Essential Information Sharing Thresholds for Reducing Market Power in Financial Access: A study of the African Banking Industry

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Abstract

This study investigates the role of information sharing offices (public credit registries and private credit bureaus) in reducing market power for financial access in the African banking industry. The empirical evidence is based on a panel of 162 banks from 42 countries for the period 2001-2011. Three simultaneity-robust empirical strategies are employed, namely: (i) Two Stage Least Squares with Fixed Effects in order to account for simultaneity and the observed heterogeneity; (ii) Generalised Method of Moments (GMM) to control for simultaneity and time-invariant omitted variables and (iii) Instrumental Variable Quantile regressions to account for simultaneity and initial levels of financial access. In order to ensure that information sharing offices influence market power for loan price (quantity) to decrease (increase), public credit registries should have between 3.156% and 3.3% coverage, while private credit bureaus should have between 1.443 and 18.4% coverage. The established thresholds are cut-off points at which information sharing offices completely neutralise the negative effect of market power on financial access. The thresholds are contingent on the dimension (loan price versus loan quantity) and distribution (conditional mean versus conditional distribution) of financial access.

JEL Classification: G20; G29; L96; O40; O55
Keywords: Financial access; Market power; Information sharing

1. Introduction

This inquiry assesses if information sharing offices (private credit bureaus and public credit registries) play their theoretical role of reducing market power for financial access in the African banking industry. There are four main motivations for the positioning of the inquiry: African financial institutions are characterised with surplus liquidity whereas economic operators have limited financial access (Saxegaard, 2006; Fouda, 2009; Asongu, 2014, p.70); the interaction of information and market power is essential in understanding the distribution of prices and quantities that lead to economic equilibriums (see Bergemanny et al., 2015); recent empirical evidence on the nexus between information sharing offices and market power show that the latter, for the most part, have not significantly influenced the former (see Boateng et al., 2016) and contemporary literature has concluded that financial institutions may be abusing their market power in order to enjoy a 'quiet life'[1] instead of increasing financial access (Asongu et al., 2016a).

This inquiry is particularly relevant to policy because information sharing offices were introduced across Africa, during the past decade, in order to increase financial access by mitigating information asymmetry between lenders and borrowers in the banking sector, stimulating interbank competition and reducing market power. The findings are therefore to inform policy makers on initiatives that can be used to effectively reduce the market power enjoyed by big banks which often translates into these banks setting prices far above marginal costs. Increasing financial access is important because it provides small businesses and households with the possibility of capitalising on mobilised resources to ultimately boost investment, productivity and economic consumption, which eventually culminates in higher economic prosperity and employment.

Noticeably, this study complements a recent strand of literature which is fundamentally motivated by the issue of whether big financial institutions in the African banking industry have been exploiting information sharing offices to increase their market power to the detriment of enhanced financial access (see Triki & Gajigo, 2014; Barth et al., 2009; Tchamyou & Asongu, 2016). Unfortunately, the underlying literature has been based on indirect policy inferences because an indicator of market power has not been directly

[1] The Quiet Life Hypothesis (QLH) is a postulation that, banks with substantial market power would invest less in pursuing intermediation efficiency and enhancing financial access. According to the hypothesis, instead of using their favourable market position to decrease the prices of loans and/or increase the quantity of loans, such banks tend to exploit such 'market power' in order to increase their gains or enjoy a 'quiet life' (Coccorese & Pellecchia, 2010).

engaged. This inquiry therefore complements existing studies by directly engaging how information sharing offices interact with market power to influence financial access in the African banking industry.

Apart from the need to address a gap in the extant literature, stylized facts accord with the need to engage such an investigation in Africa. For instance, Ariss (2010, p. 766) has stated that "*developing countries provide a fertile laboratory to examine issues of competition because they are engaged in a process of deregulation, bank privatization and financial liberalization, while the industry is witnessing more consolidation*". Moreover, according to Luoto et al. (2007, p. 313) "*in many developing countries, credit information systems are still in their infancy, and information sharing among lenders remains weak*". The authors further maintain that "*Africa remains the region of the world with the least developed credit information systems*" (2007, p. 315).

The empirical evidence in this study is based on a panel of 162 banks from 42 countries for the period 2001-2011; we use Generalised Method of Moments (GMM) to control for simultaneity and time-invariant omitted variables; Two Stage Least Squares to control for simultaneity and the observed heterogeneity and Quantile regressions to control for initial levels of financial access and the unobserved heterogeneity.

Our study introduces the notion of thresholds, which are particularly relevant for informing policy. In essence, policy is better informed if cut-off points at which information sharing offices completely neutralise the negative effect of market power on financial access can be established. Above these thresholds, information sharing offices can interact with market power to enhance financial access. The conception and definition of thresholds is consistent with Cummins (2000) that a certain stage in language proficiency needs to be attained, before advantages in another language can be enjoyed. Furthermore, the concept of thresholds is also consistent with the theory of critical mass that is substantially documented in the economic development literature (see Roller & Waverman, 2001; Ashraf & Galor, 2013). A contemporary application of the notion of threshold or critical mass theory from interactive empirical specifications can be found in Batuo (2015). In essence, within the framework of this inquiry, the notion of threshold is similar to: critical masses for appealing effects (Batuo, 2015; Roller & Waverman, 2001); the minimum requirement for reaping expected effects (Cummins, 2000) and the requirements for Kuznets and U shapes (Ashraf & Galor, 2013).

The rest of the paper is organised in the following manner. In section 2 we discuss theoretical underpinnings and the relevant literature. Data and methodology are covered in Section 3, while Section 4 presents the empirical results. Section 5 concludes with future research directions.

2. Theoretical underpinnings and related literature

During the past decade, information sharing offices have been introduced across Africa in order to increase financial access (see Lin et al., 2011; Boateng et al., 2016). Such information sharing offices are theoretically expected to mitigate information asymmetry between borrowers and lenders; boost interbank competition and reduce the market power enjoyed by big banks in the industry. While the theoretical framework of this inquiry is particularly concerned with the third effect of information sharing, the others also complement the ultimate goal of increasing financial access.

In essence, the theoretical relationship between information sharing and market power is founded on the anticipation that information sharing reduces informational rents previously enjoyed by big banks and hence, increases interbank competition by making the credit market more contestable (see Jappelli & Pagano, 2002). Ultimately, information sharing offices act as market brokers by enabling enhanced competition for credit, reduced constraints to credit and efficiency in the transformation of mobilised resources into credit for economic operators. These underpinnings for the most part are in accordance with theoretical literature on the relationship between market power and information (see Bergemanny et al., 2015)

According to Bergemanny et al. (2015), the consumer can exercise market power by strategically changing the quantity he/she demands in order to influence the demand curve and market price. A producer can also strategically influence the supply curve and thereby the market price by determining the quantity of commodities he/she supplies at a given point in time. It follows that price and quantity effects are closely associated with market power since prices respond to both consumer demand shifts and producer supply shifts. From the consumer's point of view, marker power is associated with inefficiency because the consumer's marginal value is greater than the market price. In the same vein, from a producer's perspective, when the marginal cost of production is substantially lower than the supply price, considerable gain is made.

Since the ability of consumers and producers to generate such inefficiencies builds on information asymmetry in the market, information sharing is important in curbing the

underlying inefficiencies. It follows that the exercise of market power fundamentally builds on the presence of information asymmetry. This theoretical background aligns with the positioning of our study from two angles. On the one hand, we measure market power in the banking sector as the rate at which prices are set above marginal cost. On the other hand, information sharing offices have a fundamental mission of decreasing information asymmetry that limits financial access. Furthermore, credit information systems are intuitively expected to have significant effects on market power because monopolistic features of large financial institutions become hard to conceal owing to the increasing transparency and availability of previously privileged information and also a reduction in informational rents.

Over the past three decades, the concern about market power and financial access has been at the heart of scholarly and policy discourses (Townsend, 1979; Stiglitz & Weiss, 1981; Aghion & Bolton, 1992; Neven & Roller, 1999; Maudo & Fernandez de Guevara, 2007; Boateng et al., 2016). Such interest is considerably motivated by the inefficient externalities of market power in the banking sector, notably, net losses in economic and social welfare (Maudo & Fernandez de Guevara, 2007).

The literature is consistent with the position that market power is associated with lower economic prosperity, lower saving and investment levels and higher financial intermediation cost (see Stiglitz & Weiss, 1981; Djankov et al., 2007). Given the negative development consequence of market power, both developing and developed countries have been tailoring policies towards reducing information asymmetry and enhancing competition in the banking sector. A notable reform within this framework in the African financial industry has been the liberalisation of the banking sector, a policy led by the World Bank and International Monetary Fund (IMF).

Moreover, there is a growing realisation by many lending institutions on the continent that credit information systems are also essential for increasing financial access. Such a realisation aligns with dominant power theories of credit that have been advanced and formalised in scholarly circles (see Townsend, 1979; Jaffee & Russell, 1976; Stiglitz & Weiss, 1981; Aghion & Bolton, 1992; Hart & Moore, 1994). According to these theories of credit, two main characteristics affect the level at which financial systems grant credit to individuals and firms, namely: information and the power of creditors i.e., their market power.

More contemporary literature suggests that compared to big banks, smaller banks are linked to lower margins of interest (see Beck & Hesse, 2006; Ahokpossi, 2013)[2]. This is a paradox because, banks with greater market power are expected to be associated with lower interest margins because of the economies of scale they enjoy (internal and external advantages). Unfortunately, instead of increasing access to finance, big banks have been documented to reflect more financial allocation inefficiency (Mitchell & Onvural, 1996). Three main points have been advanced to elucidate this paradox. Firstly, larger banks may be more concerned about enjoying a 'quiet life' than with increasing financial access (Mitchell & Onvural, 1996). Secondly, bigger banks are not exclusively associated with economies of scale and could also be linked with considerable diseconomies of scale, which engender inefficiencies in terms of poor organisation, coordination and management (Berger et al., 1987; Noulas et al., 1990; Mester, 1992; Clark, 1996; Karray & Chichti, 2013). Finally, big banks could be using information sharing offices to increase their profit margins (Brown & Zehnder, 2010; Boateng et al., 2016).

In spite of the perceived advantages that are linked to the introduction of credit information services across Africa, a recent stream of banking literature shows that big banks are continuing to take advantage of their positions to enjoy a 'quiet life' (Boateng et al., 2016; Tchamyou & Asongu, 2016).

3. Data and Methodology

3.1 Data

This study investigates a panel of 162 banks with data from 42 countries for the period 2001-2011. The data has been sourced from Bankscope and World Development Indicators. The periodicity, number of countries and banks are based on data availability constraints. It is important to note that data on information sharing is only available from the year 2011.

Consistent with recent literature (Ariss, 2010; Boateng et al., 2016), we use the Lerner Index to measure market power. The index takes into account the degree to which banks set prices above marginal costs. Hence, a higher index implies more market power. We discuss the steps to be followed to compute the index in greater detail in Section 3.1.1. Private credit bureaus and public credit registries have been used as a proxy for information sharing offices

[2] Consistent with Beck and Hesse (2006, p.1), the size of a bank considerably affects variations in the interest rate margins/spreads in the banking sector. Ngigi (2013ab) has shown that in Kenya, compared to small banks, big banks are associated with higher cost of loans. Moreover, in Sub-Saharan Africa (SSA), policies that are designed to reduce market competition and increase interbank competition contribute towards reducing interest margins (Ahokpossi (2013, p.1).

(see Djankov et al., 2007; Triki & Gajigo, 2014). Loan price and loan quantity effects (which are dependent variables) are measured respectively by '*price charged on loans*' and '*logarithms of loans*' (Coccorese & Pellecchia , 2010; Asongu & Le Roux, 2016).

Three sets of control variables are adopted, notably: market-related features (Population density, Inflation and GDP per capita growth); bank-oriented characteristics (Deposit/Assets and Bank branches) and the unobserved heterogeneity such as '*compliance with Sharia finance*' (Non-Islamic versus (vs) Islamic); size (large vs. small) and ownership (foreign vs. domestic). The choice of these control variables is in accordance with recent literature on financial access in the African banking industry (see Asongu & Le Roux, 2016; Boateng et al., 2016).

We provide hypotheses on the signs that we would expect to find on analysis of the data.

Firstly, with respect to market-oriented characteristics, the following can be anticipated:

- GDP per capita (which accounts for fluctuations in the business cycle) is anticipated to positively affect the quantity of loans. The expected sign for the price of loans is difficult to establish because it depends on market expansion and dynamism. However, decreasing GDP per capita can affect both loan price and loan quantity, owing to decreasing demand. A negative effect is anticipated from GDP per capita because it has been decreasing over the past decade, owing to the population growing more proportionately than GDP.
- Population density is expected to influence both dependent variables positively, essentially because a growing demand for loans due to high population density is also likely to positively affect the price of loans.
- Inflation should intuitively increase (decrease) the price (quantity) of loans. Accordingly, since less investment (and therefore loan quantity) is likely in periods of economic uncertainty (e.g. chaotic inflation), the price of loans (or interest changed) is adjusted for inflation. It is important to note that investors have been documented to prefer investing in economic environments that are less ambiguous (see Kelsey & Le Roux, 2016; Le Roux & Kelsey, 2016).

Secondly, with regard to the bank-related characteristics, the following can be expected:

- Intuitively, while the number of bank branches has a positive influence on the quantity of loans, it has a negative effect on loan prices.
- The 'deposit to asset' ratio is expected to boost both the price and the quantity of loans. This is essentially because mobilised deposits are the main source of financing

for banks. Therefore a greater proportion of deposits in liquid liabilities can boost loan quantity and/or margins in interest rate, given that good organisation is essential for adequate management and effective mobilisation of underlying bank resources.

Thirdly, expected signs from dummy variables used to control for the unobserved heterogeneity are difficult to establish. In particular, we note that:

- Banks, irrespective of size (small vs. big), can be linked to both negative and positive impacts accruing from loan dynamics, though banks with substantial sizes could comparatively be more associated with coordination and management concerns connected with bank size. Moreover, tackling apparent challenges that are inherently associated with the increasing size of banks is also a source of inefficiency, given concerns that may be encountered with the resolution of conflicts connected to customer requirements and needs.
- Similarly, the incidences of ownership heterogeneity (foreign vs. domestic banks) and compliance with Sharia finance (Islamic vs. Non-Islamic) are contingent on a variety of characteristics such as, staffs' capacities in organisation, market expansion and market dynamism.

A tabular synthesis of expected signs from the control variables can be found in Appendix 1, while Appendix 2 provides the definitions and sources of variables. Appendix 3 and Appendix 4 provide the summary statistics and correlation matrix, respectively.

3.2 Methodology

3.2.1 Estimation of Market Power (Lerner Index)

We employ the stochastic frontier model in estimating the Lerner Index for market power. The employment of the approach is consistent with both contemporary (Coccorese & Pellecchia, 2010; Boateng et al., 2016) and non-contemporary (Battese & Coelli, 1992) literatures. According to Coccorese and Pellecchia (2010), this estimation approach is more efficient when compared to other modelling techniques that are based on deterministic frontiers (see Farrell, 1957; Aigner & Chu, 1968). The adopted modelling approach controls for the possibility that, in addition to inefficiency in businesses, variations between the frontier outcome and the observed output could be based on factors like measurement errors and stochastic shocks.

We assume that for firm i at time t, production costs depend on input prices (W), output (Q), a random error (v) and inefficiency (u). If the corresponding random error

inefficiency terms are identically and independently distributed (iid), then the logarithmic specification reflecting the cost function can be disclosed as follows:

$$\ln C_{it} = f(Q_{it}, W_{it}) + v_{it} + u_{it} \quad , \tag{1}$$

where, the error term and non-negative inefficiency terms are iid, and follow a normal distribution and a truncated normal distribution, respectively. Therefore, while the random error $v_{it} \sim N(0, \sigma_v{}^2)$, the term that captures inefficiency, $u_{it} \sim N(\mu, \sigma_u{}^2)$.

Cost is then modelled with a translog cost function, that encompasses three inputs and one output. The translog cost function which was proposed by Christensen et al. (1971) and extended by Brown et al. (1979) to a multiproduct framework has been considerably used in contemporary empirical literature (see Koetter & Vins, 2008; Ariss, 2010; Coccorese & Pellecchia, 2010; Boateng et al., 2016).

The cost function is as follows:

$$\ln C_{it} = \alpha_0 + \alpha_1 \ln Q_{it} + \sum_{h=1}^{3} \alpha_h \ln W_{hit} + \frac{1}{2}\left\{ \alpha_{QQ} (\ln Q_{it})^2 + \sum_{h=1}^{3} \sum_{k=1}^{3} \alpha_{hk} \ln W_{hit} \ln W_{kit} \right\}$$

$$+ \sum_{h=1}^{3} \alpha_{Qh} \ln Q_{it} \ln W_{hit} + v_{it} + u_{it} \quad , \tag{2}$$

where, $i = 1,...., N$ and $t = 1,....T$, are subscripts indicating banks and time, respectively. C denotes the total cost, Q represents the output, W_h entails factor prices, while u_{it} and v_{it} are the error and inefficiency terms respectively.

Three inputs and one output are specified in order to estimate the cost in a realistic manner. The total operating cost is measured with the following variables: price of labour; price of capital; output by total assets; inputs by the price of deposits and total operating cost measured with overheads[3].

As shown in Eq. (4), the Lerner index is then computed from the price and marginal cost. While the 'marginal cost' is obtained from the output of a translog cost function (see Eq. (3)), the 'price' denotes the price that banks charge on their output or total assets. It is calculated as the ratio of total revenues (net interest income plus non-interest income) to total assets.

[3] The deposit price is obtained by dividing interest expenses with the sum of deposits, short term finance plus money market. The price of labor is defined as the ratio of personnel expenses to total assets. The price of capital is equal to the ratio of 'other operating costs' to the value of fixed assets.

$$MC_{it} = \frac{\partial C_{it}}{\partial Q_{it}} = \frac{\partial \ln C_{it}(C_{it})}{\partial \ln Q_{it}(Q_{it})} = \left(\alpha_Q + \alpha_{QQ} \ln Q_{it} + \sum_{h=1}^{3} \alpha_{Qh} \ln W_{hit} \right) \frac{C_{it}}{Q_{it}} \quad (3)$$

$$LERNER_{it} = \frac{P_{it} - MC_{it}}{P_{it}}, \quad (4)$$

where, P_{it} is the price that a bank charges on its output. From a theoretical perspective, the Lerner index ranges from 0 (signifying a market with perfect competition) and 1 (signifying a perfect monopoly).

3.2 2 Instrumentation and Two Stage Least Squares estimations

Three simultaneity-robust empirical strategies are used, namely: Two Stage Least Squares in order to account for simultaneity and the observed heterogeneity; Generalised Method of Moments (GMM) to control for simultaneity and time-invariant omitted variables and Instrumental Variable (IV)[4] Quantile regressions to account for initial levels of financial access. The employment of multiple estimation approaches for the purposes of robustness is in accordance with recent literature on financial access (see Asongu & Nwachukwu, 2016a; Boateng et al., 2016).

The concern about simultaneity (in endogeneity) is tackled by instrumenting the private credit bureaus, public credit registries and market power on their first lags. For example, the process of instrumenting public credit registries can be seen in Eq. (5) below.

$$PCR_{i,t} = \alpha + \delta_j \left(PCR_{i,t-1} \right) + \varepsilon_{i,t} \quad , \quad (5)$$

where, $PCR_{i,t}$, is the public credit registries indicator of bank i at period t, α is a constant, $PCR_{i,t-1}$, represents public credit registries in bank i at period $t-1$, and $\varepsilon_{i,t}$ is the error term.

The instrumentation process in Eq. (5) which is replicated for private credit bureaus and the Lerner index consists of regressing public credit registries on their first lags and then saving the fitted values which are then employed as the independent variables of interest in the Two Stages Least Squares and Quantile regressions. The specifications are Heteroscedasticity and Autocorrelation Consistent (HAC) in terms of standard errors.

The Two Stage Least Squares with Fixed Effects is presented in Eq. (6) below.

[4] Throughout the study, we employ 'Instrumental' and 'Instrumental Variable' interchangeably. This is simply for the ease of communication.

$$LQ_{i,t} = \partial_0 + \partial_1 ISO_{i,t} + \partial_2 MP_{i,t} + \partial_3 Inter_{i,t} + \sum_{h=1}^{5} \omega_h W_{h,i,t-\tau} + \eta_i + \varepsilon_{i,t} \ , \quad (6)$$

where, $LQ_{i,t}$ is Loan quantity of bank i at period t, ∂ is a constant, *ISO* represents information sharing offices (public credit registries or private credit bureaus), *MP* denotes Market Power or the Lerner index, *Inter* is the interaction between ISO and MP. *W* captures the vector of control variables (*GDP per capita growth, Inflation, Population density, Deposit/Assets, Bank Branches)*), η_i is the bank-specific effects (*Small banks, Domestic banks* and *Islamic banks*) and $\varepsilon_{i,t}$ is the error term.

3.2.3 Generalised Method of Moments: specification, identification and exclusion restrictions

The adoption of the Generalised Method of Moments (GMM) is motivated by five main reasons, while the first-two constitute basic conditions for the employment of the strategy; the other three represent associated-advantages.

Firstly, the estimation approach controls for persistence in loan price and quantity, since the rule of thumb or information criterion needed to confirm persistence in the two financial access variables is met. Accordingly, the correlation between loan quantity and loan price and their first lags are respectively 0.996 and 0.845, which are higher than the required 0.800 rule of thumb threshold.

Secondly, the N>T criterion for the GMM approach is also met because we have 162 banks for an 11 year span. Hence, the number of cross sections is substantially higher than the number of time series in each cross section. Moreover, this estimation strategy accounts for endogeneity by controlling for simultaneity in all the regressors and accounting for time-invariant omitted variables in order to control for the unobserved heterogeneity.

In addition, the system estimator tackles inherent biases that are associated with the difference estimator. Finally, cross-country differences are taken into account by the approach essentially because GMM exclusively deals with panel data structures.

As documented by Bond et al. (2001), the *system* estimator (see Arellano & Bond, 1995; Blundell & Bond, 1991) has better estimation properties when compared to the *difference* estimator (Arellano & Bond, 1991), because it addresses the concerns of small sample biases that are associated with the *difference* estimator. In this study, we adopt an extension of Arellano and Bover (1995) by Roodman (2009ab). Instead of employing first differences as instruments, the extension adopts forward orthogonal deviations which have

been established in prior literature to limit over-identification and restrict instrument proliferation (see Baltagi, 2008; Love & Zicchino, 2006). A *two-step* procedure is adopted in place of the *one-step* process in order to correct for heteroscedasticity.

Equations (7) and (8), represent level and first difference estimation procedures for loan quantity, respectively.

$$LQ_{i,t} = \sigma_0 + \sigma_1 LQ_{i,t-\tau} + \sigma_2 ISO_{i,t} + \sigma_3 MP_{i,t} + \sigma_4 Inter_{i,t} + \sum_{h=1}^{5} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t}, \quad (7)$$

$$\begin{aligned} LQ_{i,t} - LQ_{i,t-\tau} = {} & \sigma_0 + \sigma_1 (LQ_{i,t-\tau} - LQ_{i,t-2\tau}) + \sigma_2 (ISO_{i,t} - ISO_{i,t-\tau}) + \sigma_3 (MP_{i,t} - MP_{i,t-\tau}) \\ & + \sigma_4 (Inter_{i,t} - Inter_{i,t-\tau}) + \sum_{h=1}^{5} \delta_h (W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + \varepsilon_{i,t-\tau} \end{aligned}, \quad (8)$$

where, τ represents the coefficient of auto-regression and ξ_t is the time-specific constant. Equations (7) and (8) are replicated using the same regressors, when the dependent variable is loan price.

Clearly articulating exclusion and identification restrictions is paramount for a sound GMM specification. In accordance with recent GMM literature with forward orthogonal deviations, all explanatory indicators are considered as suspected endogenous or predetermined variables whereas time-invariant omitted indicators are acknowledged to exhibit strict exogeneity (see Asongu & Nwachukwu, 2016a). The identification condition builds on the intuition that it is unfeasible for years or time-invariant omitted indicators to be first-differenced endogenous (Roodman, 2009b). Therefore, the process for treating *ivstyle* (years) is 'iv(years, eq(diff))' while the *gmmstyle* is used for predetermined variables.

In the light of the above, years (which are acknowledged to be strictly exogenous) affect financial access exclusively through predetermined variables. Furthermore, the statistical validity of the exclusion restriction is examined with the Difference in Hansen Test (DHT) for instrument exogeneity. It is important to note that failure to reject the null hypothesis of this test is an indication that the time-invariant omitted variables elicit financial access exclusively via the predetermined variables. Hence, while for a standard IV approach, rejecting the null hypothesis of the Sargan Overidentifying Restrictions (OIR) test implies that the instruments explain the financial access beyond the suspected endogenous variables (see Beck et al., 2003; Asongu & Nwachukwu, 2016b), with the GMM approach, the DHT is used as the information criterion needed to examine if time-invariant omitted variables exhibit

strict exogeneity. In the results that are reported in Section 4, this assumption of exclusion restriction is confirmed, if the null hypothesis of the DHT corresponding to IV (year, eq(diff)) is not rejected.

3.2.4 Instrumental Quantile regressions

The modelling approaches covered above are based on mean values of financial access. Unfortunately, only exclusively blanket policies can be obtained from such estimations. Furthermore, the corresponding blanket policies may be ineffective unless they are contingent on initial levels of financial access and varyingly specified across banks corresponding to low, intermediate and high levels of financial access. This issue of modelling exclusively at the conditional mean of financial access is addressed with the *Quantile* Regressions (QR) estimation approach which enables this inquiry to assess the relationships throughout the conditional distributions of financial access (see Keonker & Hallock, 2001; Billger & Goel, 2009; Okada & Samreth, 2012). Such a technique has recently been employed to investigate the nexus between information asymmetry and financial access (see Asongu et al., 2016b).

Mindful of the above points, studies that assess mean impacts with Ordinary Least Squares (OLS) are essentially based on the assumption of normally distributed error terms. Such an assumption is not valid with the QR approach. Moreover, the approach which enables an investigation of parameter estimates at multiple points of the conditional distribution of financial access is robust in the presence of outliers (see Koenker & Bassett, 1978).

The θ^{th} quintile estimator of financial access is obtained by solving the following optimization problem, which is presented without subscripts for simplicity in Eq. (9)

$$\min_{\beta \in R^k}\left[\sum_{i\in\{i:y_i\geq x_{i'}\beta\}}\theta\left|y_i-x_{i'}\beta\right|+\sum_{i\in\{i:y_i\geq x_{i'}\beta\}}(1-\theta)\left|y_i-x_{i'}\beta\right|\right], \quad (9)$$

where, $\theta\in(0,1)$. Contrary to OLS that is fundamentally based on minimizing the sum of squared residuals, with QR, it is the weighted sum of absolute deviations that is minimised. For example, the 25th or 90th quintiles (with θ=0.25 or 0.90 respectively) are examined by approximately weighing the residuals. The conditional quintile of financial access or y_i given x_i is:

$$Q_y(\theta / x_i) = x_{i'}\beta_\theta, \quad (10)$$

where, unique slope parameters are modelled for each θ^{th} specific quintile. This formulation is analogous to $E(y/x) = x_{i'}\beta$ in the OLS slope where parameters are examined only at the mean of the conditional distribution of financial access. In Eq. (10), the dependent variable y_i is the financial access while x_i contains a constant term, *public credit registries, private credit bureaus, market power, GDP per capita growth, Inflation, Population density, Deposit/Assets, Bank branches, Small banks, Domestic banks* and *Islamic banks*.

4. Empirical results

Table 1 presents the GMM findings and Tables 2-3 show the results corresponding to the Quantile regressions. Consistent differences in estimated coefficients between Two Stage Least Squares and quintiles (in terms of sign, significance and magnitude of significance) justify the relevance of the Quantile regressions empirical strategy adopted in our study.

In Table 1, there are four specifications corresponding to each financial access variable: two on private credit bureaus and two on public credit registries. Either 'public credit registries' or 'private credit bureaus' specification has two sub-specifications, one corresponding to a full sample and another related to a partial sample. The full sample is from 2001-2011, while the partial sample is from 2005-2011.

There are two motivations for adopting the partial sample. Firstly, it enables this study to limit the proliferation of instruments or restrict over-identification since T (time) is reduced. Secondly, data on private credit bureaus and public credit registries for the most part is available from the year 2005. Four principal information criteria are employed to assess the validity of the GMM model with forward orthogonal deviations[5]. The findings are discussed based on these information criteria.

[5] "*First, the null hypothesis of the second-order Arellano and Bond autocorrelation test (AR(2)) in difference for the absence of autocorrelation in the residuals should not be rejected. Second the Sargan and Hansen over-identification restrictions (OIR) tests should not be significant because their null hypotheses are the positions that instruments are valid or not correlated with the error terms. In essence, while the Sargan OIR test is not robust but not weakened by instruments, the Hansen OIR is robust but weakened by instruments. In order to restrict identification or limit the proliferation of instruments, we have ensured that instruments are lower than the number of cross-sections in most specifications. Third, the Difference in Hansen Test (DHT) for exogeneity of instruments is also employed to assess the validity of results from the Hansen OIR test. Fourth, a Fischer test for the joint validity of estimated coefficients is also provided*" (Asongu & De Moor, 2016, p.9).

Table 1: Financial access effects of reducing market power with information sharing

	Dependent variable: Financial Access							
	Loan Price Effects				Loan Quantity Effects			
	Public Credit Registries (PCR)		Private Credit Bureaus (PCB)		Public Credit Registries (PCR)		Private Credit Bureaus (PCB)	
	Full Sample	Partial Sample	Full Sample	Partial Sample	Full Sample	Partial Sample	Full Sample	Partial Sample
Constant	**0.038*** **	0.010	**0.044*** **	**0.305*** **	**0.226*** **	**0.146***	**0.300*** **	-0.305
	(0.001)	(0.860)	**(0.000)**	**(0.001)**	**(0.000)**	**(0.052)**	**(0.000)**	(0.156)
Price of Loans (-1)	**0.498*** **	**0.599*** **	**0.513*** **	**0.610*** **	---	---	---	---
	(0.000	**(0.000)**	**(0.000)**	**(0.000)**				
Quantity of Loans	---	---	---	---	**1.010*** **	**1.012*** **	**0.978*** **	**1.013*** **
					(0.000)	**(0.000)**	**(0.000)**	**(0.000)**
Market Power	-0.002	-0.006	**-0.013****	0.006	**-0.115*** **	**-0.099***	**-0.092****	-0.071
	(0.710)	(0.481)	**(0.016)**	(0.617)	**(0.002)**	**(0.071)**	**(0.024)**	(0.162)
PCR	**-0.001*** **	**-0.001*** **	---	---	-0.001	**-0.021*** **	---	---
	(0.001)	**(0.007)**			(0.696)	**(0.000)**		
PCB	---	---	-0.0003	-0.0007	---	---	**-0.006*** **	0.0006
			(0.374)	(0.132)			**(0.000)**	(0.597)
PCR*Market Power	0.0005	0.0008	---	---	0.002	**0.030*** **	---	---
	(0.239)	(0.200)			(0.665)	**(0.000)**		
PCB*Market Power	---	---	**0.001*** **	0.0008	---	---	**0.005*** **	-0.0005
			(0.004)	(0.220)			**(0.001)**	(0.754)
GDPpcg	**0.0009****	0.0006	0.0004	-0.0001	**0.005*** **	**0.007*** **	**0.005*** **	**0.007*** **
	(0.023)	(0.101)	(0.252)	(0.777)	**(0.000)**	**(0.002)**	**(0.002)**	**(0.000)**
Inflation	**0.0006*** **	**0.0007****	**0.0006*** **	-0.0000007	0.0009	-0.0003	0.001	0.001
	(0.001)	**(0.019)**	**(0.002)**	(0.999)	(0.240)	(0.813)	(0.157)	(0.302)
Pop. density	**0.00003*** **	**0.00002***	**0.00007*** **	0.00002	0.00007	-0.00007	-0.0001	0.000005
	(0.007)	**(0.088)**	**(0.000)**	(0.173)	(0.126)	(0.372)	(0.102)	(0.913)
Deposit/Assets	**0.016**	0.014	0.016	0.018	**-0.222*** **	-0.048	**-0.128****	-0.010
	(0.270)	(0.237)	(0.153)	(0.477)	**(0.004)**	(0.714)	**(0.042)**	(0.828)
Bank Branches	**-0.0007****	**-0.0005***	**-0.001*** **	**-0.001****	-0.001	**-0.002***	0.002	-0.0002
	(0.017)	**(0.084)**	**(0.000)**	**(0.027)**	(0.103)	**(0.085)**	(0.231)	(0.859)
Net effect of PCR	n.a	n.a	---	---	n.a	-0.037	---	---
Threshold of PCR	n.a	n.a	---	---	n.a	3.30	---	---
Net effect of PCB	---	---	n.s.a	n.a	---	---	-0.054	n.a
Threshold of PCB	---	---	n.s.a	n.a	---	---	18.40	n.a
AR(1)	(0.000)	(0.742)	(0.000)	(0.001)	(0.002)	(0.028)	(0.001)	**(0.167)**
AR(2)	**(0.508)**	**(0.415)**	**(0.449)**	(0.000)	(0.041)	**(0.628)**	**(0.193)**	**(0.482)**
Sargan OIR	(0.000)	(0.015)	(0.000)	(0.003)	(0.000)	(0.057)	(0.000)	(0.064)
Hansen OIR	(0.021)	**(0.168)**	(0.007)	**(0.487)**	(0.019)	**(0.349)**	**(0.164)**	**(0.341)**
DHT for instruments								
(a)Instruments in levels								
H excluding group	(0.049)	**(0.110)**	(0.012)	**(0.425)**	**(0.924)**	**(0.282)**	**(0.905)**	**(0.770)**
Dif(null, H=exogenous)	(0.077)	**(0.353)**	(0.076)	**(0.488)**	(0.002)	**(0.429)**	(0.041)	**(0.169)**
(b) IV (years, eq(diff))								
H excluding group	(0.025)	**(0.220)**	(0.010)	**(0.602)**	(0.009)	**(0.300)**	**(0.133)**	**(0.272)**
Dif(null, H=exogenous)	**(0.194)**	**(0.221)**	**(0.144)**	**(0.261)**	**(0.453)**	**(0.498)**	**(0.420)**	**(0.537)**
Fisher	**64.32*** **	**135.37*** **	**33.42*** **	**50.04*** **	**1060.85*** **	**1514.08*** **	**980.85*** **	**2380.31*** **
Instruments	42	41	42	40	42	40	42	41
Banks	135	101	135	100	137	101	137	100
Observations	627	127	618	125	637	127	628	125

*, **, ***: significance levels of 10%, 5% and 1% respectively. DHT: Difference in Hansen Test for Exogeneity of Instruments' Subsets. Dif: Difference. OIR: Over-identifying Restrictions Test. The significance of bold values is twofold. 1) The significance of estimated coefficients, and the Fisher statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the AR(1)and AR(2) tests and; b) the validity of the instruments in the OIR and DHT tests. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of market power. nsa: not specifically applicable because the information criteria does not valid the model. Mean value of PCR is 2.056. Mean value of PCB is 7.496. Range of PCR: 0.000 to 49.800. Range of PCB is 0.000 to 64.800.

The findings are discussed in terms of marginal impacts, net effects and thresholds at which the policy variables (private credit bureaus and public credit registries) influence market power to increase financial access. For instance, from the second-to-the last column of Table 1, we note that while the net effect of using private credit bureaus to influence market power to increase loan quantity is negative (-0.054), the corresponding marginal effect is positive (0.005). This implies that a certain threshold of 18.40% (0.092/0.005) coverage in private credit bureaus is required to reverse the sign of the unconditional effect of market power (-0.092) from negative to positive.

The net effect on loan quantity is derived from the interaction between private credit bureaus and market power on the one hand and unconditional market power impacts on the other hand. For instance, when the mean value of private credit bureaus is 7.496, the unconditional effect of market power equals -0.092, and the corresponding conditional impact is 0.005, the net effect on loan quantity would be: -0.054= [0.005× 7.496] + [-0.092].

In the third-to-the last column of Table 1, we examine the role of public credit registries in market power for loan quantity, the marginal effects, net impacts and thresholds are respectively 0.030, -0.037 and 3.30. This implies that a threshold of 3.30% coverage is needed to neutralise the effect of market power. In other words, 3.30% coverage of public credit registries is required to reverse the negative effect of market power on financial access (in terms of loan quantity). The computed thresholds make economic sense because they are within the range (minimum to maximum) disclosed by the summary statistics, notably: 0.000 to 49.800 for public credit registries and 0.000 to 64.800 for private credit bureaus. Most of the significant control variables have signs consistent with our hypothesis (Section 3.1.1).

We now consider the findings displayed in Table 2, on the role of public credit registries in reducing market power for financial access. We find that net effects are negative in the top quintiles of the loan price distribution. Marginal effects are negative in the 0.10^{th} quintile and top quintiles of the loan quantity distributions, with a corresponding threshold of 3.156 percentage coverage in the 10^{th} quintile being within range. Most of the significant control variables have signs consistent with our hypotheses.

Table 3 displays our findings on the role of private credit bureaus in reducing market power for financial access. Marginal effects from the interaction between private credit bureaus and market power are negative in the bottom quintiles and 0.90^{th} quintile of the loan price distribution. We find that the influence of private credit bureaus in market power for

enhanced loans is consistent with theoretical underpinnings throughout the conditional distribution of loan quantity.

Notably, there exists negative unconditional impacts from market power; positive marginal or conditional effects from the interaction between market power and private credit bureaus; positive net effects and thresholds that are within range (0.359 to 63.894) and which vary from 1.443 percentage coverage (see 0.75^{th} quintile) to 4.161 percentage coverage (see 0.10^{th} quintile). Most of the significant control variables have the hypothesised signs.

Table 2: Financial Access Effects of PCR with Market Power (IV QR)

	Dependent variable: Financial Access											
	Loan Price Effects						Loan Quantity Effects					
	2SLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**2SLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	**0.101*** **	**0.087*** **	**0.090*** **	**0.083*** **	**0.126*** **	**0.148*** **	**4.021*** **	**3.046*** **	**3.630*** **	**3.776*** **	**4.611*** **	**6.087*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Market Power (IV)	-0.004	-0.006	-0.001	0.002	**-0.038*** **	**-0.056*** **	**-0.544*** **	**-1.010*** **	**-0.914*** **	**-0.586***	-0.322	-0.149
	(0.603)	(0.584)	(0.774)	(0.595)	**(0.000)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.061)**	(0.112)	(0.328)
PCR (IV)	**-0.009*** **	**-0.012*** **	**-0.010*** **	**-0.006***	**-0.008** **	**-0.008*** **	-0.089	-0.162	-0.049	0.122	**-0.259** **	**-0.459*** **
	(0.000)	**(0.005)**	**(0.002)**	**(0.070)**	**(0.012)**	**(0.002)**	(0.263)	(0.108)	(0.748)	(0.531)	**(0.029)**	**(0.000)**
PCR(IV)*Market Power(IV)	**0.013*** **	**0.017** **	**0.014** **	0.008	**0.011** **	**0.012** **	0.197	**0.320***	0.141	-0.162	**0.473** **	**0.802*** **
	(0.001)	**(0.019)**	**(0.014)**	(0.193)	**(0.045)**	**(0.012)**	(0.153)	**(0.069)**	(0.590)	(0.624)	**(0.021)**	**(0.000)**
GDPpcg	**-0.0009** **	**-0.001** **	-0.0005	-0.0006	-0.0008	-0.0002	-0.016	**0.033*** **	-0.024	-0.037	-0.028	**-0.036*** **
	(0.017)	**(0.029)**	(0.233)	(0.152)	(0.165)	(0.667)	(0.179)	**(0.003)**	(0.111)	(0.154)	(0.146)	**(0.007)**
Inflation	**0.001*** **	0.0001	**0.0009*** **	**0.001*** **	**0.002*** **	**0.002*** **	**-0.012***	0.0006	-0.001	-0.012	-0.011	-0.008
	(0.001)	(0.776)	**(0.005)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.090)**	(0.925)	(0.911)	(0.420)	(0.305)	(0.221)
Pop. Density	**0.00004*** **	0.00003	**0.00005*** **	**0.00008*** **	**0.00007*** **	**0.00006*** **	**-0.001*** **	**-0.002*** **	**-0.002*** **	-0.001	**-0.002** **	**-0.001*** **
	(0.009)	(0.334)	**(0.003)**	**(0.000)**	**(0.001)**	**(0.004)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.102)	**(0.015)**	**(0.007)**
Deposit/Assets	-0.001	-0.007	-0.003	0.006	0.006	0.001	**2.135*** **	**1.357*** **	**1.988*** **	**2.662*** **	**2.116*** **	**0.545** **
	(0.881)	(0.615)	(0.666)	(0.476)	(0.583)	(0.887)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.016)**
Bank Branches	**-0.0009*** **	**-0.0009** **	**-0.0009*** **	**-0.001*** **	**-0.001*** **	-0.0002	**-0.064*** **	**-0.010***	**-0.039*** **	**-0.065*** **	**-0.072*** **	**-0.061*** **
	(0.001)	**(0.010)**	**(0.002)**	**(0.001)**	**(0.003)**	(0.545)	**(0.000)**	**(0.099)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**
Small Banks	**0.007***	0.008	0.001	0.003	-0.0008	0.0007	**-0.727*** **	**-0.909*** **	**-1.237*** **	**-0.864*** **	**-0.504** **	**-0.368*** **
	(0.098)	(0.254)	(0.676)	(0.464)	(0.893)	(0.910)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.010)**	**(0.005)**
Domestic Banks	0.002	-0.008	-0.0005	**0.006***	**0.010** **	0.009	**0.388*** **	0.082	**0.387*** **	**0.414***	**0.687*** **	**0.521*** **
	(0.502)	(0.141)	(0.886)	**(0.086)**	**(0.042)**	(0.105)	**(0.001)**	(0.519)	**(0.008)**	**(0.051)**	**(0.000)**	**(0.000)**
Islamic Banks	**-0.024*** **	-0.009	**-0.024** **	**-0.031*** **	-0.016	**-0.025*** **	**-0.508** **	0.174	-0.291	-0.050	**-0.940***	**-1.489*** **
	(0.002)	(0.584)	**(0.015)**	**(0.021)**	(0.255)	**(0.001)**	**(0.035)**	(0.606)	(0.496)	(0.935)	**(0.056)**	**(0.000)**
Net effect of the PCR	n.a	n.a	n.a	n.a	-0.013	-0.029	n.a	-0.302	n.a	n.a	n.a	n.a
Threshold of PCR	n.a	n.a	n.a	n.a	3.454	4.666	n.a	3.156	n.a	n.a	n.a	n.a
Pseudo R^2/R^2	0.230	0.157	0.173	0.161	0.141	0.133	0.209	0.083	0.123	0.156	0.111	0.114
Fisher	**15.79*** **						**24.03*** **					
Observations	573	573	573	573	573	573	573	573	573	573	573	573

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. 2SLS: Two Stage Least Squares. R^2 (Pseudo R^2) for OLS (Quantile Regressions). Lower quantiles (e.g., Q 0.1) signify nations where financial access is least. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of market power. Mean value of IVPCR is 2.211. Range of IVPCR: 0.143 to 56.596.

Table 3: Financial Access Effects of PCB with Market Power (IV QR)

	Dependent variable: Financial Access											
	Loan Price Effects						Loan Quantity Effects					
	2SLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**2SLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	**0.092*** **	**0.071*** **	**0.073*** **	**0.077*** **	**0.125*** **	**0.139*** **	**3.901*** **	**2.447*** **	**3.261*** **	**3.620*** **	**4.264*** **	**5.894*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Market Power (IV)	0.0002	-0.006	0.0006	0.004	**-0.042*** **	**-0.037*** **	**-1.099*** **	**-1.315*** **	**-1.213*** **	**-1.013*** **	**-0.605*** **	**-0.947*** **
	(0.980)	(0.339)	(0.929)	(0.378)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.002)**	**(0.001)**	**(0.000)**
PCB (IV)	**0.002*** **	**0.002*** **	**0.002** **	0.001	0.0006	**0.002* **	**-0.261*** **	**-0.172*** **	**-0.206*** **	**-0.363*** **	**-0.240*** **	**-0.270*** **
	(0.001)	**(0.007)**	**(0.016)**	(0.158)	(0.729)	**(0.069)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
PCB(IV)*Market Power(IV)	**-0.003*** **	**-0.003* **	**-0.004** **	-0.002	-0.0008	**-0.003* **	**0.453*** **	**0.316*** **	**0.362*** **	**0.621*** **	**0.419*** **	**0.465*** **
	(0.004)	**(0.056)**	**(0.041)**	(0.240)	(0.788)	**(0.072)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
GDPpcg	**-0.0008** **	**-0.001** **	**-0.0008* **	**-0.0008** **	0.00009	0.0002	0.001	0.017	0.008	-0.004	-0.016	-0.018*
	(0.047)	**(0.038)**	**(0.094)**	**(0.048)**	(0.873)	(0.633)	(0.900)	(0.126)	(0.539)	(0.854)	(0.359)	(0.086)
Inflation	**0.001*** **	0.0007	**0.002*** **	**0.002*** **	**0.002*** **	**0.003*** **	-0.007	0.001	0.004	-0.015	-0.005	0.003
	(0.000)	(0.166)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.326)	(0.889)	(0.606)	(0.286)	(0.551)	(0.626)
Pop. Density	**0.00003** **	**0.00007*** **	**0.00003** **	**0.00004*** **	0.00002	0.000001	**-0.0006* **	-0.0003	-0.0001	-0.0005	-0.0007	-0.0004
	(0.012)	**(0.001)**	**(0.020)**	**(0.002)**	(0.221)	(0.917)	**(0.056)**	(0.263)	(0.689)	(0.485)	(0.201)	(0.374)
Deposit/Assets	0.003	-0.009	0.006	0.007	0.006	0.001	**2.438*** **	**1.489*** **	**1.947*** **	**2.894*** **	**2.624*** **	**1.107*** **
	(0.694)	(0.421)	(0.509)	(0.341)	(0.594)	(0.930)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Bank Branches	**-0.002*** **	**-0.003*** **	**-0.002*** **	**-0.002*** **	**-0.001*** **	**-0.001*** **	**-0.052*** **	0.002	**-0.031*** **	**-0.055*** **	**-0.069*** **	**-0.064*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.004)**	**(0.002)**	**(0.000)**	(0.717)	**(0.000)**	**(0.001)**	**(0.000)**	**(0.000)**
Small Banks	0.005	**0.015** **	0.0001	0.002	0.002	0.009	**0.742*** **	**-0.547*** **	**-1.124*** **	**-0.636*** **	**-0.556*** **	**-0.451*** **
	(0.196)	**(0.010)**	(0.971)	(0.542)	(0.673)	(0.125)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.009)**	**(0.001)**	**(0.001)**
Domestic Banks	-0.0006	-0.007	0.00007	0.003	0.004	0.008	**0.350*** **	0.174	**0.455*** **	**0.418** **	**0.489*** **	**0.493*** **
	(0.846)	(0.137)	(0.985)	(0.359)	(0.393)	(0.139)	**(0.003)**	(0.174)	**(0.000)**	**(0.045)**	**(0.001)**	**(0.000)**
Islamic Banks	**-0.019** **	-0.001	**-0.023** **	**-0.025** **	-0.018	**-0.033** **	-0.309	0.462	-0.228	0.186	-0.531	**-1.100*** **
	(0.011)	(0.900)	**(0.011)**	**(0.010)**	(0.244)	**(0.015)**	(0.223)	(0.164)	(0.518)	(0.756)	(0.222)	**(0.002)**
Net effect of the PCB	n.a	n.a	n.a	n.a	n.a	-0.059	2.353	1.093	1.545	3.719	2.588	2.596
Threshold of PCB	n.a	n.a	n.a	n.a	n.a	Synergy	2.426	4.161	3.350	1.631	1.443	2.036
Pseudo R^2/R^2	0.207	0.184	0.162	0.142	0.122	0.125	0.254	0.117	0.147	0.186	0.146	0.129
Fisher	**10.47*** **						**30.87*** **					
Observations	572	572	572	572	572	572	572	572	572	572	572	572

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. 2SLS: Two Stage Least Squares. R^2 (Pseudo R^2) for OLS (Quantile Regressions). Lower quantiles (e.g., Q 0.1) signify nations where financial access is least. na: not applicable due to the insignificance of marginal effects and/or unconditional effect of market power. Mean value of IVPCB is 7.621. Range of IVPCB is 0.359 to 63.894. Synergy implies that both the conditional and unconditional effects of market power have the same sign.

5. Conclusions and future research directions

This study has investigated the role of information sharing offices (public credit registries and private credit bureaus) in reducing market power for financial access in the African banking industry. The empirical evidence is based on a panel of 162 banks from 42 countries for the period 2001-2011. Three simultaneity-robust empirical strategies are employed, namely: Two Stage Least Squares in order to account for simultaneity and the unobserved heterogeneity; Generalised Method of Moments (GMM) to control for simultaneity and time-invariant omitted variables and Instrumental Variable (IV) Quantile regressions to account for simultaneity and initial levels of financial access.

Our analysis based on the GMM estimation establishes the following results: Firstly, the unconditional (marginal or conditional) effect of using private credit bureaus to influence market power to increase loan quantity is negative (positive) and a corresponding threshold of 18.40 percent coverage in private credit bureaus is required to reverse the negative unconditional effect of market power. Secondly, on the role of public credit registries in market power for loan quantity, the marginal effects, net effects and thresholds are respectively 0.030, -0.037 and 3.30. This implies that a threshold of 3.30% coverage in public credit registries is required for public credit registries to reverse the negative effect of market power on loan quantity.

Our analysis based on the Quantile Regressions establishes the following results: In terms of the role of public credit registries in reducing market power for financial access; net effects are negative in the top quintiles of the loan price distribution and marginal effects are negative in the 0.10^{th} quintile and top quintiles of the loan quantity distributions, with a corresponding threshold of 3.156% coverage in the 10^{th} quintile. In terms of the relevance of private credit bureaus, marginal effects from the interaction are negative in the bottom quintiles and the 0.90^{th} quintile of the loan price distribution. With regards to the incidence on loan quantity, there are consistently negative unconditional impacts from market power; positive marginal or conditional effects from the interaction between market power and private credit bureaus; positive net effects and thresholds that are within range and which vary from 1.443% coverage (at the 0.75^{th} quintile) to 4.161 % coverage (at the 0.10^{th} quintile).

Results broadly show that information sharing offices are for the most part playing their theoretical role of reducing market power in order to enhance financial access in the African banking industry. Our findings further clarify those of Boateng et al. (2016), who have concluded that information sharing offices have not significantly reduced market power

in the African banking industry. Hence, we have demonstrated in this extension that an indirect assessment with financial access as the outcome variable is more likely to produce desired results on the nexus between information sharing offices and market power.

This inquiry is not directly comparable with other studies because of the scarce literature on market power in Africa. However, it does provide underpinnings from which future research can build to improve extant literature on the field. Assessing how information sharing offices interact with other information sharing mechanisms/channels in order to enhance financial access is an interesting future research direction.

Appendices

Appendix 1: Summary of hypothesised signs

	Variables	Expected sign on loan price	Expected sign on loan quantity
Bank-oriented features	Deposit/Asset ratio	+	+
	Bank Branches	-	+
Market-related characteristics	GDP per capita growth	Uncertain	+
	Population density	+	+
	Inflation	+	-
Characteristics of the unobserved heterogeneity	Small versus (vs). Big banks	Uncertain	Uncertain
	domestic vs. foreign banks	Uncertain	Uncertain
	Islamic vs. non-Islamic banks	Uncertain	Uncertain

Appendix 2: Variable Definitions

Variables	Signs	Variable Definitions	Sources
Market Power	Lerner index	The ratio of the 'difference between the Marginal Cost and Price' on the Price	Authors' calculation and BankScope
Loan Quantity	Quantity	Logarithm of Loans Quantity	BankScope
Price (charged on Loans or Quantity)	Price	(Gross Interest and Dividend income +Total Non-Interest Operating Income)/Total Assets	BankScope
Public credit registries	PCR	Public credit registry coverage (% of adults)	WDI (World Bank)
Private credit bureaus	PCB	Private credit bureaus coverage (% of adults)	WDI (World Bank)
GDP per capita	GDP	GDP per capita growth (annual %)	WDI (World Bank)
Inflation	Infl.	Consumer Price Index (annual %)	WDI (World Bank)
Populaton density	Pop.	People per square kilometers of land area	WDI (World Bank)
Deposits/Assets	D/A	Deposits on Total Assets	BankScope
Bank Branches	Bbrchs	Number of Bank Branches (Commercial bank branches per 100 000 adults)	BankScope
Small Banks	Ssize	Ratio of Bank Assets to Total Assets (Assets in all Banks for a given period) ≤ 0.50	Authors' calculation and BankScope
Large Banks	Lsize	Ratio of Bank Assets to Total Assets (Assets in all Banks for a given period)>0.50	Authors' calculation and BankScope
Domestic/Foreign banks	Dom/Foreign	Domestic/Foreign banks based on qualitative information: creation date, headquarters, government/private ownership, % of foreign ownership, year of foreign/domestic ownership…etc	Authors' qualitative content analysis.
Islamic/Non-Islamic	Islam/NonIsl.	Islamic/Non-Islamic banks based on financial statement characteristics (trading in derivatives and interest on loan payments…etc)	Authors' qualitative content analysis; Beck et al. (2010); Ali (2012).

WDI: World Development Indicators. GDP: Gross Domestic Product. The following are dummy variables: Ssize, Lsize, Dom/Foreign and Islam/NonIsl.

Appendix 3: Summary Statistics

		Mean	S.D	Minimum	Maximum	Observations
Market Power	Lerner	0.513	0.587	0.032	0.969	893
Dependent variables	Price of Loans	0.338	0.929	0.000	25.931	1045
	Quantity of Loans (ln)	3.747	1.342	-0.045	6.438	1091
Information sharing	Public credit registries	2.056	6.206	0.000	49.800	1240
	Private credit bureaus	7.496	18.232	0.000	64.800	1235
Market variables	GDP per capita growth	13.912	96.707	-15.306	926.61	1782
	Inflation	10.239	22.695	-9.823	325.00	1749
	Population density	81.098	106.06	2.085	633.52	1782
Bank level variables	Deposits/Assets	0.664	0.198	0.000	1.154	1052
	Bank Branches	6.112	6.158	0.383	37.209	1129
Dummy variables	Small Size	0.804	0.396	0.000	1.000	1255
	Large Size	0.195	0.396	0.000	1.000	1255
	Domestic	0.753	0.431	0.000	1.000	1782
	Foreign	0.246	0.431	0.000	1.000	1782
	Islamic	0.037	0.188	0.000	1.000	1782
	Non-Islamic	0.962	0.188	0.000	1.000	1782

Ln: Logarithm. GDP: Gross Domestic Product. S.D: Standard Deviation. GDP: Gross Domestic Product.

Appendix 4: Correlation Matrix

Market-Level Controls			Bank-Level Controls				Dummy-Controls						Info. Sharing		Lerner	
GDP	Infl.	Pop.	D/A	Bbrchs	Price	Quantity	Ssize	Lsize	Dom.	Foreign	Islam	NonIsl.	PCR	PCB		
1.000	0.136	0.007	-0.008	-0.068	-0.014	-0.026	-0.0002	0.0002	0.034	-0.034	0.0001	-0.0001	0.019	-0.163	-0.016	GDP
	1.000	-0.028	0.037	-0.236	0.256	-0.009	0.046	-0.046	0.028	-0.028	-0.050	0.050	-0.205	-0.178	-0.062	Inf.
		1.000	0.112	0.410	-0.029	-0.125	-0.098	0.098	-0.045	0.045	-0.088	0.088	0.546	-0.233	0.035	Pop.
			1.000	-0.041	0.080	0.306	-0.041	0.041	-0.062	0.062	-0.210	0.210	-0.038	-0.083	0.021	D/A
				1.000	-0.266	-0.227	-0.078	0.078	0.135	-0.135	-0.051	0.051	0.602	0.139	0.109	Bbrchs
					1.000	-0.075	0.094	-0.094	0.016	-0.016	-0.097	0.097	-0.342	0.094	0.082	Price
						1.000	-0.171	0.171	0.052	-0.052	-0.067	0.067	-0.096	0.007	-0.038	Quantity
							1.000	-1.000	0.026	-0.026	-0.020	0.020	-0.084	0.080	-0.056	Ssize
								1.000	-0.026	0.026	0.020	-0.020	0.084	-0.080	0.056	Lsize
									1.000	-1.000	0.089	-0.089	0.010	0.187	0.147	Dom.
										1.000	-0.089	0.089	-0.010	-0.187	-0.147	Foreign
											1.000	-1.000	-0.014	-0.071	0.006	Islam
												1.000	0.014	0.071	-0.006	NonIsl.
													1.000	-0.151	0.051	PCR
														1000	0.091	PCB
															1.000	Lerner

Info: Information. PCB: Private Credit Bureaus. PCR: Public credit registries. GDP: GDP per capita growth. Infl: Inflation. Pop: Population growth. D/A: Deposit on Total Assets. Bbrchs: Bank branches. Szize: Small banks. Lsize: Large banks. Domestic: Domestic banks. Foreign: Foreign banks. Islam: Islamic banks. NonIsl: Non-Islamic banks. Price: Price of Loans. Quantity: Quantity of Loans. Lerner: Market Power.

References

Aghion, P., & Bolton, P. (1992). "An incomplete contracts approach to corporate bankruptcy", *Review of Economic Studies*, 59(3), pp. 473-494.

Ahokpossi, C., (2013). "Determinants of bank interest margins in Sub-Saharan Africa", *IMF Working Paper* No. 13/34, Washington.

Aigner, D. J., & Chu, S. F., (1968). "On Estimating the Industry Production Function", *American Economic Review*, 58(4), pp. 826-839.

Ali, S. S., (2012). "Islamic Banking in the MENA Region", Islamic Research and Training Institute (IRTI), *Working Paper Series* No. 1433-01, Jeddah.

Arellano, M., & Bond, S., (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations" *The Review of Economic Studies*, 58(2), pp. 277-297.

Arellano, M., & Bover, O., (1995). "Another look at the instrumental variable estimation of error components models", *Journal of Econometrics*, 68(1), pp. 29-52.

Ariss, R. T., (2010). "On the Implications of Market Power in Banking: Evidence from Developing Countries", *Journal of Banking and Finance*, 34(4), pp. 765-775.

Ashraf, Q., & Galor, O., (2013). "The Out of Africa Hypothesis, Human Genetic Diversity, and Comparative Economic Development". *American Economic Review*, 103(1), pp. 1-46.

Asongu, S. A., (2014). "Correcting Inflation with Financial Dynamic Fundamentals: Which Adjustments Matter in Africa?", *Journal of African Business*, 15(1), pp. 64-73.

Asongu, S. A., & Anyanwu, J. C., & Tchamyou, S. V., (2016b). "Information sharing and conditional financial development in Africa", *Information Technology for Development* (Revised and resubmitted).

Asongu, S. A, & De Moor, L., (2016). "Financial Globalisation Dynamic Thresholds for Financial Development: Evidence from Africa", *European Journal of Development Research*, DOI: 10.1057%2Fejdr.2016.10.

Asongu, S. A., & Le Roux, S., (2016). "Reducing Information Asymmetry with ICT: A critical review of loan price and quantity effects in Africa", *African Governance and Development Institute Working Paper* No. 16/024, Yaoundé.

Asongu, S. A, & Nwachukwu, J. C., (2016a). "The Mobile Phone in the Diffusion of Knowledge for Institutional Quality in Sub Saharan Africa", *World Development*, 86(October), pp. 133-147.

Asongu, S. A, & Nwachukwu, J. C., (2016b). "Foreign aid and governance in Africa", *International Review of Applied Economics*, 30(1), pp. 69-88.

Asongu, S. A., & Nwachukwu, J. C., (2016c). "The Role of Governance in Mobile Phones for Inclusive Human Development in Sub-Saharan Africa", *Technovation*, 55-56 (September-October), pp. 1-13.

Asongu, S. A., Nwachukwu, J., & Tchamyou, S. V., (2016a). "Information Asymmetry and Financial Development Dynamics in Africa", *Review of Development Finance*, DOI: 10.1016/j.rdf.2016.09.001.

Baltagi, B. H., (2008). "Forecasting with panel data", *Journal of Forecasting*, 27(2), pp. 153-173.

Barth, J., Lin, C., Lin, P., & Song, F., (2009). "Corruption in bank lending to firms: cross-country micro evidence on the beneficial role of competition and information sharing", *Journal of Financial Economics*, 99(3), pp. 361-368.

Battese, G. E., & Coelli, T. J., (1992). "Frontier Production Function, Technical Efficiency and Panel Data with Application to Paddy Farmers in India", *Journal of Productivity Analysis*, 3(1), pp. 153-169.

Batuo, M. E., & Kupukile, M., (2010), "How can economic and political liberalization improve financial development in African countries?", *Journal of Financial Economic Policy*, 2(1), pp. 35-59.

Beck, T., Demirgüç-Kunt, A., & Levine, R., (2003). "Law and finance: why does legal origin matter?", *Journal of Comparative Economics*, 31(4), pp. 653-675.

Beck, T., Demirguc-Kunt, A., & Merrouche, O., (2010). "Islamic vs. Conventional Banking: Business Model, Efficiency and Stability", *World Bank Policy Research Working Paper* No. 5446, Washington.

Beck, T., & Hesse, H., (2006). "Bank efficiency, ownership and market structure: why are interest spreads so high in Uganda?", *Policy Research Working Paper Series* No. 4027, The World Bank, Washington.

Bergemanny, D., Heumannz, T., & Morris, S., (2015). "Information and Market Power", Department of Economics, Yale University, New Haven, https://economics.wustl.edu/files/economics/imce/bergemann_paper.pdf (Accessed: 16/08/2016).

Berger, A. N., Hanweck, T. N., & Humphrey, D. B., (1987). "Competitive viability in banking: Scale, scope and product mix economies", *Journal of Monetary Economics*, 20(3), pp. 501-520.

Billger, S. M., & Goel, R. K., (2009). "Do existing corruption levels matter in controlling corruption? Cross-country quantile regression estimates", *Journal of Development Economics*, 90(2), pp. 299-305.

Blundell, R., & Bond, S., (1998). "Initial conditions and moment restrictions in dynamic panel data models" *Journal of Econometrics*, 87(1), pp. 115-143.

Boateng, A., Asongu, S. A., Akamavi, R., & Tchamyou, V. S., (2016). "Information Asymmetry and Market Power in the African Banking Industry", *African Governance and Development Institute Working Paper* No. 16/032, Yaoundé.

Bond, S., Hoeffler, A., & Tample, J. (2001). "GMM Estimation of Empirical Growth Models", University of Oxford.

Brown, M., & Zehnder, C., (2010). "The emergence of information sharing in credit markets". *Journal of Financial Intermediation*, *19*(2), pp. 255-278.

Carson, R. T., & Sun, Y. (2007). "The Tobit model with a non-zero threshold", *Econometrics Journal*, 10(3), pp. 488-502.

Christensen, L. R., Jorgenson, D. W., & Lau, L. J., (1971). "Transcendental Logarithmic Production Frontiers", *Review of Economics and Statistics*, 55(1), pp. 28-45.

Clark, J., (1996). "Economic cost, scale efficiency and competitive viability in banking", *Journal of Money, Credit and Banking*, 28(3), pp. 342-364.

Coccorese, P., & Pellecchia, A., (2010). "Testing the 'Quiet Life' Hypothesis in the Italian Banking Industry", *Economic Notes by Banca dei Paschi di Siena SpA*, 39(3), pp. 173-202.

Cummins, J. (2000). Language, power and pedagogy: Bilingual children in the crossfire. Clevedon, England: Multilingual Matters.

Dewan, S., & Ramaprasad, J., (2014). "Social media, traditional media and music sales", *MIS Quarterly*, 38(1), pp. 101-128.

Djankov, S., McLiesh, C., & Shleifer, A. (2007). "Private credit in 129 countries". *Journal of Financial Economics*, *84*(2), pp.299-329.

Farrell, M. J., (1957). "The Measurement of Productive Efficiency", *Journal of Royal Statistics Society*, 120(3), pp. 253-290.

Fouda, O. J. P., (2009), "The excess liquidity of banks in Franc zone: how to explain the paradox in the CEMAC", *Revue Africaine de l'Integration*, 3(2), pp. 1-56.

Hart, O., & Moore, J., (1994). "A theory of debt based on the inalienability of human capital", *Quarterly Journal of Economics*, 109(4), pp. 841-879.

Jaffee, D., &Russel, T. (1976). "Imperfect information, uncertainty and credit rationing", Quarterly Journal of Economics, 90(4), pp. 651-666.

Jappelli, T., & Pagano, M., (2002). "Information sharing, lending and default: Cross-country evidence", *Journal of Banking & Finance*, 26(10), pp. 2017-2045.

Karray, S. C., & Chichti, J. E., (2013). "Bank size and efficiency in developing countries: intermediation approach versus value added approach and impact of non-traditional activities", *Asian Economic and Financial Review*, 3(5), pp. 593-613.

Kelsey D & le Roux, S., (2016), "Dragon Slaying with Ambiguity: Theory and Experiments", *Journal of Public Economic Theory*. doi: 10.1111/jpet.12185.

Koetter, M., Kolari, J. W., & Spierduk, L., (2008). "Efficient Competition ? Testing the 'Quiet Life' of U.S Banks with Adjusted Lerner Indices", Proceedings of the 44th 'Bank Structure and Competition' Conference, Federal Reserve Bank of Chicago.

Koetter, M., & Vins, O., (2008). "The Quiet Life Hypothesis in Banking-Evidence from German Savings Banks", Department of Finance, Goethe University, *Working Paper Series: Finance and Accounting* No. 190, Frankfurt.

Koenker, R., & Bassett, Jr. G., (1978). "Regression quantiles", *Econometrica*, 46(1), pp. 33-50.

Koenker, R., & Hallock, F. K., (2001). "Quantile regression", *Journal of Economic Perspectives*, 15(4), pp. 143-156.

Kumbhakar, S. C., & Lovell, C. A. K., (2000). *Stochastic Frontier Analysis*, Cambridge MA: Cambridge University Press.

Le Roux, S., & Kelsey, D., (2016). "Strategic Ambiguity and Decision-making An Experimental Study", Department of Economics, Oxford Brookes University.

Lin, C., Ma, Y., Malatesta, P., & Xuan, Y. (2011). "Ownership structure and the cost of corporate borrowing". *Journal of Financial Economics*, *100*(1), pp.1-23.

Love, I., & Zicchino, L., (2006). "Financial Development and Dynamic Investment Behaviour: Evidence from Panel VAR" .*The Quarterly Review of Economics and Finance*, 46(2), pp. 190-210.

Luoto, J., McIntosh, C., & Wydick, B. (2007). "Credit information systems in less developed countries: A test with microfinance in Guatemala". *Economic Development and Cultural Change*, *55*(2), pp.313-334.

Maudos, J., & Fernandez de Guevara, J. (2007). "The cost of market power in banking social welfare loss vs. cost efficiency", *Journal of Banking and Finance*, 31(7), pp. 2103-2125.

Mester, L. J., (1992). "Traditional and nontraditional banking: An information-theoretic approach", *Journal of Banking and Finance*, 16(3), pp. 545-566.

Mitchell, K., & Onvural, N. M., (1996). "Economies of scale and scope at large commercial banks: Evidence from the Fourier flexible form", *Journal of Money, Credit and Banking*, 28(2), pp. 178-199.

Neven, D., & Roller, L-H (1999). "An aggregate structural model of competition in the European banking industry", *International Journal of Industrial Organisation*, 17(7), pp. 1059-1074.

Ngigi, G., (2013a, July). "CBK puts big banks on the spot over high interest rates", *BUSINESS DAILY*, http://www.businessdailyafrica.com/CBK-puts-big-banks-on-the-spot-over-high-interest-rates/-/539552/1908098/-/7t6949z/-/index.html (Accessed: 20/06/2016).

Ngigi, G., (2013b, April). "High cost of loans favours big banks over small lenders", *BUSINESS DAILY*, http://www.businessdailyafrica.com/High-cost-of-loans-favours-big-banks-over-small-lenders/-/539552/1744902/-/awkd24/-/index.html (Accessed: 20/06/2016).

Noulas, A. G., Ray, S. C., & Miller, S. M., (1990). "Returns to scale and input substitution for large banks", *Journal of Money, Credit and Banking*, 22(1), pp. 94-108.

Okada, K., & Samreth, S.,(2012). "The effect of foreign aid on corruption: A quantile regression approach", *Economic Letters*, 11(2), pp. 240-243.

Pagano, M., & Jappelli, T., (1993). "Information sharing in credit markets", *Journal of Finance*, 43(5), pp. 1693-1718.

Roller, L-H., & Waverman, L. (2001). "Telecommunications infrastructure and economic development: a simultaneous approach", *American Economic Review*, 91(4), pp. 909-923.

Roodman, D., (2009a). "A Note on the Theme of Too Many Instruments", *Oxford Bulletin of Economics and Statistics*, 71(1), pp. 135-158.

Roodman, D., (2009b). "How to do xtabond2: An introduction to difference and system GMM in Stata", *Stata Journal*, 9(1), pp. 86-136.

Saxegaard, M., (2006), "Excess liquidity and effectiveness of monetary policy: evidence from sub-Saharan Africa", *IMF Working Paper* No. 06/115, Washington.

Stiglitz, J., &Weiss, A. (1981). "Credit rationing in market with imperfect information", *American Economic Review*, 71(3), pp. 393-410.

Townsend, R. (1979). "Optimal contracts and competitive markets with costly state verification", *Journal of Economic Theory*, 21(2), pp. 265-293.

Tchamyou, S. V., & Asongu, S. A., (2016). "Information Sharing and Financial Sector Development in Africa", *Journal of African Business*. DOI: 10.1080/15228916.2016.1216233.

Tobin, J. (1958). "Estimation of relationships for limited dependent variables". *Econometrica* 26(1), pp. 24-36.

Triki, T., & Gajigo, O., (2014). "Credit Bureaus and Registries and Access to Finance: New Evidence from 42 African Countries", *Journal of African Development*, 16(2), pp. 73-101.