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Bank Competition in Sub-Saharan African Countries: Has Anything Changed in the Light of 2007-2008 Global Financial Crisis?

Steve Motsi[a], Oluseye Samuel Ajuwon[b] & Collins Ntim[c]

[a]*Department of Development Finance*
University of Stellenbosch Business School
South Africa. Email: steve.motsi@ariseinvest.com
[b]*Development Finance, University of Stellenbosch Business School, South Africa.*
E-mail: aajuwon@unilag.edu.ng
[c]*Professor and Head of Department, Accounting,*
University of Southampton Business School, United Kingdom
Email: c.g.ntim@soton.ac.uk

Abstract

This paper investigated the changes in competitive behaviour of banks in sub-Saharan Africa, following the 2007/2008 global financial crisis. Using 481 bank-year observations from an unbalanced panel of 83 banks from six countries over the period 2008–2013. We employed the Panzar-Rosse model of firm competition, and found that the degree of competition among banks in Sub-Saharan Africa increased. This increase is due to the effect of reform/liberalisation policies, largely initiated in the pre-crisis era. The success that followed via the development of banking systems, nonetheless moderated at the onset of the 2007/2008 financial crisis. System instabilities, which were characteristic of a post-crisis period, exposed deficiencies in regulation and asymmetric incentives for bank management. A significant recalibration of prudential policies followed, as regulators sought to restore system stability, which again had an impact in altering competitive conduct of banks. Policymakers should continue to develop and promote policies geared towards the development of financial intermediation and improved competitive conduct of banks in sub-Saharan Africa.

Keywords: Bank competition, competitive behaviour, Panzar-Rosse model, H-Statistics, E-Statistics, sub-Sahara Africa.
JEL Classifications: D41, D42, D43, E32, E44, F36

1. Introduction

In the light of 2007/2008 financial crisis, this study investigated bank competition using the Panzar-Rosse model, a non-structural approach that determines the pricing behaviour of firms. The analysis contained sample banks in Sub-Saharan Africa between 2008 and 2013, a period in which substantial macroeconomic challenges and increased systemic risk materialised (Brambila-Macias & Massa, 2009; Arieff, 2010; Allen, Otchere & Senbet, 2011) because of the financial crisis. However, in the pre-crisis era, significant economic reforms and financial liberalisation policies (Bikker, Spierdijk & Finnie, 2007; Claessens, Laeven,

Igan & Dell'Ariccia, 2010; Sanya & Gaertner, 2012; Fosu, 2013), were implemented, setting the tone for increased competition among banks in Sub-Saharan Africa.

Increasing competitiveness among banks matters[1] for a number of reasons. First, it promotes effective financial intermediation, and explains the structure, stability, efficiency and performance of the industry (Casu & Girardone, 2006; Fosu, 2013; Schaeck & Čihák, 2014). Second, it lowers interest rates and improves the production, quality and distribution of banking products. Third, it explains the level of access to financial services and extent of external financing at household and firm level (Rajan & Zingales, 1996; Allen & Gale, 2004; Claessens & Laeven, 2005; Bikker *et al*, 2007; Simbanegavi, Greenberg & Gwatidzo, 2012). Finally, it improves effectiveness of monetary policy transmission, supports real economy production efficiency and promotes overall growth and development (Claessens & Laeven, 2003, 2005; Kot, 2004; Casu & Girardone, 2006; Bikker *et al*., 2007; Claessens *et al*., 2010; Fosu, 2013).

The primary motivation for this study stemmed from the sheer diversity of economies in Sub-Saharan Africa, and their influence on competitiveness in banking systems. With an estimated total GDP of approximately USD 1.60 trillion in 2013, and estimated 650 banks on the sub-content (as obtained from each country's central bank). Historically linked to World Bank and IMF[2] reform that commenced in the early 1980s (Senbet & Otchere, 2006), the structure and size of economies and their banking systems reflect the extent of deregulation of markets and trade, promotion of private enterprise and innovation, as well as ease of entry of foreign participants. The Nigerian and South African economies, for example, comprise approximately 50 percent of total sub-continental GDP (WDI, 2013), and have large and diversified banking systems that are competitive and active compare to most countries in the region. Medium-sized economies such as Angola, Kenya and Ghana also have competitive banking systems with significant foreign participants, while smaller island economies such as Mauritius and The Seychelles have, by comparison, first-class leading banks and sophisticated financial products and services. As such, the diversity, size and sophistication of economies and banking systems in Sub-Saharan Africa triggered an investigation into competitiveness and performance of banks.

The second motivating factor was a desire to investigate how the 2007/2008 financial crisis triggered poor performance of banks (Fosu, 2013). In turn, poor performance led to increased systemic risk to the financial architecture and the exposure of structural weakness in supervision and prudential policies (Dahou, Omar & Pfister, 2009; Allen & Giovannetti, 2011; Čihák, Demirgüç-Kunt, Pería & Mohseni-Cheraghlou, 2012). Following from the concept of information asymmetry (Mishkin, 2013), in which banks faced problems of adverse selection and moral hazard in their lending activity, the risk to small depositors, for instance, increased in the wake of financial crises (Stiglitz, 1994; Mishkin, 2013). This risk materialised in the form of sequential service constraints (Andolfatto & Nosal, 2008), which created an incentive for depositors to seek verification of the solvency of banks (Diamond &

[1] Notwithstanding the benefits of competition, aggressive conduct by banks or excessive risk-taking can have several negative implications, such as: (1) creation of asset-price bubbles, (2) artificial credit growth and proliferation of opaque financial products, (3) deterioration of asset quality, (4) excess leverage and build-up of systemic risk to the financial architecture, and (5) triggering de-marketing campaigns (Boot & Thakor, 1997; Claessens, Laeven, Igan & Dell'Ariccia, 2010; Sanusi, 2012).

[2] A blueprint of economic structural adjustment programmes.

Dybvig, 1983). In the interests of depositors, global recalibration of prudential policies followed with enactment of the Volcker Rule[3] (Whitehead, 2011; Thakor, 2012).

Lastly, a motivating factor for this study was that the existing literature on bank competition in developing countries remains crucially limited, thus presenting an opportunity to provide additional insights. Moreover, a significant limitation of the literature is that it largely covers single country analyses (Buchs & Mathisen, 2005; Hauner & Peiris, 2005; Greenberg & Simbanegavi, 2009; Biekpe, 2011; Simpasa, 2011; Simbanegavi *et al*., 2012, Osuagwu & Nwokoma, 2017), as opposed to cross-country evidence, which remains limited (Sanya & Gaertner, 2012; Fosu, 2013). This limitation results in an omission of the effect of regional integration, trade, interdependence of intermediation and harmonisation of regulation and monetary policy (Claessens & Laeven, 2003; Bikker, Shaffer & Spierdijk, 2009; Sanya & Gaertner, 2012; Fosu, 2013). However, authors have often indicated that insufficient data availability is a critical reason for the scant literature (Claessens & Laeven, 2003, 2005; Sanya & Gaertner, 2012; Fosu, 2013).

The objectives of this study were in two parts as follows:

i. Measuring banking competition

The first objective was to examine changes in banking competition in Sub-Saharan Africa, in a period of significant banking and economic reform that also coincided with the onset of the 2007/2008 global financial crisis. Specifically, the study sought to examine, from a non-structural view, pricing behaviour of banks by applying the Panzar-Rosse model to compute a continuous measure of a static *H*-statistic. The computed value would therefore suggest the extent of contestability of markets. Further, the research assignment sought to validate the *H*-statistic by computing an *E*-statistic, which explains a state of general market equilibrium as a pre-condition to measuring banking competition.

ii. Adding insights to existing literature

Apart from empirical testing, another objective of this study is to contribute new insights to the current debate on competition and its impact on financial sector development strategy (Claessens & Laeven, 2003). To the best of the authors' knowledge, prior studies on banking competition remain limited (Claessens & Laeven, 2003; Buchs & Mathisen, 2005; Hauner & Peiris, 2005; Bikker *et al*., 2009; Greenberg & Simbanegavi, 2009; Schaeck, Čihák & Wolfe, 2009; Simpasa, 2011; Sanya & Gaertner, 2012; Simbanegavi *et al*., 2012; Fosu, 2013, and Osuagwu and Nwokoma 2017), by comparison with developed economies. Moreover, reviewed studies do not adequately capture the post 2007/2008 financial crisis in which significant implementation of reform/liberalisation and prudential policies influenced competitive behaviour.

2.1 Literature Review

This section provides a theoretical background to the various pricing strategies of firms that influence competitive behaviour. A review of relevant empirical literature, was also undertaken.

[3] Volcker Rule was enacted in 2010 to counter the negative effects universal banking introduced by the Gramm-Leach-Bliley Act.

2.2.1 Structural approach to measuring competition

The structural approach assumes a causal relationship between market structure and performance (Bikker & Haaf, 2002) and consists of two competing hypotheses—Structure-Conduct-Performance (SCP) paradigm and Efficient Structure Hypothesis. The SCP paradigm, according to Bain and Qualls (1968: 381), posits that high concentration in an industry weakens the degree of competition and encourages collusive behaviour by organisations. In turn, collusive behaviour leads to abnormal profit at the expense of efficiency. Popular empirical tests that support the SCP paradigm are the Herfindahl-Hirschman Index (HHI) and firm concentration ratio (CRn).

The Efficient Structure Hypothesis (ESH), originally proposed by Demsetz (1973), indicates that a larger market share for an individual bank that leads to high industry concentration is the result of efficiency and lower input costs, as opposed to a low degree of competition. The hypothesis further argues that the SCP paradigm ignores barriers to entry and exit in an industry such as economic, legal and technological barriers. In addition, it argues that the SCP paradigm does not account for firm efficiency, such as superior staff, technology and production efficiency. Therefore, an efficient bank will, over time, increase market share, market power and ultimately drive superior performance relative to competitors.

2.2.2 Non-structural approach to measuring competition

The non-structural approach, on the other hand, is a modern view, in the manner of the New Empirical Industrial Organisation (NEIO) theories. The approach suggests that changes in input costs influence pricing behaviour and ultimately performance of banks. This ultimately leads to prices being set equal to marginal costs (Iwata, 1974; Bresnahan, 1982; Panzar & Rosse, 1987; Bikker & Haaf, 2002). In addition, the non-structural approach argues against the notion of a causal relationship between market structure and performance. Popular empirical tests are the Panzar-Rosse model (1982, 1987) and Bresnahan model (1982).

2.2.2.1 The Panzar-Rosse Model

The Panzar-Rosse model, primarily assumes that the conduct of competing banks influences performance of any individual bank. The idea is that banks employ dissimilar pricing strategies as they respond to changes in factor input prices; and competitiveness therefore is the extent to which changes in input prices reflect in revenues in a state of equilibrium (Panzar-Rosse, 1987; Bikker & Haaf, 2002). Assumptions of the model include a single product output and profit maximisation, where marginal revenue is set equal to marginal cost. Using data at firm level, the test derives a measure called an *H*-statistic, which is a summation of the elasticities of revenue with respect to changes in input prices. In other words, an *H*-statistic is a continuous measure of the level of competition (Bikker & Haaf, 2002).

At one end of the measurement, an *H*-statistic is less than or equal to zero, which implies monopoly or oligopoly pricing behaviour. At the other end, it is equal to unity, which implies perfect competition. Results for an *H*-statistic which lie between zero and unity imply varying degrees of monopolistic pricing behaviour. Panzar and Rosse (1987) show that for a profit-maximising monopolist, an *H*-statistic cannot be positive, since an increase in input raises marginal cost. This they say lead to an output restriction and therefore lower revenues. For perfect competition where an *H*-statistic is equal to unity, individual firms incur an increase in marginal and average costs without altering equilibrium output.

Therefore, deriving an *H*-statistic follows:

$$R_i'(x_i, n, z_i) - C_i'(x_i, w_i, t_i) = 0 \tag{3.1}$$

where R_i' and C_i' are marginal revenue and marginal cost of bank *i*. Output is x_i. The number of banks is *n*. A vector of input prices is w_i. Vectors of exogenous variables that shift the revenue and cost functions are z_i and t_i. Long-run equilibrium imposes a zero-profit constraint at market level.

$$R_i^*(x_i, n, z_i) - C_i^*(x_i, w_i, t_i) = 0 \tag{3.2}$$

where variables with an asterisk are in long-run equilibrium.

$$H = \sum_{k=1}^{m} \frac{\delta R_i^*}{\delta w_{ki}} \frac{w_{ki}}{R_i^*} \tag{3.3}$$

where the derivative of total revenue is $\frac{\delta R_i^*}{\delta w_{ki}}$, based on the price of the k^{th} input.

In forming comparative static properties of a reduced-form revenue equation, the Panzar-Rosse model initially utilised cross-sectional data, although in later studies panel data estimations became prevalent as cross-country evidence emerged. Despite popularity among authors, criticism levelled against the Panzar-Rosse model suggests overestimation of results in static equilibrium form, due to the use of price equations, as opposed to unscaled revenue (Bikker *et al*., 2009). Employing a gradual or dynamic approach to equilibrium therefore tackles this limitation and provides a model robustness check (Goddard & Wilson, 2009).

2.2.2.2 The Bresnahan Model

The Bresnahan model was not applied in this study, but primarily differs from the Panzar-Rosse model in that it assumes a two-product bank, for example loans and deposits; whereas the Panzar-Rosse approach considers one. Other assumptions, nonetheless, are consistent with the Panzar-Rosse model, such as general market equilibrium condition and profit maximisation. Notably, banks set price P and quantity Q, such that marginal cost MC is equal to 'perceived' marginal revenue MRP. In a competitive market, MRP = P and in a monopoly, MRP = MR. Where there is monopolistic competition, MRP < P. Importantly, bank customers are considered price takers, where P = MC. Therefore, the model estimates a parameter that ranges from perfect competition to monopoly power. Further, the model typically applies aggregate data as opposed to firm-level data.

2.3 Studies on Sub-Saharan Africa

In sub-Saharan Africa, a few country-specific studies (Buchs & Mathisen, 2005; Hauner & Peiris, 2005; Greenberg & Simbanegavi, 2009; Biekpe, 2011; Simpasa, 2011; Simbanegavi *et al*., 2012, Osuagwu and Nwokoma, 2017), in varying periods between 1998 and 2014, were conducted in Ghana, South Africa, Tanzania, Uganda and Nigeria. The various empirical studies tested for changes in competitive conduct by applying the Panzar-Rosse model, and all of them determined monopolistic competition. Tests for general market equilibrium validated the outcomes. Importantly, the studies highlighted the impact of reform/liberalisation and prudential policies on the conduct of banks following periods of financial repression.

Sanya and Gaertner (2012) examined the determinants of competition in the East African region by conducting an empirical test using the Panzar-Rosse model in a sample of four out of the five East African Community (EAC) members in the years 2001-2008. Their measured *H*-statistic indicated monopolistic competition, but they found Kenyan banks to be the most competitive and Rwandan banks the least.

Findings from their empirical test suggested that low levels of intermediation, a lack of access to financial services and inefficiencies in banking systems in East Africa were associated with limited competition. However, reform/liberalisation and prudential policies introduced in the early 2000s contributed to a rapid increase in credit to the private sector. Policy implementation included restructuring and privatisation of state-owned banks, write-off of non-performing loans, fostering good governance, easing of barriers to entry and tightening of supervision. Importantly, the entry of foreign banks into the region was significant, and helped to improve bank sophistication, but state-owned banks retained a very large market share.

Lastly, Fosu (2013) completed a first-ever attempt at broadly assessing bank competition in all the sub-regions of Africa. The study employed the Panzar-Rosse model in a sample of 38 African countries in the period 2002-2009. A test for general market equilibrium validated the results. Overall, the study measured the prevalence of monopolistic competition in Africa, linked to the implementation of reform/liberalisation and prudential policies undertaken to undo critical underperformance of banking systems.

Fosu (2013) described a continent in which banking systems had been previously plagued by controls on interest rates and credit allocation, poor asset quality, as well as dominance by state-run banks. However, deregulation had resulted in an increase in regional integration, recapitalisation, entry of foreign banks, cross-border competition, advances in technology, restructuring and privatisation of state-run banks, and write-off of non-performing loans. This resulted in an improvement in the allocative efficiency of credit to the private sector. Importantly, Fosu (2013) highlighted that generating interest income was an influencing factor in competitive conduct, since most banks in Africa relied on lending activity as a key source of revenue. This study build on Fosu (2013) to look at a period that sufficiently encapsulated the effect of changes to the bank operating environment in sub-Saharan Africa since the onset of the 2007/2008 global financial crisis.

2.4 Development of hypotheses

Bikker and Haaf (2002) clearly indicated that the competitive structure of a banking system could change over time due to the process of reform/liberalisation and deregulation. From that view, a calculated *H*-statistic explains pricing behaviour of firms. By measuring the sum of elasticities of revenue to factor input prices, an *H*-statistic equates to unity where there is perfect competition/contestability, implying that an increase in factor prices would not alter bank output. A calculated result, which is less than unity but above zero, would suggest an alternative view of monopolistic competition or partial contestability, which implies that changes in factor input prices affect bank pricing of output. Therefore, the hypothesis follows:

H1. There is a statistically significant positive association between unit factor input prices (market power) for a bank and the extent of competitive behaviour.

Following from the empirical theory on banking competition, in the manner of the NEIO framework (Iwata, 1974; Bresnahan, 1982; Lau, 1982; Panzar & Rosse, 1987; Roeger, 1995), the validity of the competition parameter is sufficient only when the banking system is

observed in general market equilibrium (Bikker & Haaf, 2002; Brooks, 2013: 495). As such, an *E*-statistic, calculated to explain that general market equilibrium exists where the factor input prices of funds, labour and capital expenditure do not influence banking returns, is statistically equivalent to zero. The hypothesis therefore follows that:

H2. Market equilibrium exists where returns on bank assets are not associated with factor input prices.

3.1 Research Methodology

This study applied the Panzar-Rosse approach to measuring banking competition in sub-Saharan Africa, in light of the 2007/2008 global financial crisis.

3.2 The Population and Sample

This study drew a sample of banks from a selection of six countries, which represented three sub-regions in Sub-Saharan Africa, namely East Africa (Kenya and Uganda), Southern African (Mauritius and South Africa) and West Africa (Ghana and Nigeria). Specifically, the selection criteria for the sample anchored on data availability, economic and financial development, advanced legal frameworks, good corporate governance and disclosure, and use of IFRS reporting standards. From the selected countries, 83 banks (cross-sections) were included in the sample out of a possible 152 (see Table 1), which was most representative of banks in Sub-Saharan Africa.

Table 1: Banks population and sample

Country	Population	Sample	Representation
Ghana	27	16	59
Kenya	42	23	55
Mauritius	21	10	48
Nigeria	21	14	67
South Africa	16	11	69
Uganda	25	9	36
Total	**152**	**83**	**55**

Notes: Representation refers to sample as a percentage of population.
Source: Computed by the Authors

Excluded from the sample were banks with missing data in at least three of the time series periods. This was mainly because data for several banks was not available from data sources. The selected years (2008-2013) represented a period that sufficiently encapsulated the effect of changes to the operating environment in sub-Saharan Africa since the onset of the 2007/2008 global financial crisis. As a result, the data panel was unbalanced. Consequently, possible observations were 498, but 481 were included in the empirical estimation.

3.3 Data Sources and Collection

Banks data were mainly sourced from a public database called African Financials. A significant number of annual financial statements for banks in Sub-Saharan Africa were contained on the platform. For a few other banks, the financial statements pages of bank-specific websites were used. We utilised only parent or in-country bank financial statements, as opposed to consolidated accounts. This satisfied a common-effect specification and

reduced bias from multi-country representation (Bikker & Haaf, 2002; Sanya & Gaertner, 2012). Countries with significant multi-country bias were Kenya, Nigeria and South Africa (Claessens & Van Horen, 2011; Sanya & Gaertner, 2012). Data on macroeconomic variables were sourced from the World Bank.

3.4 Definition of Variables and Model Specification

Table 2 below defines the variables used in the analysis.

Table 2: Summary of definitions and operationalisation of variables (All in natural log)

Dependent variables – revenue and general market equilibrium functions	
REV	Ratio of interest income to total assets. It represents a scaled revenue function, which is explained by changes in unit input prices.
ROA	Ratio of net income to total assets. It is regressed to validate the Panzar-Rosse model in general market equilibrium.
Independent variables – unit factor input prices that influenced the output pricing behaviour of banks	
PF	Unit price of funds or average cost of funds is the ratio of interest expense to total customer deposits.
PL	Unit price of labour is the ratio of staff expenses to total assets.
PK	Unit price of capital is the ratio of other operating expenses to fixed assets. It represents the level of capital expenditure.
Bank-specific control variables – controlled for differences in business mix, activity and scale	
RISKASS	Ratio of loan loss provisions to total assets. It represents the level of conservatism of management in lending activity.
ASSET	USD value of balance sheet. It controls for scale.
CREDIT	Ratio of total loans to total assets. This is a representation of lending activity, which is a key source of income for banks.
EQUITY	Ratio of shareholder equity to total assets. It controls for leverage.
Country-specific variables – macroeconomic controls which were time variant but fixed per country	
GROWTH	Annual GDP growth rate. It captures changes in national income, which is related to performance of banks.
INFL	Annual rate of inflation controls for the effect of changes in prices.

Source: Authors compilation.

3.4.1 Specifying the Panzar-Rosse equation for H1

In a sense, the Panzar-Rosse model was a contestability regression (Brooks, 2013: 495), which tested whether a change in input prices influenced the output of banks or not. Under such influence, the observation indicated a state of monopolistic competition. Without influence, the observation indicated perfect competition. Therefore, assuming the hypothesised relations were linear, the main fixed-effects regression estimated in this study are:

$$\ln REV_{it} = \alpha + \beta_1 \ln PF_{it} + \beta_2 \ln PL_{it} + \beta_3 \ln PK_{it} + \gamma_1 \ln RISKASS_{it} + \gamma_2 \ln ASSET_{it} + \gamma_3 \ln CREDIT_{it} + \gamma_4 \ln EQUITY_{it} + \delta_1 \ln GROWTH_t + \delta_2 \ln INFL_t + \varphi D_2 + \varphi D_3 + \cdots + \varphi D_6 + \vartheta_{it}, \quad \text{(i)}$$

Alternatively,

$$\ln REV_{it} = \alpha + \beta_1 \ln PF_{it} + \beta_2 \ln PL_{it} + \beta_3 \ln PK_{it} + \gamma_1 \ln RISKASS_{it} + \gamma_2 \ln ASSET_{it} + \gamma_3 \ln CREDIT_{it} + \gamma_4 \ln EQUITY_{it} + \delta_1 \ln GROWTH_t + \delta_2 \ln INFL_t + \mu_{it} + \vartheta_{it}, \quad \text{(ii)}$$

where subscripts i and t, denoted bank i at year t.

This study therefore estimated a static version of an *H*-statistic for the specified equation i, using a panel fixed-effects[4] approach or least squares dummy variables (LSDV) method. In essence, the fixed-effects approach controlled for heterogeneity at bank-specific level (Fosu, 2013). Further, according to the literature, a fixed-effects model allowed the intercept in the equation to vary cross-sectionally, but not over time (Brooks, 2013: 490), where $\alpha = \alpha_i$ (Claessens & Laeven, 2003). Appendix C provides details of the diagnostic tests (*Hausman test and Wald test*) for the chosen model. An *H*-statistic, therefore, equated to the sum of the coefficients of the unit factor prices of funds, labour and capital expenditure (Molyneux *et al*., 1994; Bikker & Haaf, 2002; Claessens & Laeven, 2003). This was denoted as follows:

$$H = \beta_1 + \beta_2 + \beta_3 \quad \text{(iii)}$$

where β_1 was the coefficient of price of funds, β_2 was the coefficient of price of labour and β_3 was the coefficient of capital expenditure.

3.4.2 Specifying the Panzar-Rosse equation for H2

Since the literature specified that conditions observed in general market equilibrium validated the Panzar-Rosse model (Panzar & Rosse, 1987, Molyneux *et al*., 1994; Bikker & Haaf, 2002; Claessens & Laeven, 2003), some minor re-specification of the model to represent the natural log of the dependent variable *ROA* altered the equation as follows:

$$\ln ROA_{it} = \alpha + \beta_1 \ln PF_{it} + \beta_2 \ln PL_{it} + \beta_3 \ln PK_{it} + \gamma_1 \ln RISKASS_{it} + \gamma_2 \ln ASSET_{it} + \gamma_3 \ln CREDIT_{it} + \gamma_4 \ln EQUITY_{it} + \delta_1 \ln GROWTH_t + \delta_2 \ln INFL_t + \varphi D_2 + \varphi D_3 + \cdots + \varphi D_6 + \vartheta_{it}, \quad \text{(iv)}$$

Alternatively,

$$\ln ROA_{it} = \alpha + \beta_1 \ln PF_{it} + \beta_2 \ln PL_{it} + \beta_3 \ln PK_{it} + \gamma_1 \ln RISKASS_{it} + \gamma_2 \ln ASSET_{it} + \gamma_3 \ln CREDIT_{it} + \gamma_4 \ln EQUITY_{it} + \delta_1 \ln GROWTH_t + \delta_2 \ln INFL_t + \mu_{it} + \vartheta_{it}, \quad \text{(v)}$$

where the dependent variable was specified as ROA´ = ln(1+*ROA*), in order to adjust for negative values of net income (Claessens & Laeven, 2003).

3.4.3 Defining parameters of an E-statistic

This study computed an *E*-statistic to test for equilibrium using a Wald test F-statistic. In this case, the assumption was that the sum of the coefficients of the factor prices of funds, labour and capital expenditure were statistically equivalent to zero. As such, the null was formulated

[4] This study applied the Hausman test to choose a specification between random- and fixed effects. The null hypothesis of random-effect was rejected at the five percent level of significance. A further specification test using the Wald test rejected null that pooled OLS is appropriate, and did not reject the fixed-effect or least squared dummy variables (LSDV) specification.

as E = zero; and it followed that if not rejected, the market was sufficiently in a state of long-run equilibrium. Notation of an E-statistic followed:

$$\beta_1 + \beta_2 + \beta_3 = 0 \quad \text{(vi)}$$

4.1 Findings

This section presents a review of descriptive statistics and an analysis of the correlation matrix. A detailed presentation on findings from hypotheses testing then follows.

4.2 Review of Descriptive Statistics

Table 3 presents a summary of descriptive statistics of all dependent and independent variables for the period 2008-2013. Importantly, the impact of the 2007/2008 financial crisis was captured during this period, and a number of interesting findings emerged. First, in all periods observed, 2009 appeared to have been a relatively more challenging year as the effects of the crisis were still evolving.

4.2.1 Dependent variables

In 2009, *REV* increased to its highest level of 14.53 percent from 11.82 percent in 2008, intuitively suggesting that banks' pricing behaviour altered to reflect increasing risk to lending activity in light of the financial crisis. Countries that experienced trade vulnerabilities (Berman & Martin, 2012), mainly due to declining commodity prices (Allen *et al*., 2011), would have likely reacted to a deterioration in loan quality by raising interest rates. As expected, bank performance was negatively affected by changes in the operating environment (IMF, 2011), resulting in a mean *ROA* of 1.41 percent for 2009, which was the lowest over the observed period, as some banks reported losses.

4.2.2 Independent variables

Not surprisingly, *PF* increased to its maximum of 10.74 percent in 2009, reflecting rising cost of funds associated with the general loss of depositor confidence, capital flight, low liquidity and increased leverage (Arieff, 2010; Allen *et al*., 2011). Years later, however, *PF* declined as regulators tightened prudential policy and directed banks to increase capitalisation levels. In the wake of the financial crisis, banks sought to improve the quality of risk management and general operations, which resulted in an increase in the wage rate as skilled talent was acquired. For instance, the median wage rate in 2009 was the highest ever for the observed period, highlighting the short-term pressures faced by banks. Nevertheless, as alternative methods of distribution such as branchless banking (Klein & Mayer, 2011) evolved over the past few years, pressure on the wage rate diminished. Banks, instead, focused on upgrading information technology infrastructure, driving *PK* to its highest levels in 2010.

4.2.3 Bank-specific control variables

Despite the negative effect of the financial crisis on asset quality in many banking systems in Sub-Saharan Africa, a bank-specific control, *RISKASS*, did not rise significantly. The average was 3.41 percent in 2008, but declined to 1.89 percent in 2011. Intuitively, this implied that some banking systems where insulated from the impact of the crisis, or had sufficiently strong risk management infrastructure to avert a banking crisis. Further, other banking systems resorted to either writing off or selling non-performing loans. For example, regulatory intervention in Nigeria led to the establishment of AMCON in 2010, and a subsequent disposal of over NGN1.5 trillion of non-performing loans by the banking sector

(AMCON, 2012). As expected, the bulk of non-performing loans purchased where related to the oil and gas sector (27%), trade finance (19%) and capital markets (18%). Nevertheless, the sell-off resulted in most banks reducing their NPL ratios to below the regulatory stipulated five percent (Sanusi, 2012), which was a key driver in mitigating against a rise in *RISKASS* and improving liquidity.

Interestingly, lending activity as measured by *CREDIT* remained relatively stable, with a mean of 50.60 percent over the observed period. The extent of financial intermediation in banking systems in Sub-Saharan Africa pre- and post-crisis was constrained due to a number of reasons, such as poor credit information, a lack of collateral and financial illiteracy, such that banks traditionally preferred to lend to larger and less-risky corporate customers or alternatively held cash and government securities. Therefore, and as expected, there was no significant level of deleveraging that occurred post-crisis.

However, in view of the crisis regulators took precaution by instigating a recapitalisation of banking systems across the sub-continent (Čihák *et al*., 2012). In essence, average *EQUITY* increased to 15.01 percent in 2010, and again increased to 15.11 percent in 2013, as profitability of banks improved. For un-scaled balance sheets, the standard deviation of *ASSET* was substantially high, owing to the enormous scale of South African banks relative to other banks in the representative sample. However, average *ASSET* reflected a steady increase over the observed period, from USD 4.50 trillion to USD 6.32 trillion.

4.2.4 Country-specific control variables

GROWTH also followed a positive trend, from 4.24 percent in 2009 to 6.40 percent in 2011, due to a recovery in commodity prices, additional resource discoveries and exploitation, as well as rising domestic demand (IMF, 2012). However, growth rates tapered off in 2012 and 2013 as uncertainties over stability in the global economy increased, and risks of faltering demand from emerging economies such as China materialised (IMF, 2014). Average inflation, however, did not indicate any trend, owing to differences in pass-through to domestic prices from associated local currency depreciation. In 2008, as commodity prices peaked (IMF, 2009; Allen *et al*., 2011), average inflation for the representative sample reached a high of 14.61 percent, but subsequently declined to 6.59 percent in 2010.

Table 3: Summary descriptive statistics (percentage, unless otherwise stated)

Variables	Measure	2008	2009	2010	2011	2012	2013	All
REV	Mean	9.829	10.323	8.866	8.696	9.836	9.593	9.524
	Median	10.525	10.182	8.775	8.740	10.362	9.977	10.079
	STD	0.020	0.027	0.025	0.025	0.031	0.028	0.026
	Min	6.439	5.413	4.352	4.573	4.356	4.703	4.352
	Max	11.824	14.532	12.789	12.266	13.616	13.106	14.532
ROA	Mean	2.041	1.408	2.216	1.712	2.176	2.187	1.957
	Median	1.791	1.198	2.403	1.724	2.053	1.973	1.882
	STD	0.011	0.012	0.008	0.013	0.008	0.010	0.010
	Min	0.665	-0.642	1.043	-0.663	1.216	1.258	-0.663

	Max	4.016	3.435	3.032	3.517	3.303	3.711	4.016
PF	Mean	5.930	6.210	4.826	4.359	5.387	5.139	5.309
	Median	5.535	5.879	4.475	4.224	5.278	5.331	5.305
	STD	0.014	0.023	0.017	0.010	0.018	0.016	0.016
	Min	4.237	3.538	2.632	2.761	2.572	2.630	2.572
	Max	7.763	10.735	8.338	5.776	8.045	7.559	10.735
PL	Mean	2.692	2.859	2.571	2.485	2.475	2.395	2.579
	Median	2.900	3.107	2.763	2.651	2.596	2.521	2.707
	STD	0.008	0.009	0.007	0.007	0.008	0.008	0.008
	Min	1.121	1.041	0.989	1.002	0.886	0.934	0.886
	Max	3.415	3.821	3.247	3.373	3.416	3.407	3.821
PK	Mean	142.024	152.060	216.405	187.613	183.472	178.887	176.743
	Median	133.189	134.596	151.517	145.338	169.733	157.370	148.428
	STD	0.517	0.553	1.317	1.065	0.776	0.604	0.805
	Min	78.562	90.574	93.407	88.962	103.179	118.372	78.562
	Max	240.921	264.995	452.526	408.562	341.490	285.799	452.526
RISKASS	Mean	3.406	3.201	2.385	1.880	1.965	2.063	2.484
	Median	2.112	2.219	2.052	1.780	1.792	1.734	1.922
	STD	0.031	0.027	0.014	0.006	0.007	0.008	0.015
	Min	1.424	1.265	0.780	1.120	1.427	1.453	0.780
	Max	10.145	9.065	5.181	3.040	3.360	3.918	10.145
ASSET	Mean	4 674	4 502	4 666	5 214	5 744	6 319	5 186
	Median	998	1 011	1 088	1 140	1 312	1 488	1 114
	STD	7 585	7 207	7 382	8 008	8 552	9 126	7 977
	Min	163	205	253	302	347	526	163
	Max	21 325	20 312	20 854	22 619	24 196	25 888	25 888
	Total	321 419	313 092	328 038	370 604	410 640	452 011	365 967
CREDIT	Mean	48.685	50.448	50.068	51.487	51.320	51.586	50.599
	Median	49.692	49.860	49.744	54.044	51.510	49.722	49.802
	STD	0.073	0.052	0.061	0.083	0.072	0.064	0.068
	Min	33.877	42.734	43.062	38.362	38.573	41.468	33.877
	Max	57.127	58.138	61.118	62.014	61.890	60.947	62.014

Source: Computed by the Authors.

Summary descriptive statistics (continued)

Variables	Measure	2008	2009	2010	2011	2012	2013	All
EQUITY	Mean	14.911	14.445	15.013	14.269	14.675	15.112	14.737
	Median	15.228	15.354	14.933	14.340	14.997	15.119	15.058
	STD	0.034	0.035	0.020	0.017	0.019	0.027	0.025
	Min	9.805	8.895	11.805	11.458	11.605	11.112	8.895
	Max	18.878	18.126	18.010	17.155	17.530	19.606	19.606
GROWTH	Mean	5.678	4.241	5.794	6.397	4.454	4.683	5.208
	Median	5.891	3.499	5.832	4.654	3.845	5.041	4.847
	STD	0.025	0.021	0.018	0.040	0.021	0.017	0.024
	Min	1.527	1.526	3.140	3.599	2.467	1.891	1.526
	Max	8.709	7.251	8.007	15.007	8.790	7.132	15.007
INFL	Mean	14.610	10.453	6.587	10.682	9.006	6.753	9.682
	Median	11.814	10.386	4.119	9.784	9.270	5.712	9.527
	STD	0.056	0.052	0.041	0.046	0.035	0.026	0.043
	Min	9.733	2.550	2.893	5.280	3.852	3.543	2.550
	Max	26.240	19.251	13.720	18.693	14.016	11.608	26.240

Source: Computed by the Authors**.**

4.3 Analysis of Correlation Matrix

The correlation matrix presented in Table 4 mainly indicates positive signs for the coefficients. There was a statistically significant positive association between *REV* and the main independent variables *PF* and *PL*, with correlation coefficients of 0.62 and 0.64 respectively. *PK*, on the other hand, had a negative sign, but the relationship with *REV* was statistically weak as the coefficient was only 0.10. *RISKASS* and *CREDIT* had similar correlation coefficients with *REV*, of approximately 0.40 respectively, indicating a positive relationship between lending activity and risk management in the determination of interest rates. This can also be explained by the notion that the higher the risk associated with granting each loan, the higher the lending rate (Brooks, 2013: 498).

Likewise, the association of *RISKASS* and *CREDIT* to *PF* was also relatively strong, indicating that cost of funds played a role in determining the quantity of risk and extent of lending activity assumed by each individual bank. Further, the correlation coefficient between *RISKASS* and *CREDIT* was positive with a correlation coefficient of 0.60. Notably, the correlation coefficient between *PL* and *RISKASS* of 0.41 indicated that bank wage rates were partly influenced by the acquisition of specialised talent in risk management in the wake of the financial crisis. *PL* and *INFL* had a coefficient of 0.39, but the positive sign highlighted the effect of inflationary pressures on the wage rate.

Lastly, the relationship between *ASSET* and *GROWTH* had a correlation coefficient of 0.49 and, significantly, the positive sign was associated with the notion of a causal link between financial sector development and economic growth (King & Levine, 1993; Claessens & Laeven, 2003).

Table 4: Correlation matrix for the variables for all 481 observations

	REV	PF	PL	PK	RISKASS	ASSET	CREDIT	EQUITY	GROWTH	INFL
REV		0.624	0.638	-0.095	0.394	0.134	0.406	0.237	0.248	0.443
PF	0.624		0.164	-0.228	0.471	0.195	0.597	-0.109	0.162	0.278
PL	0.638	0.164		0.056	0.405	0.115	0.185	0.248	0.180	0.389
PK	-0.095	-0.228	0.056		-0.308	-0.166	-0.325	-0.003	-0.158	-0.050
RISKASS	0.394	0.471	0.405	-0.308		0.288	0.600	-0.075	0.170	0.197
ASSET	0.134	0.195	0.115	-0.166	0.288		0.021	-0.114	0.490	0.300
CREDIT	0.406	0.597	0.185	-0.325	0.600	0.021		-0.220	-0.033	0.077
EQUITY	0.237	-0.109	0.248	-0.003	-0.075	-0.114	-0.220		0.105	0.158
GROWTH	0.248	0.162	0.180	-0.158	0.170	0.490	-0.033	0.105		0.118
INFL	0.443	0.278	0.389	-0.050	0.197	0.300	0.077	0.158	0.118	

Note: Variables taken in natural log.
Source: Authors Compilation.

4.4 Empirical Results and Discussion

This section provides detailed findings of the empirical tests of the H1 and H2. In the first instance, the outcome of testing for H2 indicated sufficient conditions of market equilibrium. Thereafter, H1 was regressed and the conditions of monopolistic competition identified were consistent with previous studies.

4.4.1 General market equilibrium analysis

H2 was tested for a sample of 83 banks in Sub-Saharan Africa, that banking competition exists under conditions of general or long run market equilibrium. Following literature, this could also be stated as *ROA* is not influenced by factor input prices in the long run (Molyneux *et al*., 1996), such that a computed *E*-statistic = zero. The empirical test, presented in detail in Appendix D and summarised in Table 5 below, was conducted using a Wald test. The outcome was that the computed value of the *E*-statistic was 0.003, with a *p-value* of 0.407. Therefore, the null hypothesis that unit factor input prices were equivalent to zero, was not rejected. The implication, therefore, was that banking competition was observed in a state of general equilibrium.

Table 5: Test of banking market equilibrium with LSDV model

Independent variables	Dependent variable: lnROA	Probability
lnPF	-0.001	0.470
lnPL	-0.005*	0.059
lnPK	0.003*	0.069
lnRISKASS	-0.001	0.324
lnASSET	0.005***	0.000
lnCREDIT	0.003	0.130
lnEQUITY	0.013***	0.000
lnGROWTH	0.008**	0.018
lnINFL	0.004	0.164
D2	-0.053***	0.000
D3	-0.065***	0.000
D4	-0.007*	0.063
D5	-0.017***	0.004
D6	-0.020***	0.000
Intercept	0.031**	0.048
Number of observations / period	481	2008-2013
R^2 (adjusted) - %	22.3	
H_0: E=0	0.003	0.407
Decision	Do not reject null hypothesis; Evidence of long-run equilibrium exists	

Note: *, ** and *** denote significance at 10, 5, and 1 percent respectively.
Source: Authors Compilation.

The results of the empirical test for H2 were consistent with findings from previous studies, where, in the long run, factor input prices were not having any influence on bank returns. These findings were also consistent with the theoretical literature, which states that, in equilibrium, the zero profit constraint holds constant at market level (Shaffer, 1982; Molyneux *et al*., 1996; Bikker & Haaf, 2002).

4.4.2 Test of competition using the Panzar-Rosse approach

Having satisfied conditions of general market equilibrium, H1 was tested for the same sample of 83 banks in sub-Saharan Africa, that there is statistically significant relationship between changes in market conditions/power and the extent of competitive conduct. Specifically, a regression of the Panzar-Rosse model, using a fixed-effects method, was used to compute a continuous measure of an *H*-statistic that had a value of 0.57 (see Table 6 below). The results were validated by a Wald test, which confirmed that the *H*-statistic was significantly different from both unity and zero at the one percent level of significance. The findings therefore suggested that the banking system is characterised by monopolistic competition, as opposed to perfect competition or pure monopoly.

Also, the use of a fixed-effects method was validated by conducting a Hausman test (random-effects versus fixed-effects) and also a Wald test that dummy variables were jointly zero.

Both null hypotheses that the random-effects model was appropriate and dummy variables were equal to zero, were strongly rejected, allowing for heterogeneity among the banks (Bikker & Haaf, 2002; Claessens & Laeven, 2003; Brooks, 2013: 496; Fosu, 2013).

Table 6: Test of banking competition with LSDV model

Independent variables	Dependent variable: lnREV	Probability
lnPF	0.289***	0.000
lnPL	0.295***	0.000
lnPK	-0.014	0.392
lnRISKASS	-0.020	0.120
lnASSET	0.008	0.299
lnCREDIT	0.020	0.295
lnEQUITY	0.118***	0.000
lnGROWTH	0.019	0.555
lnINFL	0.034	0.190
D2	-0.133*	0.092
D3	-0.299***	0.000
D4	-0.111***	0.008
D5	-0.354***	0.000
D6	-0.183***	0.002
Intercept	0.028	0.866
Number of observations / period	481	2008 - 2013
R^2 (adjusted) - %	22.3	75.1
***H*-statistic**	**0.570**	
H_0: H=0 (pure monopoly)	-0.430	0.000
H_0: H=1 (perfect competition)	0.570	0.000
Decision	Reject both null hypotheses; evidence of monopolistic competition	

Note: *, ** and *** denote significance at 10, 5, and 1 percent respectively.
Source: Authors Compilation.

Similarly, the results of monopolistic competition were consistent with outcomes of previous studies, and consistent with theoretical literature, since changes in factor input prices (market power) incurred by a specific bank influenced changes to its revenue. Under conditions of perfect competition, on the one hand, an increase in input prices would have raised marginal costs and total revenue by the same amount, where an *H*-statistic is equal to unity. Under pure monopoly, on the other hand, marginal costs would have increased but equilibrium output would have declined, such that H-statistic is less than zero (Claessens & Laeven, 2003).

4.4.3 Interpretation and discussion

Consistent with the outcome of monopolistic competition, Fosu (2013) suggested that reform/liberalisation and prudential policies would have likely influenced pricing behaviour of individual banks and market discipline. The findings, therefore, supported H1, that there is

a statistically significant positive association between the effect of market conditions (banking reform) and the extent of competitive behaviour.

The results of the LSDV model had a mixed outcome regarding the statistical significance of independent variables in explaining differences in *REV* or pricing behaviour of banks (Bikker & Haaf, 2002). Specifically, main independent variables *PF* and *PL* strongly influenced *REV* at the one percent level of significance. Their coefficients carried positive signs, which intuitively suggested the impact of liberalisation of interest rates (Fosu, 2013) on financial intermediation, and the significance of talent acquisition for bank operations (Biekpe, 2011), such as risk management and loan pricing. *PK*, on the other hand, carried a negative sign, but not statistical significance.

Unexpected, bank-specific control variables largely carried no statistical significance (*RISKASS, ASSET* and *CREDIT*), while RISKASS had a negative sign. *EQUITY*, however, had a strong statistical significance, with a positive sign on the coefficient, implying that higher capital levels led to strong pricing power. This was expected in view of the impact of prudential policies which followed the onset of the 2007/2008 financial crisis, where a significant number of banks in Sub-Saharan Africa increased capital via M&A activity, IPOs and/or capitalisation of reserves. Further, the coefficients of macroeconomic control variables (*GROWTH and INFL*) carried positive signs but were not statistically significant. Notably, the dummy variables were all statistically significant, vindicating the application of a LSDV approach (Brooks, 2013: 497).

5. Policy Implications

The findings of this research assignment had significant implications for policy design in financial sector development strategy. This was mainly due to the linkage between the extent of competition, technological advancement, efficiency of financial intermediation, access to financial services, performance and stability (Sanya & Gaertner, 2012; Fosu, 2013).

First, from the findings it was evident that reform/liberalisation and prudential policies had a bearing on the revenue and cost functions of banking systems (Bikker & Haaf, 2002, Fosu, 2013). As such, market players would likely continue to alter their conduct to ensure profit maximisation. For example, interest rate liberalisation could drive higher cost of funds as banks sought to compete for market share of deposits. In turn, banks could increase lending rates by a higher proportion to expand net interest margin. Second, policy-driven recapitalisation of banks resulted in increased market power in pricing of loan output.

Third, higher contestability of markets, owing to unrestricted/universal banking approaches and deregulation of formal barriers, had the implication of driving excessive risk-taking by banks in order to defend or expand market share. For example, excessive risk-taking by banks in Nigeria, via the provision of ill-fated margin loans (Sanusi, 2012), had significant implications in triggering regulatory responses to the ensuing crisis. Fourth, foreign bank entry also had implications for contestability of markets, as well as technological advancement, recalibration of risk management frameworks and capital flow (Claessens & Van Horen, 2011). In East Africa, for example, where formal regulatory barriers were largely withdrawn (Sanya & Gaertner, 2012) as a part of policy design, there were a number of implications. These included a rise in foreign bank participation, significant cross-border capital flows and strong technological innovation, which ultimately enhanced competitive conduct of banks.

Fifth, policy implications on the provision of credit to the private sector indicated a trend towards promoting access to finance, further enhancing competitive conduct and performance

among banks. Although findings in relation to lending activity were statistically insignificant, banks made significant progress in extending their market to low income households and SMEs. Lastly, empirical testing and analysis of descriptive statistics found that policy helped to foster the development of banking systems and efficiency of financial intermediation in the real economy, which ultimately influenced economic growth.

6. Recommendations

In view of the implications highlighted above, policymakers should continue to develop and promote policies geared towards the development of financial intermediation and improved competitive conduct of banks in Sub-Saharan Africa. In the first instance, liberalisation of interest rates should remain a pivotal tool for increased contestability of markets and sustainable performance, while attracting new players into the market. Further, policy design in modernisation of banking infrastructure via technological advancement in branchless/alternative distribution should further ease contestability by alleviating wage rates.

Likewise, prioritising the development and modernisation of credit information bureaux and legal systems should further reduce perceived high risk of lending, which currently inhibits effective financial intermediation. Also, financial literacy programmes targeted at the household and SMEs should foster a financially inclusive approach by banks. This is so, because numerous banks operating on the sub-continent remain averse to extending their markets beyond a traditional large corporates base. For example, a pilot program for the provision of basic accounting techniques through open tutorials in East Africa (Equity Bank, 2013) has met with success as it has helped to reduce the perception of high risk attached to small borrowers.

Lastly, enhancing contestability of markets by privatising state-run banks and promoting regional integration should remain key policy objectives. This would ensure a level playing field for existing competitors and present an opportunity for new investors (Sanya & Gaertner, 2012). In addition, new investment would expand and develop the credit industry, ultimately driving real sector growth.

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APPENDIX A:
SUMMARY OF SAMPLE BANKS BY COUNTRY AND YEAR

Country	2008	2009	2010	2011	2012	2013
Ghana	16	16	16	16	16	16
Nigeria	14	14	14	14	14	14
Kenya	18	21	22	23	23	23
Uganda	7	8	9	9	9	6
South Africa	11	11	11	11	11	11
Mauritius	8	9	10	10	10	10

Source: Authors Compilation.

APPENDIX B: DIAGNOSTIC TEST FOR H_1.

Wald test			
Null hypothesis: Pooled OLS is appropriate; dummy variables/fixed-effects are equal to zero			
Hausman test			
Null hypothesis: Random-effects model is appropriate			
Alternative: Fixed-effects model is appropriate			
Decision: Reject null hypothesis			
Dependent variable: LNREV			
Test summary	Chi-Sq. statistic	Chi-Sq. d.f.	Probability
Cross-section random	42.669	9	0.000
Cross-section random effects test comparisons:			
Variable	Fixed	Random	Probability
LNPF	0.345	0.337	0.382
LNPL	0.264	0.302	0.161
LNPK	0.015	0.019	0.730
LNRISKASS	0.012	-0.015	0.000
LNASSET	0.049	0.000	0.017
LNCREDIT	0.106	0.031	0.041
LNEQUITY	0.024	0.069	0.000
GROWTH	0.0174	0.040	0.006
INFL	0.041	0.043	0.869
Cross-section random-effects test equation:			
Method: Fixed-effects; Dependent variable: LNREV			
Variable	Coefficient	Std. Error	Probability
C	-0.449	0.207	0.030
LNPF	0.345	0.021	0.000
LNPL	0.263	0.039	0.000
LNPK	0.015	0.021	0.476
LNRISKASS	0.012	0.015	0.423
LNASSET	0.049	0.021	0.021
LNCREDIT	0.106	0.043	0.015
LNEQUITY	0.024	0.026	0.363
GROWTH	0.017	0.023	0.445
INFL	0.041	0.020	0.036
R^2 (adj.)	0.883	Probability (F-stat)	0.000
S.E of regression	0.151	Mean dependent var.	-2.407
Sum squared residuals	8.820	S.D. dependent var.	0.441
F-statistic	40.949	Durbin-Watson stat.	1.418

APPENDIX C:
DIAGNOSTIC TEST FOR H_2

Hausman test			
Null hypothesis: Random-effects model is appropriate			
Alternative: Fixed-effects model is appropriate			
Decision: Reject null hypothesis			
Dependent variable: LNROA			
Test summary	Chi-Sq. statistic	Chi-Sq. d.f.	Probability
Cross-section random	25.314	9	0.003
Cross-section random effects test comparisons:			
Variable	Fixed	Random	Probability
LNPF	0.000	-0.002	0.305
LNPL	-0.005	-0.008	0.518
LNPK	0.000	0.002	0.308
LNRISKASS	0.000	-0.001	0.557
LNASSET	0.011	0.000	0.000
LNCREDIT	-0.003	0.005	0.097
LNEQUITY	0.011	0.011	0.986
GROWTH	0.007	0.007	0.737
INFL	0.005	0.002	0.008
Cross-section random-effects test equation:			
Method: Fixed-effects; Dependent variable: LNROA			
Variable	Coefficient	Std. Error	Probability
C	-0.042	0.025	0.091
LNPF	0.000	0.002	0.903
LNPL	-0.005	0.005	0.265
LNPK	0.000	0.002	0.984
LNRISKASS	0.000	0.002	0.818
LNASSET	0.011	0.003	0.000
LNCREDIT	-0.003	0.005	0.620
LNEQUITY	0.011	0.003	0.000
GROWTH	0.007	0.003	0.006
INFL	0.005	0.002	0.021
R^2 (adj.)	0.441	Probability (F-stat)	0.000
S.E of regression	0.018	Mean dependent var.	0.019
Sum squared residuals	0.126	S.D. dependent var.	0.024
F-statistic	5.154	Durbin-Watson stat.	2.141

Source: Authors Compilation.

Wald test			
Null hypothesis: Pooled OLS is appropriate; dummy variables/fixed-effects are equal to zero			
Alternative: Panel least squares dummy variables model is appropriate			
Decision: Reject null hypothesis			
Dependent variable: LNROA			
Test statistic	Value	d.f.	Probability
F-statistic	17.701	(5, 466)	0.000
Chi-square	88.505	5	0.000
	Coefficient	Std. Error	Probability
C(1)	0.031	0.016	0.048
C(2)	-0.001	0.002	0.470
C(3)	-0.005	0.002	0.059
C(4)	0.003	0.002	0.069
C(5)	-0.001	0.001	0.324
C(6)	0.005	0.001	0.000
C(7)	0.003	0.002	0.130
C(8)	0.013	0.002	0.000
C(9)	0.008	0.003	0.018
C(10)	0.004	0.003	0.164
C(11)	-0.053	0.008	0.000
C(12)	-0.065	0.007	0.000
C(13)	-0.007	0.004	0.063
C(14)	-0.017	0.006	0.004
C(15)	-0.020	0.006	0.000
R^2 (adj.)	0.223	Probability (F-stat)	0.000
S.E of regression	0.021	Mean dependent var.	0.019
Sum squared residuals	0.210	S.D. dependent var.	0.024
F-statistic	10.816	Durbin-Watson stat.	1.291
Null hypothesis: C(11)=C(12)=C(13)=C(14)=C(15)			
Normalised restriction (=0)		Value	Std. Error
C(11)		-0.053	0.007560
C(12)		-0.065	0.007308
C(13)		-0.007	0.004026
C(14)		-0.017	0.006076
C(15)		-0.020	0.005632