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Banking Competition in Africa: Sub-regional Comparative Studies

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Abstract

This paper examines the extent of banking competition in African subregional markets. A dynamic version of the Panzar-Rosse model is adopted beside the static model to assess the overall extent of banking competition in each subregional banking market over the period 2002 to 2009. Consistent with other emerging economies, the results suggest that African banks generally demonstrate monopolistic competitive behaviour. Although the evidence suggests that the static Panzar-Rosse H-statistic is downward biased compared to the dynamic version, the competitive nature identified remains robust to alternative estimators.

JEL classification: G21 L10 L13 D40

Keywords: Market structure, African banking, Competition, Panzar-Rosse model

1. Introduction

African banking sectors have witnessed significant reforms over the last three decades following a long period of underperformance. Recent reforms have led to the liberalisation of interest rates and credit markets. For instance, interest rate controls, particularly in Kenya, Ghana and Tanzania, and directed lending in Uganda, have been replaced with open market operations. Another area of development within each subregion is the significant privatisation of state-owned banks, predominantly in Kenya, Uganda, Rwanda, Tanzania and Zambia, as a step to minimising inefficiencies.[1] Also, by opening up the banking markets, the growth of foreign banks

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[1] See Allen et al. (2011) for detailed review of the African financial system.

in each subregion has been significantly high, especially in East and West African subregions in recent times.[2] Moreover, in response to increased regional integration and advances in information technology, there has been a significant upward trend in cross-border banking particularly within the East African subregion, allowing customers to operate their accounts outside their home country. These developments have implications for banking sector competition.

Whilst the number of banks has undoubtedly increased across Africa, attempts to gain financial stability have also fostered recapitalisation programmes in a number of countries. Hence, African banking sectors remain highly concentrated even though the trend is generally downward. The downward trend in banking sector concentration may suggest an improvement in competition as, theoretically, banks' market power may have been diminishing in line with the structural-conduct-performance paradigm. However, this may not be the case if market concentration does not necessarily imply undesirable exercise of market power.

In view of the above, this study seeks to address the following questions: first, how competitive are African banks after years of banking sector reforms? Second, to what extent do competitive outcomes differ across subregional banking sectors in Africa? Finally, how does competition differ across interest-generating activities and overall banking activities? The answers to these questions are particularly significant as they help us compare banking sector competitiveness across Africa with other emerging markets. This should help ascertain the effectiveness and possible impact of continued reforms on African banking. The outcome may also shed light on the possible link between competition and concentration inferred from the structural-conduct performance paradigm.

The study employs the Panzar-Rosse model to assess the degree of competition in African banking sectors at the subregional level, assuming common banking markets.[3] The Panzar-Rosse model has been extensively applied to the study of banking competition, particularly in respect of banking sectors in advanced countries (e.g., Bikker & Haaf, 2002; Coccorese, 2004; De Bandt & Davis, 2000; Molyneux et al., 1994, 1996; Nathan & Neave, 1989; Shaffer, 1982; Vesala, 1995), with recent interest in emerging markets' banking sectors (e.g., Al-Muharrami et al., 2006; Gunalp & Celik, 2006; Mamatzakis et al., 2005; Perera et al., 2006). However, less attention has been paid to banking competition in Africa. Selected African countries have of-

[2]For the purpose of this study Africa is divided into four subregions, namely, Southern Africa, West Africa, North Africa and East Africa. For a list of countries in each subregion see Table 1.

[3]This assumption is consistent with the similarities of characteristics and increased regional integration among the relevant countries.

ten been considered as part of major studies where their competitive conditions are not highlighted (e.g., Bikker et al., 2009; Claessens & Laeven, 2004; Schaeck et al., 2009). Single country studies have been conducted by Biekpe (2011) and Simpasa (2011) in respect of Ghanaian and Tanzanian banking sectors, respectively. A critical assumption of the Panzar-Rosse model, which is often verified, is that banks are observed under long-run equilibrium. However, Goddard & Wilson (2009) convincingly highlight the fact that adjustment towards market equilibrium may be gradual rather than instantaneous, thus requiring a dynamic approach to the Panzar-Rosse model.

Employing both the static and dynamic versions of the Panzar-Rosse model, the findings of this paper show that banks in African subregional markets can be characterised as monopolistically competitive. The paper finds H-statistics ranging between 0.312 and 0.810, depending on the choice of estimator and model specification. In particular, the findings suggest that, with the exception of North Africa, African banks exhibit higher competition at interest-generating activities compared to total banking activities. Further, it is found that the degree of competition in African banking markets is comparable to that existing in other emerging markets. Finally, the paper finds consistent results for both the static and dynamic versions as it does for the scaled and unscaled versions of the Panzar-Rosse model, even though the static version is biased downwards, as documented in Goddard & Wilson (2009).

The paper contributes to the extant literature in banking competition in several ways. First, the paper attempts a broader empirical investigation of African banking competition. To the author's knowledge, this has not been previously addressed. Whilst banking competition has attracted much research interest in several countries and regions, little has been done to assess the competitive conditions in African banking markets. Second, the regional or common banking market approach adopted in this paper provides a useful way to assess the overall effectiveness of the recent wave of financial sector reforms in Africa. Third, by combining both static and dynamic estimation methods, the paper is less likely to misidentify the competitive nature of the African banking markets. In particular, a dynamic two-step system GMM estimator employed to estimate the dynamic Panzar-Rosse model in this paper is an improvement, in terms of efficiency, on the difference GMM estimator used in previous studies. The dynamic approach is profoundly important given the dramatic changing environment within banking markets. Finally, the paper provides first-hand evidence in support of Goddard & Wilson (2009) that the static H-statistic could be downward biased

The rest of the paper is organised as follows: Section 2 presents some background information about African banking sectors. Section 3 outlines the Panzar-Rosse model and discusses the related literature. Section 4 details the econometric estimation methods; while Section 5 presents the empirical results. Finally, Section 6 summarises the findings and concludes the paper.

2. African banking sectors

The study of banking sector competition has attracted much empirical attention in recent times in response to the possible link between competition and banking stability. Whilst a significant amount of studies have been carried out in respect of developed countries, attention has just recently been drawn to African banking sectors. Recent structural changes across African financial sectors, particularly banking markets, and increased regional integration, which extends banking markets beyond geographic boundaries, underscore the need for a broader study of banking sector competition. In what follows, recent reforms and the response of banking sectors across Africa are discussed.

African banking sectors are generally well below the standards of developed countries, notwithstanding recent reforms across the continent. With domestic credit to the private sector averaging about 32% of GDP, financial intermediation remains relatively low in a number of African countries. This feature of the banking sectors is coupled with strong government ownership and traditional banking activities. The unfavourable performance, particularly record high levels of problem loans in the 1980s, led to significant financial sector reforms. As discussed in Senbet & Otchere (2006), financial sector reforms in Africa have been aimed at deregulating the financial sector, opening it up to foreign entry, liberalising interest rates and exchange rates, removing credit ceilings, restructuring and privatising banks, and promoting the capital markets.

Whilst there is still strong government presence in African banking sectors (e.g., Algeria and Tunisia), a significant amount of success has been achieved in privatising banks in a number of countries including Morocco, Kenya, Tanzania, Uganda, Rwanda and Zambia (Allen et al., 2011). These reforms have not only led to significant growth in the number of banks in many African countries but also to a noticeable increase in the degree of cross-border banking.[4]

As noted in Allen et al. (2011), banking sector reforms have led many banks to increase their capital base. The significant growth in the number of small banks with relatively less capital base, as a by-product of reforms, attracted recapitalisation

[4]Recapitalisation programmes have, however, led to significant decrease in the number of banks in Nigeria in particular.

programmes (e.g., Ghana, Sierra Leone and Nigeria) in order to address any possible threat to financial stability. Over the period under study, the subregional average of the ratio of equity to total assets was as high as approximately 15% in Southern and West Africa and 16% in North and East Africa.

Whilst some level of success has been recorded across all the African subregions, there is still more to be achieved. Savings mobilisation and credit allocation have generally not improved by as much as expected (Senbet & Otchere, 2006). The ratio of loans to total assets is just about 48% on average for the whole African region. At a subregional level, this ratio is approximately 45% and 46% in the Southern and West African subregions, respectively. Meanwhile, the Southern African subregion boasts of the top largest banks on the African continent (mainly in South Africa), with generally well-developed and sophisticated banking systems (e.g., South Africa, Botswana, Namibia, Seychelles and Malawi). There are many countries in this subregion with total banking sector assets exceeding US$500 million (e.g., South Africa, Angola, Mauritius, Namibia and Botswana) compared to the West African subregion (e.g., Nigeria and Togo). For example, over the period under study, the average total banking assets is approximately US$5.6 billion for the Southern African subregion. This compares favourably to an average of approximately US$667 million for the West African subregion. In the North and East African subregions, however, the ratio of loans to total assets are relatively higher; the North African subregion with average total banking assets of approximately US$2.6 billion commands 55%, whilst the East African subregion with average total banking assets of US$287 million boasts 50%.

Problem loans and investment in relatively riskless government securities still remain obstacles in African banking. Over the period under study, the average impaired loans are 7%, 12%, 18% and 19% of total loans in the Southern, North, West and East African subregions, respectively. This problem is worsened by poor credit information. The average depth of credit information index is approximately 1 in the West and East African subregions, 2 for the North African subregion, and 3 for the Southern African subregion.[5] Moreover, the degree of contract enforcement is very low; the average regulatory quality index in each subregion falls below the world average. As a result, many banks are compelled to invest disproportionately in liquid government assets.

The ratio of liquid assets to total assets is approximately 34% in the Southern, West and East African subregions, and 26% in North Africa over the same period,

[5] Depth of credit information is an index that measures the quality of credit information. It ranges between 0 and 6.

with consequences for private sector credit. Worryingly, the credit to private sector as a percentage of gross domestic product (GDP) stands at 16% and 19% respectively in the West and East African subregions, whilst the Southern and North African subregions record approximately 55% and 45% respectively. This is unsurprising as the banking system remains the major constituent of the African financial system; debt markets are as yet generally under-developed (Allen et al., 2011).

Despite record levels of new entry and foreign penetration, very high levels of concentration characterise African banking sectors. Over the period under consideration, the average Herfindahl-Hirschman Index (HHI) is as high as 2059, whilst the five-bank concentration ratio stands at 77.29% for the whole African region.[6] On the positive side, concentration assumed a downward trend across all the subregions over the past few years, as can be seen in Figure 1. The Herfindahl-Hirschman Index (HHI) shows dramatic and consistent downward trend in all subregional banking sectors except West Africa, where the trend is moderate. A similar trend is indicated by five-bank concentration ratios,[7] as shown in Figure 2.

As indicated earlier, banking sector concentration may not necessarily suggest less competition. As argued by Boone et al. (2005), fierce competition may drive out of the market the less efficient banks, with a resultant increase in banking market concentration. Hence, a non-structural measure of competition such as the Panzar-Rosse model which is based on reduced form revenue equation may be a superior measure of competition.

3. Panzar and Rosse model and related literature

Measurement of competition can take two approaches: the structural and the non-structural. The structural approach to measuring competition, which underpins the structural-conduct-performance paradigm, associates market power with the degree of market concentration. The structural approach, thus, assumes lower competition in concentrated markets; more competition is associated with less concentrated markets. The Herfindahl-Hirschman Index (HHI) plays a major role here. Concentration-based measures of competition have been criticised on the grounds

[6] HHI is measured as the sum of the squared market share of each bank in a given country for each year. Market shares are measured in percentages. Hence, the HHI has an upper limit of 10,000 where one firm commands 100% market share (i.e., monopoly) and a lower bound of zero for perfect competition. HHI less than 1000 implies a highly competitive market. For a moderately concentrated market HHI ranges between 1000 and 1800, whilst a concentrated market has HHI above 1800.

[7] The only exception is West Africa where the trend is fairly upwards.

that concentration could be the outcome of greater efficiency, as proposed by the efficiency-structure hypothesis (Demsetz, 1973), or greater competition forcing out of the market inefficient firms, as noted earlier. The non-structural approach to measuring competition, on the other hand, infers product market competition from market behaviour. This latter approach is considered to be superior. The Panzar-Rosse model is a popular example of the non-structural approach to measuring competition.

The Panzar-Rosse model, popularised by Rosse & Panzar (1977) and Panzar & Rosse (1987), is an approach to measuring competition that is based on a reduced-form revenue equation. From this revenue equation, a measure of competition, H-statistic, is obtained by summing the elasticities of revenue with respect to input prices. This model assumes that banks have revenue and cost functions, respectively given as $R_i\left(y_i, n, z_i\right)$ and $C_i\left(y_i, w_i, t_i\right)$, where R_i and C_i are respectively the revenue and cost of bank i; y_i is the output of bank i; w_i is a vector of input prices for bank i ; n is the number of banks; and z_i and t_i are vectors of exogenous variables relevant respectively to the revenue and cost functions. Following a profit maximisation path requires that marginal revenue is equal to marginal cost. That is,

$$R_i^{'}\left(y_i, n, z_i\right) = C_i^{'}\left(y_i, w_i, t_i\right) \tag{1}$$

where $R_i^{'}$ and $C_i^{'}$ are respectively the marginal revenue and marginal costs of bank i. Long-run equilibrium in the product market imposes a zero profit constraint:

$$R_i^{*}\left(y_i^{*}, n^{*}, z_i\right) = C_i^{*}\left(y_i^{*}, w_i, t_i\right) \tag{2}$$

where the asterisked variables are the equilibrium values of the previously defined variables in equation (1).

The H-statistic is, then, derived as the sum of factor price elasticities. That is

$$H = \sum_{k=1}^{m} \frac{\partial R_i^{*}}{\partial w_{ki}} \frac{w_{ki}}{R_i^{*}} \tag{3}$$

where $\frac{\partial R_i^{*}}{\partial w_{ki}}$ is the derivative of total revenue with respect to the price of the kth input.

In the case of pure monopoly the H-statistic is zero or negative (i.e., H $\leq$ 0), implying that an increase in factor prices leads to a fall in revenue. This is particularly the case since the monopolist operates at the price elastic portion of the demand curve where an increase in price, in response to an increase in input prices, leads to a more than proportionate fall in units sold. A value of H-statistic between zero and one (i.e., 0 <H <1) indicates that banks are in a monopolistic competitive market. Here, an increase in factor prices increases average and marginal costs. This leads to the exit of loss-making banks and subsequent increase in revenue. In the extreme case of perfect competition, with free entry and exit, an increase in factor prices causes revenue to increase proportionally. Thus, H = 1 implies perfect competition.

The Panzar-Rosse model is theoretically consistent with the Lerner index, L, as it is shown to generalise to the following:

$$L = \frac{H}{H-1}; \tag{4}$$

Thus, the magnitude of H could be an indication of the level of the monopoly power (hence, competition) in the product market (see Vesala, 1995).

It must be emphasised that the Panzar-Rosse model relies on the assumption that banks are observed under long-run equilibrium.[8] Long-run equilibrium requires that (risk-adjusted) returns are not statistically significantly correlated with input prices (Shaffer, 1982). The application of the model to the banking sector further assumes that banks can be treated as single-product firms offering intermediation services (De Bandt & Davis, 2000).

Starting from Shaffer (1982), the Panzar-Rosse model has been extensively applied to the study of banking competition. Using a sample of US banking data for the period 1979, Shaffer (1982) identifies a monopolistic competitive banking behaviour. Other earlier applications of the model are in respect of Canadian banks (Nathan & Neave, 1989), European banks (Molyneux et al., 1994; Vesala, 1995) and Japanese banks (Molyneux et al., 1996). Nathan & Neave (1989) find monopolistic competition in the Canadian banking sector for the period 1983 and 1984 but perfect competition in the period 1982.

For a sample of European countries over the period 1986 to 1989, Molyneux et al. (1994) find that banks in France, Germany, Spain and the United Kingdom (UK) behave as though operating under monopolistic competitive conditions whilst those in Italy are classed as though operating under monopoly or conjectural variation short-run oligopoly conditions. Also, Vesala (1995) examines the Finnish banking system over the period 1985 to 1992. He finds monopolistic competitive conditions for all years except 1989 and 1990 where the banking conditions are consistent with perfect competition. Finally, Molyneux et al. (1996) find conditions consistent with monopoly or conjectural variation short-run oligopoly in 1986 and monopolistic com-

[8]This assumption is crucial for perfect competition and monopolistic competition conclusions to be accurate (Panzar & Rosse, 1987).

petition in 1988 for the Japanese banking sector.

All the above studies employ a cross-sectional estimation procedure. In order to explore both time series and cross-sectional variations, recent applications of the Panzar-Rosse model employ a panel data estimation approach. These include Al-Muharrami et al. (2006) for the Arab Gulf Cooperation Council's (GCC) banking system; Bikker & Haaf (2002) for 23 European Union and non-European Union countries; Coccorese (2004) for the Italian banking system; De Bandt & Davis (2000) for a sample of French, German, Italian and US banks; Hondroyiannis et al. (1999) for the Greek banking system; Mamatzakis et al. (2005) for a sample of South East European countries; and finally Perera et al. (2006) for South Asian banking sectors. The results of the above studies are generally consistent with monopolistic competition with the exception of a few submarkets.[9]

A recent development in the study of banking competition has been the gradual shift towards regionally classified common or single markets. The reasons behind such classification include similarity of banking market features (e.g., Al-Muharrami et al., 2006; Mamatzakis et al., 2005) and the introduction of a single banking licence (e.g., Casu & Girardone, 2006). Based on the similarities of characteristics within South Eastern European countries, Mamatzakis et al. (2005) class these countries' banking sectors as a single banking market and estimate Panzar-Rosse H-statistic for the entire region over the period 1998 to 2002. Depending on the choice of dependent variable, H-statistics of 0.726 and 0.746 are documented.

In a similar fashion, Al-Muharrami et al. (2006) studied the Arab Gulf Cooperation Council's banking system as a single market over the period 1993 to 2002. They found H-statistics of 0.24 and 0.47, depending on the choice of estimation method - pooled or fixed effect - which imply that the entire regional banking market behaved as though operating in monopolistic competition.[10]

Moreover, following the introduction of the Single Banking Licence in the European Union (EU), Casu & Girardone (2006) apply the Panzar-Rosse model to the study of 15 major European countries' banking sectors, assuming a common banking market. Their results show that, between the period 1997 and 2003, EU banks behaved as though operating under monopolistic competition. They find H-statistics of 0.362 and 0.364, based on the model specification.

[9]E.g.,De Bandt & Davis (2000) find that small banks in France and Germany behave as though operating under monopoly conditions. Likewise, Bikker & Haaf (2002) find that competition is relatively less in small banks assumed to be operating in local markets.

[10]Their preferred estimation method, based on model specification test, is the fixed effect which gives a H-statistic of 0.47.

A further development worth noting is the proposition by Goddard & Wilson (2009) in relation to modifying the static Panzar-Rosse model to allow for partial adjustment towards equilibrium. This disequilibrium approach, in their view, is justified because markets are not always in equilibrium. Hence, failure to take this dynamic adjustment into account may render the Panzar-Rosse model misspecified. Using both simulated and real data for the banking sectors in the Group Seven (G7) countries, they find that the static H-statistic is severely biased towards zero when the adjustment towards equilibrium is partial rather than instantaneous. Similarly, Bikker et al. (2009) suggest that the H-statistics could be biased when scaled rather than unscaled revenue equation is estimated. Scaling revenue by total assets makes the Panzar-Rosse model a price rather than a revenue equation. They further suggest that controlling for total assets in the revenue equation also biases the Panzar-Rosse model since this amounts to holding bank output fixed. In this study, these concerns are taken into consideration as part of robustness checks.

The present paper takes the view that increased regional integration coupled with advances in information technology and the banking sector reforms justify the assumption of single banking markets within African subregions. Besides, the paper embraces recent development by applying a dynamic approach to the Panzar-Rosse model.

4. Estimation method and data

Following from equations (1) and (2) and consistent with Bikker & Haaf (2002), the Panzar-Rosse model is implemented by formulating the marginal cost and marginal revenue functions, imposing an equilibrium condition, and solving for the equilibrium output as a function of input prices and exogenous control variables. Assuming a Cobb-Douglas technology, the marginal cost and revenue functions can be written as:

$$MC_{it} = \alpha_0 + \alpha_1 lnOut_{it} + \sum_{k=1}^{m} \beta_k lnInp_{k,i,t} + \sum_{k=1}^{p} \gamma_k lnXc_{k,i,t} \tag{5}$$

and

$$MR_{it} = \phi_0 + \phi_1 lnOut_{it} + \sum_{h=1}^{q} \varphi_h Xr_{h,i,t}, \tag{6}$$

where MC_{it} and MR_{it} are respectively the marginal costs and marginal revenue of bank i at time t; $lnOut_{it}$ and $lnInp_{k,i,t}$ are respectively the natural logarithms of output and factor input k of bank i at time t; and $lnXc_{k,i,t}$ and $lnXr_{h,i,t}$ are respectively the natural logarithms of exogenous control variables k and h.

Imposing a zero profit constraint in equilibrium yields

$$lnOut_{it} = \frac{(\alpha_0 - \phi_0 + \sum_{k=1}^{m} \beta_k lnInp_{k,i,t} + \gamma_k Xc_{k,i,t} - \varphi_h Xr_{h,i,t})}{\alpha_1 - \phi_1}. \tag{7}$$

Equation (7) translates into the following reduced form revenue empirical model:

$$lnRev_{it} = \alpha + \sum_{j=1}^{J} \beta_j lnW_{j,i,t} + \sum_{k=1}^{K} \gamma_k lnX_{k,i,t} + \sum_{n=1}^{N} \xi_n lnZ_{n,t} + \varepsilon_{i,t}, \tag{8}$$

where subscripts i and t refer to bank i at time t; Rev is either total revenue or interest revenue or the ratios of these to total assets; W_j is a three-dimensional vector of input prices, namely, the unit price of fund(PF), unit price of labour(PL) and the unit price of capital(PC); X_k is a vector of bank-specific explanatory factors which may shift the revenue and cost functions; Z_n is a vector of macroeconomic variables; and ε_{it} is a composite error term including bank-fixed effects:

$$\varepsilon_{i,t} = \mu_i + \nu_{i,t} \tag{9}$$

where μ_i is bank-fixed effects and $\nu_{i,t}$, by assumption, is an independently and identically distributed component with zero mean and variance σ_v^2.

Following the extant literature, PF is measured as the ratio of total interest expenses to total deposits; PL is measured as the ratio of personnel expenses to total asset; and PC is proxied by the ratio of other operating expenses to fixed assets. Bank-specific explanatory factors popular in the literature include total assets (TA) to control for size;[11] the ratio of equity capital to total assets (EQTA), a proxy of banks' leverage; the ratio of loans to total assets (NLTA) to account for credit risk exposure; the ratio of loan loss provisions to total loans (LLPL), which controls for default risk; and the ratio of other operating income to total assets (OITA).[12]

The H-statistic is then obtained as the sum of the coefficients of factor prices as follows:

$$H = \sum_{i=1}^{3} \beta_i. \tag{10}$$

[11]Following the literature (e.g., Mamatzakis et al., 2005) the natural log of total assets are excluded from the models with scaled dependent variable.

[12]Other operating income is used as additional control variable only when interest income is used as the dependent variable.

Consistent with the extant literature (e.g., Gunalp & Celik, 2006; Molyneux et al., 1996), a long-run equilibrium test is performed by replacing the dependent variable in equation (8) with the natural logarithm of return on assets ($lnROA$) as shown below:

$$lnROA_{it} = \alpha + \sum_{j=1}^{J} \beta_j lnW_{j,i,t} + \sum_{k=1}^{K} \gamma_k lnX_{k,i,t} + \sum_{n=1}^{N} \xi_n lnZ_{n,t} + \varepsilon_{i,t}. \tag{11}$$

The sum of the elasticity of returns with respect to input prices, henceforth called E-statistic, is obtained in a similar fashion as in equation (10).

Equations (8) and (11) are estimated using the panel fixed effect approach to control for heterogeneity across banks whilst controlling for country level factors such as GDP growth and inflation.

In view of the criticism raised against the static Panzar & Rosse (1987) H-statistic, equation (11) is modified to take the suggested dynamics into account. Specifically, lagged dependent variable is included in the model as follows:

$$\begin{aligned} lnRev_{it} &= \alpha lnRev_{i,t-1} + \sum_{j=1}^{J} \beta_j lnW_{j,i,t,} + \sum_{k=1}^{K} \gamma_k lnX_{k,i,t} + \sum_{n=1}^{N} \xi_n lnZ_{n,t} \\ &\quad + \varepsilon_{it}. \end{aligned} \tag{12}$$

In this regard, it is possible to wipe out the unobserved firm specific effect by first differencing equation (12) as follows:

$$\begin{aligned} \Delta lnRev_{it} &= \alpha \Delta lnRev_{i,t-1} + \sum_{j=1}^{J} \beta_j \Delta lnW_{j,i,t} + \sum_{k=1}^{K} \gamma_k ln\Delta X_{k,i,t} + \sum_{n=1}^{N} \xi_n \Delta lnZ_{n,t} \\ &\quad + \Delta\varepsilon_{i,t}, \end{aligned} \tag{13}$$

in which case a dynamic H-statistic can then be obtained as:

$$H = \frac{\sum_{i=1}^{3} \beta_i}{1-\alpha}. \tag{14}$$

A corresponding equilibrium test model will, then, be as in equation (15):

$$\Delta lnROA_{it} = \alpha \Delta lnROA_{i,t-1} + \sum_{j=1}^{J} \beta_j \Delta lnW_{j,i,t} + \sum_{k=1}^{K} \gamma_k ln\Delta X_{k,i,t} + \sum_{n=1}^{N} \xi_n \Delta lnZ_{n,t} + \Delta\varepsilon_{i,t}. \tag{15}$$

The E-statistic for equilibrium test is again obtained as previously described.

The lagged dependent variables in equations (13) and (15) introduce endogeneity problem, as, by construction, they are correlated with the differenced error terms. In order to control for such endogeneity bias, Goddard & Wilson (2009) and Olivero et al. (2011) use the difference GMM estimator proposed by Arellano & Bond (1991), in which lagged levels of the endogenous variables are used as instruments in the differenced equation. Thus, under the assumptions that the original error term, $\varepsilon_{i,t}$, is serially uncorrelated and that the explanatory variables, W_j,X_k and Z_n, are weakly exogenous, the following moment conditions apply:

$$E\left(y_{i,t-s}\Delta\varepsilon_{i,t}\right) = 0; fors \geq 2; t = 3, ..., T \tag{16}$$

$$E\left(\mathbf{X}_{i,t-s}\Delta\varepsilon_{i,t}\right) = 0; fors \geq 2; t = 3, ..., T. \tag{17}$$

where **X** represents all the explanatory variables other than the lagged revenue and returns.

Blundell & Bond (1998) and Alonso-Borrego & Arellano (1999) show that lagged levels of independent variables can perform poorly as instruments for the first-differences of these variables, due possibly to persistence or measurement error. Hence, Arellano & Bover (1995) and Blundell & Bond (1998) recommend the addition of the equation in levels to the differenced equation to obtain a system of equations. The variables in levels are, then, instrumented with lagged first difference of the corresponding variables. This approach increases efficiency compared to the difference GMM. Thus, the following orthogonality restrictions are further imposed:[13]

$$E\left(\Delta y_{i,t-s}\varepsilon_{i,t}\right) = 0; fors = 1. \tag{18}$$

[13]Lagged differences other that the most recent ones are not used because they result in redundant moment conditions (see Arellano & Bover, 1995).

$$E\left(\Delta \mathbf{X}_{i,t-s}\varepsilon_{i,t}\right) = 0; fors = 1. \tag{19}$$

By construct, first order serial correlation is expected in the first differenced equation. Hence, in order to rule out first order serial correlation in levels, a test of second order serial correlation in the differenced equation is performed (Roodman, 2009).Next, a Hansen test of over-identifying restrictions is employed to test the validity of the over-identification restrictions. As a final step, standard errors are corrected for small sample bias based on the two-step covariance matrix attributed to Windmeijer (2005).

In view of the above, the study first estimates the static Panzar-Rosse model and the corresponding equilibrium test model (equations (8) and (11), respectively) using the panel fixed effect estimation method. This approach helps to control for unobserved heterogeneity. Second, the dynamic models (equations (12), (13) and (15)) are estimated using the dynamic system GMM estimator as robustness checks. Time dummies are included in all models to control for time-specific effects including the possibility of linear association between input prices and time (Perera et al., 2006). For all estimations, a Wald test is performed to ascertain whether the H-statistics are significantly different from zero and one. Next, a similar test is conducted to verify if the E-statistics are significantly not different from zero - a necessary condition for long-run equilibrium.

Bank-level data over the period 2003 to 2009 is obtained from the BankScope database. A few data exclusion criteria are applied. First, all bank observations with negative values of equity are dropped from the data. Second, a few bank observations with interest expenses exceeding 100% of total deposits are dropped.[14] The final sample contains 845 observations of Southern African banks, 832 observations of West African banks, 484 observations of North African banks and 603 observations of East African banks. Full country-year observations and subregional totals are given in Table 1. Macroeconomic variables are sourced from World Bank (2011) World Development Indicators. Sample descriptive statistics and correlation matrix are shown in Tables 2 and 3, respectively.

5. Results

This section presents the estimations results of the static and dynamic Panzar-Rosse models for all the subregions. From these estimation results, the static and

[14] The subsequent results, however, do not significantly change when these exclusion criteria are relaxed.

dynamic H-statistics and their corresponding E-statistics are computed. Alternative dependent variables (total revenue and interest revenue) are employed as robustness checks and a series of diagnostic tests carried out.

5.1. Static H-statistic

First, the static Panzar-Rosse model is estimated using the panel fixed effect estimation technique. Columns 1-4 of Table 4 show that the H-statistics are positive and statistically significant for all the subregional banking markets. North Africa has the highest H-statistic (0.534), followed by West Africa (0.509), East Africa (0.437) and Southern Africa (0.357). The Wald test confirms that the H-statistics are significantly different from both zero and unity for all subregions. The findings suggest that the subregional banking markets are characterised by monopolistic competitive behaviour. Thus, competition coexists with high levels of banking market concentration, suggesting contestable market behaviour.

Following Vesala (1995), the H-statistic can be employed as a continuous measure of competition. In this regard, banking sector competition in Africa in recent times is somehow comparable to that existing in other single banking markets in emerging economies. However, a fair amount of caution is recommended due to cross-market differences not captured by the model. With the exception of Southern Africa, the H-statistic is higher for all subregions compared to those documented in Al-Muharrami et al. (2006) for the GCC banking system (see Section 3). However, for all subregions, the H-statistic is significantly lower than that documented in Mamatzakis et al. (2005) for South Eastern European countries. The findings reported here are not directly comparable to Casu & Girardone (2006) due to significant differences in model specification.[15]

Given that most of the studies on banking competition (cited above) report results that are consistent with monopolistic competition, the findings of this study suggest that recent financial sector reforms in Africa may have had some beneficial effects in terms of market discipline.

In line with previous studies (e.g., Bikker & Haaf, 2002; Coccorese, 2004; Molyneux et al., 1994; Yeyati & Micco, 2007), the coefficient of unit price of funds is positive and statistically significant as expected for all subregions. Likewise, the unit price of labour is positive and statistically significant for all subregions except North Africa. Also, the unit price of capital (other operating expenses) is positive and statistically

[15] Although the H-statistics reported here are larger than those reported in Casu & Girardone (2006) for 15 major European countries' banking market, their control variables somehow differ from those used in this paper.

significant for all subregions. Price of funds seems to be the biggest contributor to the H-statistic for all subregions except Southern Africa, where the biggest contributor is the price of labour. This highlights the strong effect of interest rate liberalisation.

In relation to the control variables, it is observed that bank size (proxied by total assets) is positive and statistically significant for all subregions, suggesting the existence of economies of scale. The ratio of equity to total assets is mostly positive (the exception is East Africa) but significant only for Southern Africa. Consistent with Mamatzakis et al. (2005) and Bikker & Haaf (2002), the ratio of loans to total assets is always positive as expected and significant for all subregions except for North Africa. Also, in line with Mamatzakis et al. (2005) and Al-Muharrami et al. (2006), the ratio of loan loss provisions to total assets is positive for all subregions and statistically significant except for North Africa. This is consistent with the view that higher default risk is matched with higher reward (e.g., Al-Muharrami et al., 2006).

As regards the macroeconomic environment, the impact of GDP growth is mixed: it is negative for the Southern and North African subregions but positive for West and East Africa. However, it is statistically significant only for the North African subregion. The coefficient of inflation is positive as in Mamatzakis et al. (2005), and significant only for the Southern and East African subregions.

As the validity of the H-statistics depends on the assumption of long-run equilibrium, Table 4 also provides the results of the equilibrium test in columns 4-8, obtained from equation (11) where ROA is the dependent variable. The Wald tests results show that the E-statistics are not statistically different from zero, suggesting that the banks are observed under long long-run equilibrium.

The results presented above are subjected to a series of robustness checks. First, given that a significant number of studies do scale revenue by total assets (e.g., Al-Muharrami et al., 2006; Claessens & Laeven, 2004; Hondroyiannis et al., 1999; Mamatzakis et al., 2005; Perera et al., 2006), whilst several others do not (e.g., Bikker & Haaf, 2002; Coccorese, 2004; Gunalp & Celik, 2006), and the concerns raised in Bikker et al. (2009) about possible bias arising from misspecification of the model, the paper compares the results above with the models using the ratio of revenue to total assets as the dependent variables. The results are presented in Table 5

As noted in Table 5, the main findings are qualitatively similar to those presented earlier, notwithstanding some apparent slight differences in the magnitude of the H-statistics; The H-statistics are all statistically significantly different from both zero and unity. In addition, similar results are obtained when total assets are dropped from the above estimations.[16] The existence of long-run equilibrium is also not rejected, as indicated in columns 4-8 of the table.

As interest-generating activities have been the tradition in African banking sectors for many years, results for interest income as a dependent variable are also provided in Table 6. The results show that the H-statistic is highest (0.638) for the West African subregional banking market, followed by North African (0.514), Southern African (0.490) and East African (0.444). Thus, the East African banking market is the least competitive in terms of interest income, while Southern Africa is the least competitive in terms of total banking activity. In comparison with Al-Muharrami et al. (2006) the estimates of the level of banking market competition are found to be higher for all African subregions, but lower when compared with Mamatzakis et al. (2005). Columns 4-8 of the table confirm that the banks are observed under long-run equilibrium.

As for input prices, unit prices of funds and labour are positive and significant for all subregions. However, the unit price of capital, though positive for all subregions, is significant only in the case of West Africa. Also, the coefficient of the unit price of funds is significantly higher in magnitude compared to the results for the total revenue equation and remains the biggest contributor to the H-statistic. This, coupled with the fact that the H-statistic is higher for all subregions except North Africa, suggests a higher degree of competition in interest-generating activities relative to total banking activities.

As far as the control variables are concerned, Table 6 shows that the ratio of equity to total assets, though always positive, is statistically insignificant for all subregions. Also, the coefficients of the ratio of loans to total assets are relatively higher in magnitude compared to the previous results. The ratio of other income to total assets has the expected negative sign for all subregions but is statistically significant only for Southern and West African banking markets. Thus, the engagement in other income-generating activities constrains banks' ability to generate interest income (Bikker & Haaf, 2002). The sign of the coefficient of GDP growth is again mixed but insignificant for all subregions, whilst inflation is positive and significant only for Southern Africa.

The E-statistics reported in columns 4-8 of Table 6 do not reject long-run equi-

[16] These estimations control for capacity indicators such as total fixed assets or equity (e.g., De Bandt & Davis, 2000; Gischer & Stiele, 2009; Murjan & Ruza, 2002; Vesala, 1995; Yildirim & Philippatos, 2007). Controlling for fixed assets rather than total assets does not hold banks' output constant, and it is therefore appropriate. The results are not presented here, for brevity, and are available upon request.

librium. As shown by the Wald test, the E-statistics are all not statistically different from zero.

The results presented so far suggest that banking competition in Africa is generally comparable to regional markets in other emerging economies. As in the total revenue model, the findings are robust to using the ratio of interest revenue to total assets as the dependent variable. Furthermore, the findings are robust to dropping total assets from the model.

5.2. Dynamic H-statistic

In this section, the dynamic version of the results presented above is discussed. The estimation results for the models using total revenue as the dependent variable are shown in Table 7. The maximum lag dependent variable is restricted to one in all models in order to restrain the number of moment conditions. The lag dependent variable is positive and significant; the Hansen test p-values are all well above 0.1, justifying the validity of the over-identification restriction; and, finally, the absence of second-order serial correlation is not rejected. Thus, the diagnostic tests justify the use of a dynamic model.

Table 7 shows that the H-statistic is positive and significantly different from both zero and one for all subregions, suggesting a monopolistic competitive market structure in all the banking markets. It is worth noting that the H-statistics are much larger in magnitude compared to the results in Table 4. This finding lends support to the view of Goddard & Wilson (2009) that the static H-statistic is downward biased if the adjustment towards equilibrium is partial rather than instantaneous. The results further show that, when dynamics are taken into account, H-statistic is highest (0.605) in East Africa; and it is least (0.517) in Southern Africa. The result for East Africa is not surprising given the extent of recent reforms and cross-border banking. Even after taking partial adjustment to equilibrium into account, the H-statistics for all subregions are slightly lower than those reported in Mamatzakis et al. (2005), except when interest revenue is considered.

Consistent with the previous results (Table 4), the price of funds is positive and significant for all subregions. Similarly, the price of labour is positive and significant for all subregions, whilst the price of capital is significantly positive for only the North and East African subregional banking markets. As in previous results, the price of funds seems to be the biggest contributor to the H-statistic.

As far as the control variables are concerned, the noticeable changes are that the ratio of net loans to total assets is now significant only for East Africa. GDP growth is positive and significant only for East Africa and inflation is significantly positive only for Southern Africa. The ratio of loan loss provisions to total assets is now not significant for West Africa

The results of the equilibrium test (equation (15)) are also presented in columns 4-8 (Table 7). The diagnostic tests are satisfactory, and long-run equilibrium is not rejected.[17]

As in the estimation of the static models, the robustness of these results is assessed. First, similar results are obtained when total revenue is replaced with the ratio of total revenue to total assets as the dependent variable, as shown in Table 8. Compared to the preceding results, the H-statistics are slightly larger. Also, the H-statistic for West Africa is significantly different from one only at the margin. These notwithstanding, the main findings remain unchanged.

Finally, results of the dynamic models in which interest revenue is the dependent variable are also provided in Table 9. The results are not qualitatively different from the above except that the West and East African subregional banking markets now have higher H-statistics compared with the findings of Mamatzakis et al. (2005). All the diagnostic tests are, again, satisfactory. The H-statistics are, as before, higher in magnitude compared to those shown in Table 6. Consistent with the results in Table 6, the H-statistic is highest in West Africa (0.810). However, East Africa also has a high H-statistic of 0.780. Similar results are obtained when the dependent variable is the ratio of interest revenue to total assets.

6. Conclusion

This study examines banking competition across subregional banking markets in Africa. Assuming common markets within each subregion due to increased regional integration and cross-border banking, the non-structural approach to measuring competition, proposed by Rosse & Panzar (1977) and Panzar & Rosse (1987), is used to estimate the degree of competition in each of the subregional banking market. The results suggest the existence of monopolistic competition across African subregional banking markets. These results are consistent with several recent studies for other parts of the world, particularly in emerging economies, suggesting that recent structural reforms within Africa may have had significant effects as far as banking sector competition is concerned.

The results are robust to alternative views of banking activities (i.e., interest-generating activities versus total banking activities) as well as alternative specifications and estimators. In particular, whilst the existence of long-run equilibrium,

[17] The lagged dependent variable for the equilibrium test model is, however, not significant for North Africa. Thus, a fair amount of caution is to be exercised in interpreting the results.

as a necessary condition, is verified for all model specifications, the robustness of the results in relation to the possibility of partial adjustment towards equilibrium is further assessed. In the empirical implementation, therefore, a dynamic approach is also used to estimate the Panzar-Rosse model to obtain a dynamic H-statistic for comparison with the static H-statistic. Whilst the results confirm the downwards bias of the static H-statistic, monopolistic competition cannot be ruled out.

The findings of this paper have policy significance because of the possible link between banking competition and efficient financial intermediation, bank profitability and stability. The results also offer a yardstick against which to measure the success of several years of regional integration and cross-border banking in Africa.

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Figure 1: Evolution of banking sector concentration (HHI) by subregion.

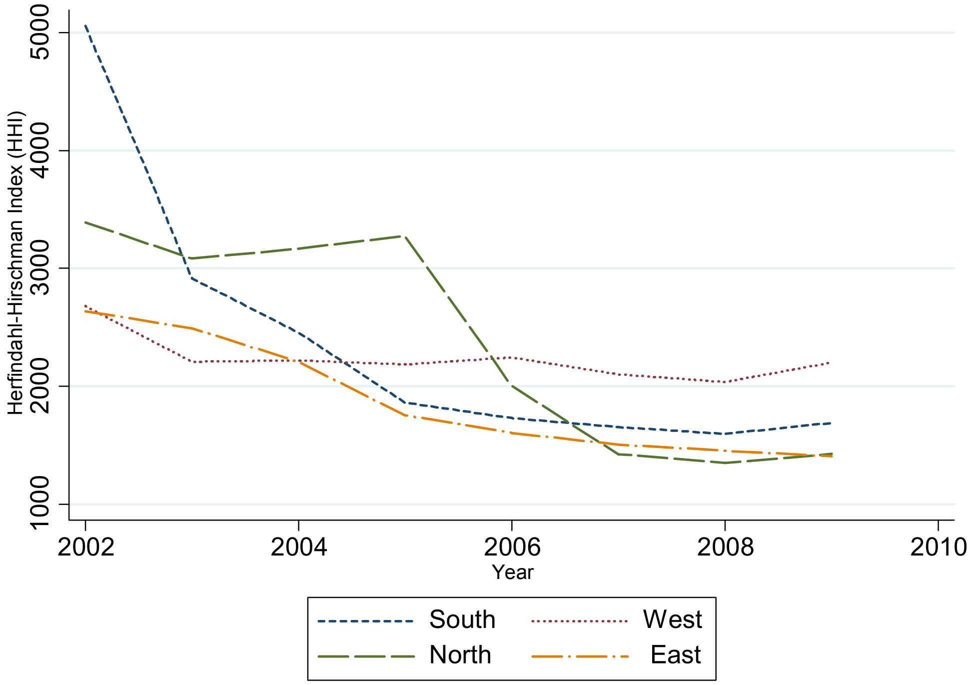

Figure 2: Evolution of banking sector concentration (CR5) by subregion.

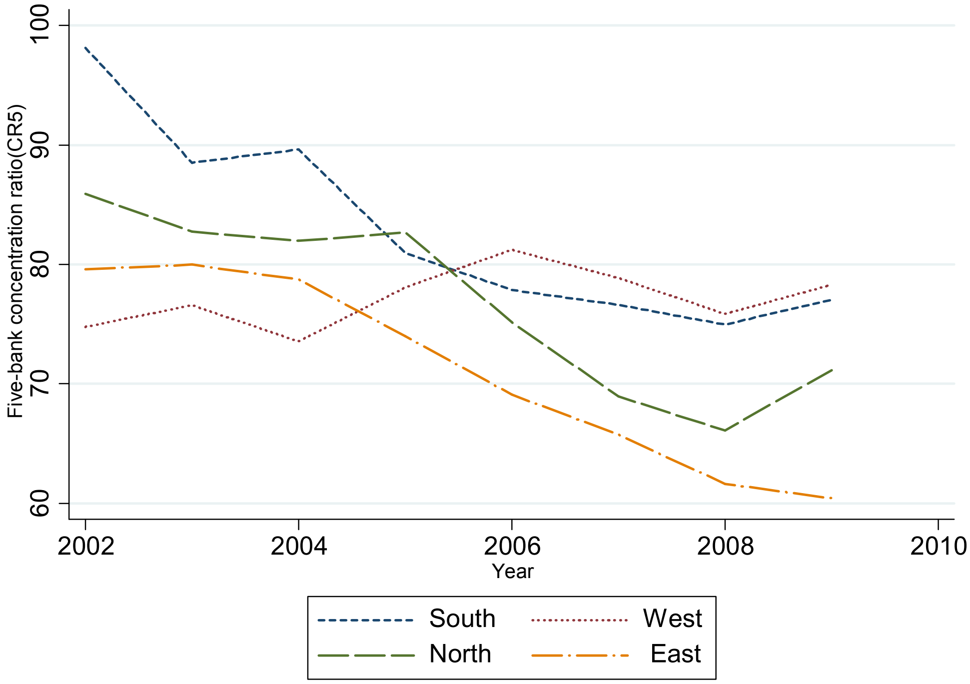

Table 1: Sample number of banks by country, year and subregion

	Year								
Country	2002	2003	2004	2005	2006	2007	2008	2009	*Total*
Panel 1: Southern Africa									
Angola	5	9	10	11	13	12	13	12	85
Botswana	1	4	6	7	9	9	11	10	57
Congo, D.R. OF	1	3	5	9	9	7	9	6	49
Lesotho	2	3	3	2	3	3	3	2	21
Madagascar	3	5	5	5	5	4	5	5	37
Malawi	7	10	10	9	9	8	11	11	75
Mauritius	2	11	13	13	14	15	16	12	96
Mozambique	2	4	4	6	6	9	11	11	53
Namibia	1	1	2	7	8	7	8	7	41
Seychelles	0	1	2	4	4	4	3	2	20
South Africa	2	3	11	25	30	34	41	37	183
Swaziland	2	5	6	6	5	5	5	5	39
Zambia	5	12	12	12	12	14	12	10	89
Regional total	33	71	89	116	127	131	148	130	845
Panel 2: West Africa									
Benin	4	6	4	6	6	6	6	5	43
Burkina Faso	3	5	7	7	8	7	6	5	48
Cameroon	5	9	10	11	12	9	6	5	67
Cape Verde	2	2	2	3	2	2	2	1	16
Gabon	1	1	1	2	2	2	2	2	13
Gambia	2	3	3	4	5	4	4	3	28
Ghana	4	4	5	9	9	21	23	22	97
Ivory Coast	8	11	11	13	12	11	10	6	82
Mali	5	5	6	6	7	7	7	6	49
Mauritania	5	7	7	8	6	5	4	5	47
Nigeria	22	28	36	26	22	23	19	17	193
Senegal	9	10	10	8	8	8	7	7	67
Sierra Leone	4	5	6	5	8	8	8	7	51
Togo	1	3	4	4	5	5	5	4	31
Regional total	75	99	112	112	112	118	109	95	832
Panel 3: North Africa									
Algeria	8	9	14	12	15	15	15	12	100
Morocco	3	5	7	7	10	17	17	15	81
Niger	1	3	4	4	5	5	4	4	30
Sudan	8	10	7	9	13	17	18	17	99
Tunisia	10	19	20	21	25	27	29	23	174
Regional total	30	46	52	53	68	81	83	71	484
Panel 4: East Africa									
Burundi	5	5	5	5	4	4	3	3	34
Ethiopia	1	8	8	9	9	10	8	9	62
Kenya	12	26	27	30	30	35	35	34	229
Rwanda	1	3	4	4	5	4	3	3	27
Tanzania	1	2	7	21	25	24	23	22	125
Uganda	9	15	16	16	17	16	18	19	126
Regional Regional total	29	59	67	85	90	93	90	90	603

Source: Fitch-IBCA's Bankscope database and own calculation

Table 2: Descriptive Statistics

Country	TA	TR	IR	ROA	PF	PL	PC	NLTA	EQTA	LLPL	GDPG	INFL
Panel 1: Southern Africa												
Angola	1329.54	135.80	81.87	1.25	2.13	1.79	67.61	29.17	14.70	8.37	13.02	32.51
Botswana	563.67	85.99	68.12	2.90	11.64	2.13	256.04	46.63	13.23	1.46	2.96	9.38
Congo D.R.	112.42	16.85	9.13	1.40	1.56	2.61	184.30	31.64	11.42	6.98	5.59	15.67
Lesotho	207.15	26.76	18.44	1.78	3.58	2.60	125.36	19.55	7.73	1.56	3.14	9.44
Madagascar	232.31	22.11	17.33	2.65	2.98	1.18	166.89	47.05	10.51	2.05	3.45	10.52
Malawi	91.77	18.72	11.49	2.23	6.34	5.36	107.43	35.42	16.74	1.37	5.86	11.06
Mauritius	1033.24	90.15	58.12	1.08	4.89	0.88	417.69	51.28	13.60	0.71	3.96	6.51
Mozambique	361.96	51.46	33.14	0.14	3.87	4.74	129.68	35.37	18.18	2.28	7.26	9.12
Namibia	996.50	139.79	110.87	1.95	8.21	2.30	142.55	81.21	19.08	0.98	4.25	6.58
Seychelles	222.13	20.83	11.81	1.90	1.22	0.67	250.53	28.81	6.22	0.58	3.62	10.45
South Africa	23689.37	2663.18	1961.88	2.54	11.78	2.87	779.36	57.95	17.38	2.05	3.49	6.85
Swaziland	158.46	22.56	15.36	2.88	8.36	3.34	223.75	64.11	19.38	0.14	2.60	7.37
Zambia	202.51	31.32	19.52	1.18	5.28	4.87	220.77	29.75	14.76	3.70	5.62	15.10
Average	5554.45	611.67	445.02	1.85	6.59	2.89	325.28	44.78	15.14	2.69	5.25	11.76
Panel 2: West Africa												
Benin	247.50	23.18	15.37	−0.27	2.55	1.86	133.12	56.19	9.21	2.37	4.02	3.34
Burkina Faso	221.78	23.30	15.65	0.68	2.60	1.96	94.34	60.29	8.17	2.63	5.17	3.18
Cameroon	377.24	39.45	22.22	1.14	3.25	1.93	104.39	50.77	11.47	1.82	3.23	2.41
Cape Verde	82.03	7.26	5.20	2.27	2.34	2.98	139.33	44.73	16.04	1.73	6.82	2.36
Gabon	93.63	11.13	8.60	1.28	6.92	4.44	91.62	56.45	41.44	−0.45	1.98	2.43
Gambia	61.87	11.25	6.82	2.95	3.93	2.77	91.77	29.55	14.28	2.60	5.42	6.91
Ghana	283.61	48.45	35.59	1.79	8.70	4.34	134.55	42.12	15.37	3.11	6.28	15.38
Ivory Coast	378.25	43.73	24.66	−0.17	3.91	3.77	184.08	59.58	10.23	0.84	0.95	3.02
Mali	271.70	23.27	15.21	1.23	1.55	1.91	69.12	57.25	10.77	1.95	4.79	2.78
Mauritania	119.69	11.64	6.58	1.87	2.58	1.89	117.39	50.87	23.87	4.12	4.72	7.22
Nigeria	1893.19	243.76	160.79	2.03	7.70	2.72	160.02	32.49	17.08	1.42	6.93	12.44
Senegal	336.09	34.61	25.61	0.88	2.30	1.62	138.29	57.79	8.98	1.38	4.10	2.02
Sierra Leone	37.85	7.37	4.33	2.62	3.60	3.93	105.32	22.94	20.23	8.71	8.22	12.03
Togo	1180.05	148.49	91.78	2.00	2.23	2.67	94.32	52.59	14.19	−1.84	2.49	3.10
Average	666.71	85.27	56.49	1.42	4.74	2.78	130.91	46.06	14.54	2.18	5.02	7.27
Panel 3: North Africa												
Algeria	4125.85	215.04	148.45	1.06	2.82	0.80	69.59	41.87	14.03	3.36	3.70	3.31
Morocco	7261.77	466.90	382.00	1.74	3.83	1.85	87.67	67.83	12.11	1.06	4.80	2.19
Niger	119.53	12.49	7.69	0.45	1.71	2.01	118.18	56.70	9.62	0.49	4.16	3.10
Sudan	953.37	78.07	45.10	1.84	5.09	2.25	84.86	31.40	17.15	4.10	7.34	9.67
Tunisia	1012.05	73.54	53.06	0.88	12.07	1.37	90.78	68.58	20.28	2.51	4.86	3.58
Average	2634.00	162.72	123.26	1.23	6.71	1.54	86.41	54.73	16.32	2.52	5.07	4.50
Panel 4: East Africa												
Bunrundi	52.75	7.28	4.84	2.02	4.80	2.62	66.47	54.63	13.72	4.14	3.05	8.93
Ethiopia	721.89	47.33	26.90	2.45	2.20	1.02	89.32	54.03	12.32	1.39	9.29	15.95
Kenya	340.55	45.70	30.66	1.51	4.77	3.11	127.49	53.47	18.99	2.37	4.26	12.71
Rwanda	90.11	10.42	7.54	1.27	4.74	2.60	116.47	43.01	10.09	3.14	7.34	9.91
Tanzania	202.11	25.34	18.15	1.50	4.69	3.46	318.81	45.85	13.11	1.88	6.99	8.07
Uganda	167.06	26.24	21.03	2.53	5.03	6.08	241.20	47.46	16.44	2.08	7.90	8.02
Average	287.37	34.65	23.31	1.83	4.54	3.22	182.66	50.26	15.86	2.23	6.17	10.76

Values are in millions of US$ for TA, TR and IR and percentages for all other variables. TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation.

Table 3: Correlation Matrix

Variables	ln TR	ln IR	ln ROA	lnPF	ln PL	ln PC	ln TA	ln NLTA	ln EQTA	ln LLPL	ln GDPG	ln INFL
Panel 1: Southern Africa												
ln TRr	1.000											
ln IR	0.978	1.000										
ln ROA	0.033	−0.012	1.000									
ln PF	0.206	0.241	0.116	1.000								
ln PL	−0.155	−0.216	0.215	0.133	1.000							
l PC	0.105	0.068	0.046	0.126	−0.036	1.000						
ln TA	0.967	0.965	−0.053	0.152	−0.345	0.109	1.000					
ln NLTA	0.317	0.381	−0.033	0.344	−0.089	−0.015	0.279	1.000				
ln EQTA	−0.243	−0.279	0.389	0.190	0.323	−0.044	−0.322	−0.015	1.000			
ln LLPL	−0.092	−0.133	0.069	−0.193	0.331	−0.079	−0.188	−0.361	0.170	1.000		
ln GDPG	−0.015	−0.031	0.001	−0.234	0.085	−0.096	−0.037	−0.134	−0.040	0.176	1.000	
ln INFL	−0.184	−0.203	0.122	−0.262	0.147	−0.154	−0.237	−0.303	0.050	0.433	0.192	1.000
Panel 2: West Africa												
ln TR	1.000											
ln IR	0.959	1.000										
ln ROA	0.056	0.053	1.000									
ln PF	0.034	0.116	0.145	1.000								
ln PL	−0.211	−0.218	0.104	0.245	1.000							
ln PC	−0.088	−0.020	0.072	0.189	0.035	1.000						
ln TA	0.966	0.927	−0.047	−0.098	−0.382	−0.086	1.000					
ln NLTA	0.162	0.147	−0.183	−0.148	−0.138	−0.031	0.238	1.000				
ln EQTAa	−0.117	−0.086	0.222	0.246	0.316	0.040	−0.241	−0.218	1.000			
ln LLPL	−0.086	−0.059	−0.086	0.212	0.137	−0.081	−0.133	−0.316	0.066	1.000		
ln GSPG	0.036	0.072	0.177	0.153	0.062	−0.005	−0.014	−0.207	0.156	0.183	1.000	
ln INFL	0.124	0.162	0.192	0.410	0.212	0.182	0.043	−0.310	0.230	0.176	0.374	1.000
Panel 3: North Africa												
ln TR	1.000											
ln IR	0.980	1.000										
ln ROAa	−0.208	−0.231	1.000									
ln PF	−0.097	−0.003	−0.033	1.000								
ln PL	−0.281	−0.343	0.244	−0.040	1.000							
ln PC	−0.236	−0.244	0.187	−0.042	0.345	1.000						
ln TA	0.975	0.957	−0.281	−0.138	−0.397	−0.312	1.000					
ln NLTA	0.128	0.193	−0.058	0.404	0.066	0.039	0.133	1.000				
ln EQTA	−0.365	−0.367	0.521	0.078	0.247	0.091	−0.430	−0.097	1.000			
ln LLPL	−0.102	−0.135	−0.169	−0.066	−0.039	−0.085	−0.116	−0.262	0.011	1.000		
ln GDPG	0.013	−0.009	0.018	0.119	0.153	−0.018	−0.036	−0.083	0.003	−0.049	1.000	
ln INFL	−0.046	−0.114	0.130	0.019	0.122	−0.061	−0.065	−0.227	0.144	0.031	0.331	1.000
Panel 4: East Africa												
ln TR	1.000											
ln IR	0.988	1.000										
ln ROA	0.208	0.214	1.000									
ln PF	−0.324	−0.276	−0.042	1.000								
ln PL	−0.163	−0.143	−0.073	0.282	1.000							
ln PC	−0.061	−0.021	0.051	−0.026	0.120	1.000						
ln TA	0.960	0.940	0.140	−0.402	−0.406	−0.137	1.000					
ln NLTA	−0.017	0.007	−0.092	0.329	0.147	−0.106	−0.075	1.000				
ln EQTA	−0.409	−0.390	0.131	0.389	0.249	−0.084	−0.432	0.201	1.000			
ln LLPL	−0.147	−0.179	−0.249	0.081	0.221	0.000	−0.234	0.013	0.057	1.000		
ln GDPG	0.051	0.046	0.167	−0.163	−0.167	0.182	0.053	−0.101	−0.175	−0.171	1.000	
ln INFL	0.209	0.186	−0.050	−0.060	−0.081	−0.212	0.262	0.096	0.046	−0.113	−0.036	1.000

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation.

Table 4: Panzar-Rosse H-statistic using total revenue: Panel fixed effect estimation

	Dependent variable: lnTR				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
ln PF	0.148***	0.238***	0.271***	0.210***	0.009	0.234**	−0.055	0.226
	(0.036)	(0.024)	(0.062)	(0.039)	(0.110)	(0.110)	(0.104)	(0.174)
ln PL	0.163***	0.210***	0.138	0.171**	−0.106	−0.556*	0.131	−0.254
	(0.057)	(0.045)	(0.103)	(0.066)	(0.141)	(0.327)	(0.470)	(0.384)
ln PC	0.047**	0.062***	0.125*	0.056*	−0.041	0.199*	−0.138	0.023
	(0.023)	(0.022)	(0.064)	(0.029)	(0.107)	(0.106)	(0.130)	(0.104)
ln TA	1.130***	0.921***	0.925***	0.956***	0.210	−0.380**	−0.196**	0.134
	(0.063)	(0.027)	(0.056)	(0.085)	(0.161)	(0.182)	(0.094)	(0.332)
ln EQTA	0.148***	0.001	0.049	−0.020	1.020***	0.196	0.412	0.919***
	(0.043)	(0.025)	(0.046)	(0.053)	(0.214)	(0.151)	(0.377)	(0.273)
ln NLTA	0.176***	0.200***	0.013	0.122***	−0.193	0.076	−0.562**	−0.334**
	(0.042)	(0.046)	(0.080)	(0.035)	(0.167)	(0.244)	(0.241)	(0.142)
ln LLPL	0.050***	0.017**	0.023	0.024***	−0.026	−0.195***	−0.200**	−0.070
	(0.010)	(0.007)	(0.017)	(0.008)	(0.044)	(0.047)	(0.078)	(0.055)
ln GDPG	−0.022	0.003	−0.027*	0.008	0.015	0.111	−0.065	−0.000
	(0.019)	(0.015)	(0.016)	(0.023)	(0.064)	(0.186)	(0.084)	(0.115)
ln INFL	0.072**	0.004	0.010	0.035*	0.022	−0.158*	−0.033	−0.048
	(0.030)	(0.011)	(0.014)	(0.019)	(0.098)	(0.083)	(0.042)	(0.114)
Constant	−2.218***	0.789**	0.194	−0.098	−5.004**	−0.889	−2.500	−4.499
	(0.788)	(0.345)	(0.619)	(0.711)	(2.211)	(1.861)	(2.492)	(3.287)
H-stat / E-stat	0.357[a]	0.509[a]	0.534[a]	0.437[a]	−0.137[e]	−0.124[e]	0.063[e]	−0.005[e]
	(0.069)	(0.053)	(0.105)	(0.085)	(0.241)	(0.346)	(0.509)	(0.438)
Wald F stat. H = 0 / E = 0	27.19***	91.88***	26.05***	26.43***	0.33	0.13	0.02	0.00
Wald F stat. H = 1	88.30***	85.30***	19.77***	43.88***				
Adj. R^2	0.908	0.962	0.859	0.932	0.126	0.132	0.191	0.150
N	487	427	286	375	479	413	292	384

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Heteroskedasticity-robust standard errors are given in parentheses. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected

Table 5: Panzar-Rosse H-statistic using the ratio of total revenue to total assets: Panel fixed effect estimation

	Dependent variable: ln(TR/TA)				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
ln PF	0.159***	0.253***	0.272***	0.209***	0.025	0.265**	−0.061	0.234
	(0.033)	(0.026)	(0.064)	(0.039)	(0.107)	(0.124)	(0.107)	(0.165)
ln PL	0.116**	0.238***	0.190**	0.185***	−0.154	−0.387	0.285	−0.305
	(0.046)	(0.044)	(0.075)	(0.050)	(0.144)	(0.279)	(0.469)	(0.349)
ln PC	0.037	0.069***	0.127*	0.061**	−0.055	0.250**	−0.149	0.007
	(0.025)	(0.020)	(0.066)	(0.024)	(0.110)	(0.105)	(0.128)	(0.109)
ln EQTA	0.121***	−0.005	0.057	−0.004	0.945***	0.176	0.424	0.863***
	(0.044)	(0.026)	(0.046)	(0.055)	(0.205)	(0.144)	(0.377)	(0.199)
ln NLTA	0.186***	0.197***	0.001	0.123***	−0.153	0.074	−0.592**	−0.346**
	(0.044)	(0.048)	(0.079)	(0.033)	(0.158)	(0.252)	(0.265)	(0.141)
ln LLPL	0.048***	0.015**	0.023	0.025***	−0.031	−0.202***	−0.200**	−0.070
	(0.011)	(0.007)	(0.017)	(0.007)	(0.045)	(0.046)	(0.079)	(0.054)
ln GDPG	−0.033	0.009	−0.024	0.005	−0.004	0.142	−0.040	0.009
	(0.022)	(0.016)	(0.015)	(0.021)	(0.066)	(0.199)	(0.087)	(0.115)
ln INFL	0.044	0.012	0.007	0.031*	−0.019	−0.115	−0.042	−0.037
	(0.036)	(0.012)	(0.013)	(0.018)	(0.097)	(0.076)	(0.039)	(0.105)
Contant	−0.760**	−0.021	−0.519	−0.507	−2.551***	−4.785***	−4.405*	−3.292**
	(0.325)	(0.192)	(0.389)	(0.247)	(0.946)	(1.038)	(2.431)	(1.608)
N	487	427	286	375	479	413	292	384
H-stat / E-stat	0.312[a]	0.561[a]	0.590[a]	0.455[a]	−0.183[e]	0.128[e]	0.076[e]	−0.064[e]
	(0.069)	(0.050)	(0.105)	(0.067)	(0.249)	(0.285)	(0.503)	(0.424)
Wald F stat. H = 0 / E = 0	20.24 ***	123.91 ***	31.73 ***	28.43 ***	0.54	0.20	0.02	0.02
Wald F stat. H = 1	98.85 ***	75.85 ***	15.28 ***	43.83 ***				
Adj. R^2	0.304	0.622	0.389	0.396	0.123	0.114	0.186	0.151
N	487	427	286	375	479	413	292	384

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Heteroskedasticity-robust standard errors are given in parentheses. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected

Table 6: Panzar-Rosse H-statistic using interest revenue: : Panel fixed effect estimation

	Dependent variable: lnIR				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
ln PF	0.323***	0.300***	0.345***	0.235***	0.055	0.219*	−0.016	0.181
	(0.041)	(0.032)	(0.078)	(0.030)	(0.108)	(0.132)	(0.127)	(0.162)
ln PL	0.130*	0.287***	0.148*	0.160***	−0.092	−0.553*	−0.449	−0.488
	(0.066)	(0.057)	(0.086)	(0.055)	(0.147)	(0.325)	(0.399)	(0.418)
ln PC	0.037	0.051**	0.022	0.049	0.040	0.227**	−0.160	−0.036
	(0.033)	(0.023)	(0.042)	(0.030)	(0.111)	(0.107)	(0.125)	(0.109)
ln TA	1.146***	0.950***	0.942***	0.986***	0.137	−0.232	−0.196***	0.136
	(0.069)	(0.031)	(0.041)	(0.082)	(0.169)	(0.190)	(0.071)	(0.347)
ln EQTA	0.089	0.012	0.033	0.036	0.946***	0.215	0.347	0.934***
	(0.066)	(0.028)	(0.049)	(0.055)	(0.218)	(0.146)	(0.359)	(0.291)
ln NLTA	0.390***	0.271***	0.038	0.234***	−0.242	0.007	−0.453*	−0.248*
	(0.067)	(0.059)	(0.099)	(0.044)	(0.163)	(0.235)	(0.249)	(0.144)
ln LLPL	0.063***	0.019**	0.001	0.022**	−0.053	−0.217***	−0.209***	−0.094
	(0.012)	(0.008)	(0.014)	(0.010)	(0.045)	(0.045)	(0.070)	(0.058)
ln OITA	−0.132***	−0.139***	−0.051	0.028	0.238*	0.424**	0.390**	0.617**
	(0.049)	(0.036)	(0.037)	(0.047)	(0.130)	(0.212)	(0.176)	(0.282)
ln GDPG	0.020	0.012	−0.022	−0.021	0.012	0.142	−0.004	−0.027
	(0.024)	(0.022)	(0.022)	(0.035)	(0.065)	(0.181)	(0.081)	(0.117)
ln INFL	0.101**	−0.007	0.004	0.035	−0.047	−0.172**	−0.036	−0.045
	(0.047)	(0.015)	(0.014)	(0.023)	(0.101)	(0.083)	(0.034)	(0.114)
Constant	−2.914***	0.138	−0.512	−0.395	−3.075	−1.348	−2.956	−3.485
	(0.958)	(0.370)	(0.473)	(0.705)	(2.284)	(1.821)	(2.050)	(3.556)
H-stat / E-stat	0.490[a]	0.638[a]	0.514[a]	0.444[a]	0.002[e]	−0.107[e]	−0.626[e]	−0.344[e]
	(0.091)	(0.068)	(0.100)	(0.088)	(0.241)	(0.371)	(0.508)	(0.470)
Wald F stat. H = 0 / E = 0	29.02***	88.33***	26.32***	25.53***	0.00	0.08	0.1.52	0.53
Wald F stat. H = 1	31.44***	28.54***	23.45***	39.95***				
Adj. R^2	0.897	0.947	0.870	0.924	0.148	0.178	0.230	0.184
N	476	426	271	375	468	408	272	381

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Heteroskedasticity-robust standard errors are given in parentheses. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected

Table 7: Dynamic Panzar-Rosse H-statistic using total revenue: Dynamic panel estimation, two-step system GMM

	Dependent variable: lnTR				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
Lagged dep. var.	0.189**	0.323**	0.439*	0.418***	0.350**	0.400*	0.170	0.646***
	(0.086)	(0.124)	(0.251)	(0.085)	(0.176)	(0.205)	(0.133)	(0.227)
ln PF	0.126***	0.162***	0.079*	0.096**	−0.027	0.071	−0.020	0.001
	(0.026)	(0.031)	(0.047)	(0.044)	(0.075)	(0.075)	(0.059)	(0.088)
ln PL	0.259***	0.218***	0.134**	0.205***	0.043	0.025	0.136	−0.036
	(0.037)	(0.042)	(0.065)	(0.038)	(0.055)	(0.096)	(0.143)	(0.071)
ln PC	0.034	0.024	0.100**	0.051***	−0.012	0.097	0.152	0.020
	(0.021)	(0.017)	(0.038)	(0.016)	(0.034)	(0.081)	(0.122)	(0.048)
ln TA	0.801***	0.672***	0.532**	0.585***	0.037***	0.051	−0.058	0.072
	(0.084)	(0.117)	(0.246)	(0.089)	(0.014)	(0.036)	(0.040)	(0.077)
ln EQTA	0.087***	0.056*	−0.022	−0.013	0.402***	0.171	0.523***	0.363
	(0.027)	(0.034)	(0.030)	(0.043)	(0.100)	(0.107)	(0.195)	(0.232)
ln NLTA	−0.009	0.015	0.043	0.150***	−0.110	0.089	−0.282***	−0.176
	(0.039)	(0.033)	(0.039)	(0.036)	(0.094)	(0.104)	(0.100)	(0.122)
ln LLPL	0.039***	0.006	0.027	0.020*	0.005	−0.148***	−0.200***	−0.080**
	(0.009)	(0.011)	(0.017)	(0.010)	(0.030)	(0.052)	(0.060)	(0.034)
ln GDPG	−0.004	0.025	−0.024	0.041**	−0.015	0.151*	−0.009	0.113
	(0.018)	(0.017)	(0.029)	(0.018)	(0.049)	(0.086)	(0.080)	(0.080)
ln INFL	0.080***	0.016	0.005	−0.008	0.175***	−0.006	−0.061**	−0.061
	(0.017)	(0.012)	(0.019)	(0.016)	(0.065)	(0.080)	(0.030)	(0.104)
Constant	0.085	0.141	0.043	0.008	−2.440***	−3.421***	−2.031***	−2.375*
	(0.159)	(0.151)	(0.345)	(0.117)	(0.485)	(1.153)	(0.449)	(1.307)
H-stat / E-stat	0.517[a]	0.596[a]	0.557[a]	0.605[a]	0.004[e]	0.193[e]	0.269[e]	−0.0152[e]
	(0.043)	(0.071)	(0.124)	(0.066)	(0.111)	(0.149)	(0.203)	(0.130)
Wald F stat. H = 0 / E = 0	232.19***	71.51***	20.06***	83.11***	0.00	1.68	1.75	0.01
Wald F stat. H = 1	203.07***	32.81***	12.68***	35.49***				
Hansen (p-values)	12.135(0.52)	15.317(0.29)	10.498(0.84)	24.343(0.18)	11.646(0.90)	28.170(0.35)	20.342(0.78)	10.088(0.86)
2^{nd} order ser. cor. test(p-values	1.178(0.24)	0.726(0.47)	−1.135(0.56)	0.228(0.82)	1.418(0.16)	−0.949(0.34)	1.448(0.15)	−0.641(0.52)
N	383	334	215	296	364	313	225	304

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Robust Windmeijer (2005) finite-sample corrected standard errors are in parenthesis. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected

Table 8: Dynamic Panzar-Rosse H-statistic using the ratio of total revenue to total assets: Dynamic panel estimation, two-step system GMM

	Dependent variable: ln(TR/TA)				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
Lagged dep. var.	0.543**	0.515**	0.465*	0.425***	0.330**	0.417**	0.879***	0.649**
	(0.222)	(0.253)	(0.246)	(0.110)	(0.147)	(0.210)	(0.175)	(0.248)
ln PF	0.086***	0.132***	0.103***	0.073***	−0.007	0.081	−0.057	−0.052
	(0.029)	(0.043)	(0.033)	(0.025)	(0.075)	(0.073)	(0.083)	(0.094)
ln PL	0.161*	0.189***	0.137*	0.219***	0.033	−0.029	−0.060	−0.069
	(0.086)	(0.065)	(0.074)	(0.051)	(0.054)	(0.084)	(0.120)	(0.090)
ln PC	0.025	0.017	0.114***	0.061***	−0.014	0.083	−0.084	−0.002
	(0.019)	(0.017)	(0.035)	(0.018)	(0.035)	(0.077)	(0.097)	(0.050)
ln EQTA	0.074**	0.048	0.019	−0.009	0.366***	0.170	0.149	0.290
	(0.036)	(0.034)	(0.028)	(0.028)	(0.087)	(0.109)	(0.151)	(0.185)
ln NLTA	0.044	0.131**	0.019	0.160***	−0.075	0.065	−0.126	−0.170
	(0.032)	(0.057)	(0.043)	(0.035)	(0.088)	(0.104)	(0.101)	(0.119)
ln LLPL	0.040***	0.013	0.043***	0.028***	0.015	−0.151***	−0.125*	−0.080**
	(0.011)	(0.010)	(0.015)	(0.008)	(0.031)	(0.052)	(0.071)	(0.038)
ln GDPG	−0.023	0.032*	−0.031	0.044**	−0.011	0.152*	0.218	0.106
	(0.017)	(0.017)	(0.021)	(0.018)	(0.050)	(0.086)	(0.226)	(0.085)
ln INFL	0.082***	0.009	0.001	0.001	0.172***	−0.005	−0.107	−0.034
	(0.024)	(0.014)	(0.012)	(0.018)	(0.064)	(0.084)	(0.070)	(0.096)
Constant	0.206*	0.352**	−0.063	−0.002	−2.010***	−2.890***	−1.426**	−1.956*
	(0.108)	(0.175)	(0.251)	(0.113)	(0.359)	(1.038)	(0.640)	(1.049)
H-stat / E-stat	0.595[a]	0.695[a]	0.661[a]	0.615[a]	0.012[e]	0.135[e]	−0.202[e]	−0.122[e]
	(0.043)	(0.162)	(0.130)	(0.047)	(0.111)	(0.131)	(0.232)	(0.166)
Wald F stat. H = 0 / E = 0	57.05 * **	18.29 * **	25.95 * **	172.18 * **	0.01	1.06	0.75	0.54
Wald F stat. H = 1	26.42 * **	3.52*	6.80 * *	67.43 * **				
Hansen J test (p-values)	16.584(0.22)	12.226(0.51)	0.115(0.73)	0.081(0.78)	11.669(0.90)	28.236(0.35)	0.136(0.71)	11.059(0.81)
2^{nd} order ser. cor. test(p-values)	0.936(0.35)	1.458(0.15)	−0.438(0.66)	0.335(0.74)	1.418(0.16)	−1.002(0.32)	1.558(0.12)	−0.537(0.59)
N	383	334	215	296	364	313	225	304

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Robust Windmeijer (2005) finite-sample corrected standard errors are in parenthesis. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected

Table 9: Dynamic Panzar-Rosse H-statistic using total revenue: Dynamic panel estimation, two-step system GMM

	Dependent variable: lnIR				Dependent variable: lnROA			
Variables	SOUTH	WEST	NORTH	EAST	SOUTH	WEST	NORTH	EAST
Lagged dep. var.	0.237**	0.325***	0.581***	0.561***	0.362	0.423**	0.303*	0.558**
	(0.102)	(0.099)	(0.192)	(0.178)	(0.222)	(0.170)	(0.162)	(0.238)
ln PF	0.220***	0.267***	0.068	0.133***	0.003	0.101	0.021	0.070
	(0.037)	(0.029)	(0.050)	(0.044)	(0.082)	(0.062)	(0.041)	(0.106)
ln PL	0.205***	0.243***	0.143*	0.160**	−0.137*	−0.055	−0.077	−0.100
	(0.039)	(0.044)	(0.076)	(0.079)	(0.080)	(0.117)	(0.137)	(0.107)
ln PC	−0.006	0.037***	0.012	0.049**	−0.001	0.179**	−0.041	0.030
	(0.025)	(0.013)	(0.038)	(0.020)	(0.035)	(0.079)	(0.080)	(0.055)
ln TA	0.751***	0.680***	0.383**	0.450***	0.022	0.040	−0.090**	0.121
	(0.101)	(0.089)	(0.189)	(0.171)	(0.015)	(0.036)	(0.037)	(0.078)
ln EQTA	0.048	0.023	−0.054	−0.027	0.397***	0.151	0.378***	0.471*
	(0.042)	(0.024)	(0.043)	(0.048)	(0.110)	(0.092)	(0.130)	(0.250)
ln NLTA	0.012	0.087	0.042	0.224***	−0.055	0.098	−0.143*	−0.167
	(0.053)	(0.064)	(0.053)	(0.043)	(0.074)	(0.104)	(0.073)	(0.144)
ln LLPL	0.016	0.005	0.005	0.008	−0.008	−0.107**	−0.161***	−0.102**
	(0.012)	(0.012)	(0.018)	(0.014)	(0.037)	(0.046)	(0.044)	(0.042)
ln OITA	−0.051*	−0.079*	−0.045*	−0.046	0.199*	0.353**	0.060	0.143
	(0.029)	(0.040)	(0.025)	(0.030)	(0.100)	(0.171)	(0.044)	(0.141)
ln GDPG	0.051*	0.086***	−0.024	0.042	0.023	0.122	−0.015	0.087
	(0.026)	(0.024)	(0.022)	(0.028)	(0.055)	(0.096)	(0.074)	(0.086)
ln INFL	0.099***	0.014	−0.007	−0.018	0.150*	−0.039	−0.046	−0.042
	(0.029)	(0.014)	(0.014)	(0.025)	(0.076)	(0.069)	(0.030)	(0.089)
Constant	−0.423**	−0.141	−0.043	−0.118	−2.146***	−2.080*	−1.729***	−2.650*
	(0.188)	(0.260)	(0.430)	(0.162)	(0.461)	(1.148)	(0.559)	(1.341)
H-stat / E-stat	0.550[a]	0.810[a]	0.534[a]	0.780[a]	−0.135[e]	0.225[e]	−0.097[e]	0.001[e]
	(0.058)	(0.078)	(0.193)	(0.100)	(0.120)	(0.142)	(0.168)	(0.157)
Wald F stat. H = 0 / E = 0	90.91***	108.83***	7.67***	61.23***	1.25	2.49	0.33	0.00
Wald F stat. H = 1	60.72***	5.95**	5.85**	4.88**				
Hansen test (p-values)	21.586(0.16)	12.295(0.50)	32.098(0.19)	27.607(0.12)	7.726(0.86)	16.315(0.43	9.274(0.90)	19.534(0.48)
Second order ser. cor. test (p-values)	0.193(0.85)	0.561(0.58)	1.373(0.17)	0.254(0.80)	0.971(0.33)	−0.677(0.50)	1.256(0.21)	−0.541(0.59)
N	374	334	206	297	354	311	212	301

TA: total assets, TR: total revenue, IR: interest revenue, ROA: return on assets, PF: price of funds, PL: price of labour, PC: price of capital, NLTA: the ratio of net loans to total assets, EQTA: The ratio of equity to total assets, LLPL: the ratio of loan loss provisions to total loans, GDPG: GDP growth rate, INFL: inflation. Time dummies are included in all models. Robust Windmeijer (2005) finite-sample corrected standard errors are in parenthesis. ***, ** and * indicate significant at 1%, 5% and 10%, respectively

[a] Significantly different from both zero and unity on Wald test (i.e. monopolistic competition)

[e] Long run equilibrium not rejected