	10524.151**	14328.703***
N	280	280	280
r2	.41367288	.0968834	.43721883
r2_a	.3873211	.07703469	.41192529
legend: * p<0.05; ** p<0.01; *** p<0.001			

Based on the results reported in Table 7, the fixed effect assumption performs better than the OLS as results from fixed effect model (as well as the *areg* model) can be interpreted with 99 percent confidence.

6.1 Testing for cross-sectional dependence/contemporaneous correlation: using Pasaran CD test

Although, according to Baltagi (2001), cross-sectional dependence is more of an issue in macro panels with long time series (over 20-30 years) than in micro panels it is worth checking here. Pasaran CD (cross-sectional dependence) test is used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in tests results (also called contemporaneous correlation). The null hypothesis is that residuals are not correlated. The tests results are presented below.

Table 8: Pasaran CD test

pesaran's test of cross sectional independence =	1.396, Pr = 0.1627
Average absolute value of the off-diagonal elements =	0.400

The reported Pr =0.1627>0.05 show absence of cross-sectional dependence.

From these results conclusions can be drawn that give insight to policy makers and practitioners.

7. Summary and conclusion

The paper set to estimate the effect of concentration on risk taking based on the observation that some banks seem to care more about market share regardless of exposure to risk. This is a threat to the industry. The main contribution of this study was to perform a focused test on the relationship between two of the key features of the South African banking sector, concentration, and bank risk taking. The study found that smaller banks indeed assume more risk than bigger banks in the highly concentrated South African banking sector. However, when clear sector leaders are acknowledged, that is, when the sector is extremely concentrated, risk accumulation is reversed. When size has been interacted by concentration measure (size*hhi) the effect becomes positive, implying that as size of banks increase, in an increasingly highly concentrated industry risk taking increase; confirming the concentration fragility hypothesis.

The analysis was done based on the assumption of fixed effects as revealed in the data through Haussmann tests, that is assuming that the time-invariant characteristics are unique to the individual bank and are not correlated with other individual characteristics. Each bank has been assumed to be different.

The dominant thinking within this field is that franchise value derived from market power and reduced competition has a key role to play in limiting the riskiness of individual banks. This paradigm is appealing to both academicians and bank supervisors. This corroborate our findings as large banks assume less risk, possibly because shareholders and management limit risk exposure to preserve the bank's franchise value. However, for smaller banks, there is trade-off between preserving franchise value and market share, leading to risk taking; there is limited franchise value to preserve given that market power is one underlying source for this value. In South Africa, only four banks control over 84% of the market.

Again a growing paradigm has been put forward by Boyd and De Nicolo (2005) which posits that the effect of market concentration on banks is ambiguous, relying on the net effect across loan and deposit sectors. This is also of interest to the South African banking market, and thus results presented here. Majority of the banks focus on specialised activities that see them participating less in the deposit taking market. For example Capitec and African bank are key leaders in the unsecured lending market compared to the big four that have a strong standing in the deposit market and offer secured lending. Therefore, banks that concentrate in the loan market, the small banks in the case of South Africa, end up having increased lending rates that will raise borrowers' debt loads as well as increased default probabilities and thus incentive to engage in riskier projects- moral hazard argument.

Despite the robust results, it is worth noting that the study suffers a limitation of unavailability of data for all banks in South Africa (Mishi & Tsegaye, 2012; Maredza & Ikhide, 2013). However the considered banks represent greater portion of the market, given than the big four only, account for over 84% of market share, adding Capitec alone will take the market share to over 95% of the South African market. For future studies it will be interesting to control for type of ownership, funding structure as well as business model of the individual banks; or to investigate what matter for bank stability.

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