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Information Asymmetry and Market Power in the African Banking Industry

Abstract

This study investigates the role of information sharing offices and its association with market power in the African banking industry based on a panel of 162 banks from 42 countries for the period 2001-2011. Five simultaneity-robust estimation techniques namely: Two Stage Least Squares; Instrumental Fixed effects to control for the unobserved heterogeneity; Instrumental Tobit regressions to control for the limited range in the dependent variable; Generalised Method of Moments (GMM) to control for persistence in market power and Instrumental Quantile Regressions (QR) to account for initial levels of market power are employed.

The following findings have been established from non-interactive regressions. First, the effects of information sharing offices are significant in Two Stage Least Squares, with a positive effect from private credit bureaus. Second, the GMM results suggest that, public credit registries increase market power. Third, from Quintile Regressions, private credit bureaus consistently increase market power throughout the conditional distributions of market power. Given that the above findings are contrary to theoretical postulations, we extended the analytical framework with interactive regressions in order to assess whether the anticipated effects can be established if information sharing offices are increased. Our extended findings show that: (i) negative net effect from public credit registries on market power in GMM regressions and; (ii) negative net impacts from public credit registries on market power in the 0.25^{th} and 0.50^{th} quartiles of market power.

JEL Classification: G20; G29; L96; O40; O55

Keywords: Information sharing; Market power; Information asymmetry, Africa

1. Introduction

The issue of bank efficiency and market power has been at the centre of economic research and analysis over the past three decades (see Townsend, 1979; Stiglitz & Weiss, 1981; Aghion & Bolton, 1992; Maudo & Fernandez de Guevara, 2007). The interest stems from the fact that market power may lead to inefficiency in the banking system, resulting in a net loss of social and economic welfare in the country (Maudo & Fernandez de Guevara, 2007). Prior research evidence indicates that market power translates into a higher costs of financial intermediation, lower volume of savings and investment and consequently lower economic growth (Stiglitz & Weiss, 1981; Djankov et al., 2007). More specifically, both theoretical

arguments and empirical evidence highlight that banks with market power tend to hinder firm growth because such banks can extract rents from existing lending relationship (Petersen & Rajan, 1995; Marquez, 2002; Canales & Nanda, 2012).

Aware of the negative effects of market power on economic growth, governments and policy makers in both developed and developing countries have embarked on policies aimed at enhancing competition and credit expansion (Buyukkarabacak and Valev, 2012). Prominent among the reform policies in the developing country context include: (i) the liberalisation of the banking sector under the auspices of the International Monetary Fund/World Bank; and (ii) the introduction of credit information systems (Luoto, McIntosh & Wydick, 2007; Triki & Gajigo, 2014; Asongu et al., 2016; Tchamyou & Asongu, 2017). However, while the past decade has witnessed growth of information sharing offices in many sub-Saharan African countries, no study has systematically examined the effects of information sharing on market power (Ariss, 2010). The above is against the background that banking sector in sub-Saharan Africa is dominated by big players, such as Barclays bank, Standard Chartered bank, Société Générale and BNP Paribas, which confers market power on these banks. More importantly, market power may be particularly problematic in sub-Saharan Africa because of lack of transparency in corporate reporting, weak company law, under-development of institutions and severe information asymmetries between lenders and borrowers (see Boateng and Abdulrahman, 2012). Theory therefore suggests that, in countries where weak company laws and creditor rights are present, the establishment of information sharing offices would not only reduce the market power of banks and increase competition but would also improve credit allocation.

Conversely, it may be argued that, if market power is reduced due to increased competition resulting in information sharing, banks incentives to generate and share

information may diminish (Marquez, 2002), thereby leading to resource misallocation because banks may generate insufficient information to make better judgement on credit decisions (Dell'Ariccia & Marquez, 2004). Petersen & Rajan (1995) echo similar views and point out that, increased in competition between banks due to information sharing may reduce credit availability, especially for new businesses. Petersen & Rajan (1995) reinforce their argument by pointing out that banks with market power are in a better position to carry out inter-temporal cross-subsidisation in lending relationships, and hence they are more likely to lend to risky young firms. The above arguments suggest that the impact of increased competition due to information sharing on market power and credit market in general is ambiguous. To Zaruskie (2006), an increase in competition because of information sharing may cut either way. The ambiguity surrounding the relationship between information sharing, market power despite the massive financial liberalization in Africa calls for investigation in order to increase our understanding of the role of information sharing offices and how they impact on market power.

In this paper, we attempt to shed lights on the effect of information sharing offices on the market power in an environment where company laws, creditor rights and institutions appear weak. More specifically, we analyse the effects of credit information offices on market power based on 162 banks from 42 sub-Saharan African countries over the period of 2001-2011. This study builds on this literature by investigating the relationship between information sharing offices and market power in African countries. The study contributes to the growing empirical literature on the role of information sharing in financial market development in an environment where credit rights, company laws and institutions are weak. The findings that information sharing offices exert insignificant effect on market power imply that information sharing offices are not having the desire effect of the reducing market power in the African banking industry. Therefore policy makers and governments should take steps

improve to upgrade the necessary infrastructure to facilitate the collection of accurate data and enhance efficient management and coordination of these office to improve credit allocation which are important for entrepreneurial activities and economic growth.

The rest of the study is organised as follows. The next section reviews briefly the effects of information sharing on credit market. Section 3 covers the data and methodology while the empirical results and discussion are provided in Section 4. Section 5 concludes with implications and future research directions.

2. Relevant Literature

2.1 Effects of information sharing on credit markets

Over the past three decades, a number of researchers have widely documented that most credit market failures are attributed to information asymmetries between lenders and borrowers (Besanko & Thakor, 1987; Stiglitz & Weiss, 1981; Dell'Ariccia & Marquez, 2006). To alleviate information asymmetries, the establishment of credit information registers is becoming widespread in many developing and emerging countries (Djankov et al., 2007; Brown, Jappelli & Pagano, 2009). It is thus argued that, information sharing offices and credit registries provide an impetus for credit expansion, and arguably constitute an important determinant of credit market competition and profitability (Pagano and Jappelli, 1993; Padilla and Pagano, 2000; Karapetyan & Stacescu, 2014). The following section reviews the effects of credit information sharing on credit markets.

At one end of the spectrum, it is argued that credit information sharing reduces moral hazard, information asymmetry, raises discipline on borrowers, fosters competition and consequently reduces bank market power. For example, scholars such as Padilla & Pagano (1997; 2000); Jappelli & Pagano (2002; 2006) and Bennardo et al. (2015) in their theoretical models contend that credit information sharing removes information differences across banks,

allowing them to make better lending decisions to all their borrowers. Thus the improved information leads to more lending and lower default rates. Similar studies by Klein (1992); and Karapetyan and Stacescu (2014) have rendered some support to above conclusion and indicated that borrowers are more likely to repay their debts because information about defaults are available to all lenders. As a result, the threat of higher interest rates in future or outright exclusion from the credit market provides a powerful disciplinary mechanism to encourage borrowers to pay their debts on time and in full. In short, both theoretical and empirical literature document that credit information sharing reduces information asymmetries, moral hazard, increases incentives for loan repayment, reduces over-borrowing and heightens competition and economic growth.

On the other hand, while there is an agreement on the beneficial effects of credit information sharing, recent studies point to the dark side of information sharing. For example, Jappelli and Pagano (2006) and Brown et al. (2007) contend that, despite the fact that information sharing reduce default probability of individual borrowers, credit information sharing may also lead to greater access of credit to riskier borrowers too. Thus, the disproportionately higher entry of risky borrowers alter adversely the composition of the pool of borrowers resulting in greater default rates on the aggregate level. Others such as Dell'Ariccia and Marquez (2006) found that credit information sharing contributes to a banking crisis. Moreover, Petersen and Rajan (1995) point out that information sharing exposes lenders to increased competition as they release private information about their existing clients and lose the informational advantage over competitors and the ability to extract rents. Scholars also contend that the introduction of credit registries and information sharing could substantially curtail banks' efforts to collect credit information. This is because the incumbent bank's investment in soft information gets wasted as some of the unlucky high-type borrowers identified are lost to outside banks. Karapetyan and Stacescu (2014) therefore

support the contention that when information is shared, the incumbent banks lose some of their advantages over their competitors. Hauswald and Marquez (2003) found that if competing bank's access to hard information improves, it erodes the rents derived by the incumbent bank. Consequently, Karapetyan and Stacescu (2014) and Vercammen (1995) argue that banks may still fight to keep their competitive advantage by acquiring more information of different nature that is not shared with information sharing offices. It is pertinent to point out that, the above arguments appears to support the power theories of credit put forward by Townsend (1979); Aghion & Bolton (1992), Hart & Moore (1994); and Stiglitz and Weiss (1981) which suggest that the power of creditors (market power) and information are two key determinants of credit decisions.

2.2 Information sharing and market power in developing countries

The introduction of information sharing offices in developing countries is a recent phenomenon. In the context of Africa, information sharing offices were introduced over the past decade in order to mitigate severe information asymmetry between borrowers and lenders in the banking industry (Lin, Ma, Malatesta & Xuan, 2011). According to Jappelli and Pagano (2002), the theoretical connection between market power and information sharing is based on the expectation that the latter renders the banking sector competitive. They report that information sharing offices increases interbank competition because informational rents previously enjoyed by big banks are reduced by information sharing offices. Accordingly, by mitigating market power and making credit markets contestable, information sharing offices play the role of market brokers by ensuring more competition for credit, efficiency in the allocation of capital and reduction of credit constraints. However, despite the perceived benefits of information sharing offices, recent stream of financial development literature in developing countries indicate that, large banks may continue to reap the benefits of the market

power due to the under-developed nature of credit information systems and the weaknesses inherent in coordinating information sharing among lenders. One such study is that of Luoto, McIntosh & Wydick (2007) which gives account of the growth in credit information systems in developing countries with specific reference to Guatemala.

In developing countries, a number of authors suggest that the size of the bank determines the interest rates charged on loans (see Beck & Hesse, 2006; Ahokpossi, 2013)[1]. In comparison to small banks, financial institutions with high market power are supposed to reduce their interest margins because of internal and external economies of scale. However, research evidence suggests that big banks with market power are rather inefficient (see Mitchell & Onvural, 1996; Karray & Chichti, 2013). Researchers point out that, instead of enhancing financial access, large banks use their market power to enjoy a 'quiet life' (see Mitchell & Onvural, 1996)[2]. This view maintains that big banks tend to use information sharing offices to augment their profit margins (Brown & Zehnder, 2010) instead of extending credit access. Others point to inefficiencies inherent in managing and coordinating the operations of large financial institutions resulting in considerable diseconomies of scale and poor performance leading to high interest rates charged to borrowers (Karray & Chichti, 2013; Mester, 1992; Noulas et al., 1990). The abuse of market power by the big banks has motivated a recent stream of African development literature on the role of information sharing offices (see Barth et al., 2009; Triki & Gajigo, 2014; Asongu et al., 2016; Tchamyou & Asongu, 2017), but these studies have focused on the relationship between information

[1] According to Beck and Hesse (2006, p.1), bank size substantially contributes to differences in interest rate spreads/margins in the banking sector. For example, in Kenya the high cost of loans is favourable to big banks compared to small lenders (see Ngigi, 2013a, b). Ahokpossi (2013, p. 1) has established that policies designed to promote competition and reduce market concentration would help lower interest margins in sub-Saharan Africa (SSA).

[2] The Quiet Life Hypothesis is a postulation that, banks with greater market power would invest less in pursuing intermediation efficiency. In other words, instead of tailoring the advantage of their favorable position to enable more borrowers to obtain loans at affordable prices, they would prefer to 'exploit their market power' for more gains or enjoy a 'quite life' (Coccorese & Pellecchia, 2010).

sharing offices and the indirect use of market power to improve financial access. It is important to balance this narrative with the view that financial access is not the only outcome of information sharing. Accordingly, the sharing of information can influence the credit quality (i.e. allocation efficiency) as well as the level of ex-post defaults.

3. Data and Methodology

3.1 Data

The study assesses a panel of 162 banks in 42 African countries with data from the World Bank Development Indicators and Bankscope for the period 2001-2011. The number of banks, countries and periodicity are driven by the lack of data availability. Information sharing data is only available from the year 2001. The choice of countries and banks is motivated by data availability constraints. Triki and Gajigo (2014) have recently adopted a similar dataset.

Following the study of Ariss (2010), the Lerner index is used as a measurement of market power[3]. The index measures the rate at which financial institutions set prices above marginal cost. Therefore, higher Lerner indices reflect greater market power. The procedure for computing the index is discussed in Section 3.2.1.

In accordance with Triki & Gajigo (2014) and Djankov, McLiesh & Shleifer (2007, p. 303), information sharing offices are measured with private credit bureaus (PCB) and public credit registries (PCR). This study's control variables include: (i) market-oriented

[3] While the choice of the Lerner index is consistent with the literature, it is also important to note that the cost of granting a loan is not easy to measure. Accordingly, whereas a proxy average can be constructed by incorporating various costs (overhead cost, operating cost and cost for drawing deposits), the quality of loans may be contingent on bank- and country-specific features. For instance, an estimated cost of funding may not reflect the marginal cost associated with a 'loan offer', essentially because in a 'loan offer' accounts for loan risks. In summary, given two banks with identical funding cost, a riskless loan logically entails less cost compared to a risky loan.

characteristics (*GDP per capita growth*, *inflation* and *population density*); (ii) bank-level features (*loan quantity, loan price, Bank branches and Deposits/Assets*) and (iii) the unobserved bank heterogeneity. Such heterogeneity is articulated in terms of bank: '*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 consistent with recent information sharing literature in the African banking industry (see Asongu & Le Roux, 2016).

Looking at the anticipated signs from bank-oriented features, the following can be expected. (1) We anticipate loan price to increase market power because high interest margins resulting from higher loan prices can be a reflection of abuse of power by big banks. (2) Growing loan quantity can indicate decreasing market power owing to the intense competition within the banking sector that drives-down prices while simultaneously augmenting loan quantity. We cannot establish with certainty the anticipate signs because increasing quantity of loans may as well be the outcome of a group of banks making decisions to influence the quantity of loans to be circulated within the banking sector. (3) The 'Deposit to asset ratio' can positively or negatively influence market power because it can increase the quantity of loans and price of loans at the same time. Accordingly, given that the main sources of bank financing are deposits, a higher proportion of deposits among liquid liabilities can increase the interest rate margin and quantity of loans at the same time. (4) While a growing number of 'bank branches' is an indication of banking sector competition, the corresponding growth in bank branches could also be the outcome of large banks increasing their outreach. Therefore, it is difficult to ascertain the direction of causality flowing from bank branches to market power.

The following are predicted as the expected signs from market-related characteristics. (1) While GDP per capita growth is employed to account for business cycle fluctuations, the

sign of its relationship with market power is difficult to establish because the effect depends on market expansion and dynamism. (2) It is very probable that the density of the population decreases the market power enjoyed by certain banks because it confers opportunities of investment in the banking sector. (3) Whereas high inflation could constrain some banks to quit the banking industry, stable/low inflation which is necessary for investment purposes could be an attraction for banks to set-up more bank branches across an economy. Accordingly, inflation is an important source of economic ambiguity and investors have been documented to be more inclined towards investment climates that are less ambiguous (see Kelsey & Le Roux, 2017).

It is not an easy task to establish expected signs from the dummy variables employed to account for the unobserved heterogeneity. (1) From logic and common sense, a growing number of small banks can decrease market power. (2) An increasing density in domestic banks can either positively or negatively affect market power because the impact depends *inter alia* on the concerns about inefficiency as well as issues about organisation and co-ordination. (3) The impact of compliance with *Sharia finance*' (Non-islamic vs. Islamic) is also not easy to establish because such an influence is contingent on *inter alia*: (i) organisational capacities of staff; (ii) dynamism and expansion of markets and (iii) constraints in fulfilling the requirements and needs of customers.

The definitions and sources of variables are provided in Appendix 1. Appendix 2 presents the summary statistics whereas the correlation matrix is disclosed in Appendix 3.

3.2 Methodology

3.2.1 Estimation of Market Power (Lerner Index)

The stochastic frontier model is employed in order to estimate the Lerner index which is the indicator of market power (see Battese & Coelli, 1992). Coccorese and Pellecchia

(2010) have argued that the model is better in comparison to other estimation techniques like approaches based on deterministic frontiers (see Aigner & Chu, 1968; Farrell, 1957). The selected empirical strategy accounts for the possibility that, beside the corporations' inefficiency, deviations between the observed output and the frontier output could derive from other factors like stochastic shocks and measurement errors.

Let us assume that for firm i at time t, production costs depend on input prices (W), output (Q), random error (v) and inefficiency (u).

If the inefficiency and random error terms are identically and independently distributed (iid), the logarithmic specification corresponding to the cost function can be presented as follows:

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

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

The translog cost function is used to model the cost. It consists of one output and three inputs. The function was first proposed by Christensen et al. (1971) and later extended to a multi-product framework by Brown et al. (1979). It has been widely applied in contemporary empirical literature (see Koetter & Vins, 2008; Coccorese & Pellecchia, 2010; Ariss, 2010).

The cost function is as follows:

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

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

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

In order to estimate the cost, one output and three inputs are specified. The total operating cost is appreciated with the following: price of capital, price of labor, inputs by the price of deposits, output by total assets and total operating cost measured with overheads[4]. The Lerner index is then computed from the marginal cost and price (see Eq. 4). Whereas the former is derived from the translog cost function output (see Eq. (3)), the latter represents the price charged by banks on their output (total assets) and it is computed as the ratio of total revenues (net noninterest income plus interest income) to total 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 charged by a bank on its output. Accordingly, in theory the Lerner index can vary between 0 (in case of perfect competition) and 1.

3.2. 2 Instrumentation and instrumental Fixed effects estimations

Five simultaneity-robust estimation techniques are employed, namely: (i) Two Stage Least Squares; (ii) Instrumental Variable (IV)[5] Fixed Effects to control for the unobserved heterogeneity; (iii) IV Tobit regressions to control for the limited range in the dependent

[4] The deposit price is calculated by dividing interest expenses by the sum of deposits, short term funding 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.

[5] Instrumental Variable and Instrumental are used interchangeably throughout the study.

variable; (iv) Generalised Method of Moments to control for persistence in market power and (v) IV Variable Quantile regressions to account for initial levels of market power. The employment of multiple estimation techniques is in accordance with data behaviour (Asongu & Nwachukwu, 2016).

The issue of endogeneity in the independent 'information sharing office' variables is tackled by instrumenting the corresponding public credit registries and private credit bureaus with their first lags. For instance, the procedure for instrumenting private credit bureaus is as follows in Eq. (5) below.

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

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

The instrumentation procedure in Eq. (5) consists of regressing private credit bureaus on their first lags, then saving the fitted values that are later used as the independent variable of interest in Two Stage Least Squares, Fixed effects, Tobit and Quantile Regression specifications. The instrumentation process which is replicated for public credit registries is Heteroscedasticity and Autocorrelation Consistent (HAC) in standard errors.

The Ordinary Least Squares (OLS) panel Fixed Effects (FE) models are presented respectively in Eq. (6) and Eq. (7) as follows:

$$L_{i,t} = \partial_0 + \partial_1 PCR_{i,t} + \partial_2 PCB_{i,t} + \sum_{h=1}^{10} \omega_h W_{h,i,t-\tau} + \varepsilon_{i,t} \tag{6}$$

$$L_{i,t} = \partial_0 + \partial_1 PCR_{i,t} + \partial_2 PCB_{i,t} + \sum_{h=1}^{7} \omega_h W_{h,i,t-\tau} + \eta_i + \varepsilon_{i,t} \quad , \tag{7}$$

where, $L_{i,t}$ is the Lerner index of bank i at period t, ∂_0 is a constant, *PCR* is public credit registries, PCB represents pubic credit bureaus, W is the vector of control variables (*ICT, loan price, loan quantity, GDP per capita growth, Inflation, Population density, Deposit/Assets, Bank Branches, Small banks, Domestic banks* and *Islamic banks*), η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term. The vector of control variables does not include dummy fixed effects (Small banks, Domestic banks and Islamic banks) because these are by definition incorporated into country-specific effects in the FE model.

3.2.3 Generalised method of moments: specification, identification and exclusion restrictions

There are four main reasons for adopting a GMM technique. First, the N>T (162>11) criterion that is essential for the application of the estimation approach is met given that the number of banks (or cross sections) is substantially higher than the number of time series in each cross section. Second, cross-country variations are not eliminated from the specifications. (3) The estimation approach has some bite on endogeneity because it accounts for simultaneity. Furthermore the use of time-invariant omitted variables also increases the control for endogeneity. (4) The *system* estimator corrects for biases in the *difference* estimator.

In accordance with Bond et al. (2001), the *system* GMM estimator proposed by Arellano and Bond (1991) and Blundell and Bond (1998) has better estimation properties when compared with the *difference* estimator proposed by Arellano and Bond (1991). Within the framework of this inquiry, we prefer the Roodman (2009ab) extension of Arellano and Bover (1995) because it has been documented to: (i) account for cross-sectional dependence and (ii) restrict over-identification or instrument proliferation (see Love & Zicchino, 2006; Baltagi, 2008). In essence, the technique adopts forward orthogonal deviations instead of first

differences. The adopted specification approach is *two-step* because it controls for heteroscedasticity. It is important to note that the *one-step* approach is homoscedasticity-consistent.

The following equations in level (8) and first difference (9) summarize the standard *system* GMM estimation procedure.

$$L_{i,t} = \sigma_0 + \sigma_1 L_{i,t-\tau} + \sigma_2 PCR_{i,t} + \sigma_3 PCB_{i,t} + \sum_{h=1}^{7} \delta_h W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (8)$$

$$\begin{aligned} L_{i,t} - L_{i,t-\tau} = {} & \sigma_1 (L_{i,t-\tau} - L_{i,t-2\tau}) + \sigma_2 (PCR_{i,t} - PCR_{i,t-\tau}) + \sigma_3 (PCB_{i,t} - PCB_{i,t-\tau}) \\ & + \sum_{h=1}^{7} \delta_h (W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + \varepsilon_{i,t-\tau} \end{aligned} , \quad (9)$$

where, τ represents the coefficient of auto-regression and ξ_t is the time-specific constant.

It is important to briefly engage exclusion and identification restrictions. As documented in recent literature, all explanatory variables are acknowledged as predetermined or suspected endogenous while only time-invariant variables are considered as strictly exogenous (see Asongu & Nwachukwu, 2016). This is essentially because it is not feasible for time-invariant variables (or years) to become endogenous in first-differences (see Roodman, 2009b). Hence, the process for treating *ivstyle* (years) is 'iv(years, eq(diff))' whereas the *gmmstyle* is used for predetermined variables.

Given the above insights, time-invariant omitted variables (which are considered to be strictly exogenous) influence the Lerner index exclusively via the predetermined indicators. Moreover, the statistical validity of the exclusion restriction is investigated with the Difference in Hansen Test (DHT) for the exogeneity of instruments. In essence, the null hypothesis of this test should not be rejected for the time-invariant omitted variables to explain the Lerner index exclusively via the endogenous explaining variables. Therefore, while in the standard instrumental variable (IV) approach, failure to reject the null hypothesis

of the Sargan Overidentifying Restrictions (OIR) test indicates that the instruments do not explain the outcome variable beyond the suspected endogenous variables (see Beck et al., 2003), with the GMM technique (based on forward orthogonal variations), the information criterion needed to investigate if time-invariant omitted variables are strictly exogenous is the DHT. Therefore, in the findings that are revealed in Section 4, this assumption of exclusion restriction is confirmed if the alternative hypothesis of the DHT corresponding to IV (year, eq(diff)) is rejected.

3.2.4 Instrumental Tobit regressions

The Lerner index theoretically is in the interval of 0 to 1. For this theoretical range, the Ordinary Least Squares (OLS) approach may not be appropriate for estimation. A double-censored Tobit model has been proposed by many authors to account for the limited range in the outcome variable (see Kumbhakar & Lovell, 2000; Coccorese & Pellecchia, 2010; Ariss, 2010). Moreover, if no observations are of either 0 or 1 are apparent (as it is the case with the Lerner index), estimations by a double-censored Tobit model is similar to estimating by a linear regression model because the two likelihood functions coincide (McDonald, 2009; Coccorese & Pellecchia, 2010).

The standard Tobit model (Tobin, 1958; Carsun & Sun, 2007) is as follows:

$$y_{i,t}^{*} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t} \ , \tag{10}$$

where $y_{i,t}^{*}$ is a latent response variable, $X_{i,t}$ is an observed $1 \times k$ vector of explanatory variables and $\varepsilon_{i,t} \approx$ i.i.d. N(0, σ^2) and is independent variable of $X_{i,t}$. Instead of observing $y_{i,t}^{*}$, we observe $y_{i,t}$:

$$y_{i,t} = \begin{cases} y_{i,t,}^{*} \, if \ y_{i,t}^{*} > \gamma \\ 0, \ if \ y_{i,t}^{*} \le \gamma, \end{cases} \tag{11}$$

where γ is a non stochastic constant. In other words, the value of $y_{i,t}^{*}$ is missing when it is less than or equal to γ.

3.2.5 Instrumental Quantile regressions

The preceding modelling approaches are based on mean values of the Lerner index. Unfortunately, mean values reflect blanket policies. Moreover, such blanket policies may be ineffective unless they are contingent on initial levels of market power and specified differently across financial institutions with high, intermediate and low market power. The concern about modelling exclusively at the conditional mean of the outcome variable is addressed with *Quantile* Regressions (QR) which enables the study to assess the nexuses throughout the conditional distributions of market power (see Koenker & Hallock, 2001; Okada & Samreth, 2012). Such a technique has recently been employed to examine the relationship between information sharing and financial access (see Asongu et al., 2017).

Cognizant of above facts, inquiries that investigate mean effects with Ordinary Least Squares are founded on the hypothesis of error terms that are normally distributed. Such an assumption of normally distributed errors terms is not valid in the QR technique. The estimation approach is robust in the presence of outliers because it enables the assessment of parameter estimates at various points of the conditional distribution of the outcome variable (or Lerner index) (see Koenker & Bassett, 1978).

The θ^{th} quintile estimator of the Lerner index is obtained by solving the following optimization problem, which is presented without subscripts for simplicity in Eq. (12)

$$\min_{\beta \in R^{k}} \left[\sum_{i \in \{i: y_i \geq x_{i'}\beta\}} \theta \left| y_i - x_{i'}\beta \right| + \sum_{i \in \{i: y_i < x_{i'}\beta\}} (1-\theta) \left| y_i - x_{i'}\beta \right| \right], \quad (12)$$

where $\theta \in (0,1)$. As opposed to OLS that is fundamentally based on minimizing the sum of squared residuals, with QR, the weighted sum of absolute deviations are minimised. For instance, the 10th decile or 90th decile (with θ=0.10 or 0.90 respectively) are investigated by approximately weighing the residuals. The conditional quantile of the Lerner index or y_i given x_i is:

$$Q_y(\theta / x_i) = x_{i'}\beta_\theta \quad (13)$$

Where unique slope parameters are modelled for each θ^{th} specific quantile. This formulation is analogous to $E(y / x) = x_{i'}\beta$ in the OLS slope where parameters are assessed only at the mean of the conditional distribution of the Lerner index. In Eq. (13), the dependent variable y_i is the Lerner index whereas x_i contains a constant term, *public credit registries, private credit bureaus, loan price, loan quantity, GDP per capita growth, Inflation, Population density, Deposit/Assets, Bank Branches, Small banks, domestic banks* and *Islamic banks*.

4. Empirical results

4.1 Presentation of results

Table 1 presents the findings of Ordinary Least Squares, Fixed Effects and Tobit regressions. Given that we are employing instrumental variables for the independent indicators of interest, the corresponding estimation technique can be qualified as respectively Two Stage Least Squares, Instrumental Variable Fixed Effects and Instrumental Variable Tobit regressions. The table entails nine specifications, with three specifications for each estimation strategy. Whereas the first and second specifications for each estimation approach respectively, articulate the effects of public credit registries and private credit bureaus, the third specification emphasises both the effects of private credit bureaus and public credit registries.

The following findings can be established. First, the effects of information sharing offices are significant only in the Two Stage Least Squares, with a positive (insignificantly

positive) effect from private credit bureaus (public credit registries). Second, most of the significant control variables have the expected signs. For instance: (i) an increasing number of small banks reduces market power because as small banks enter the banking industry, they reduce the market share of operating big banks; (ii) domestic banks are likely to increase market power because the presence of foreign competition is needed to reduce the power enjoyed by big banks and (iii) increasing loan prices may be translated as growing market power because of the higher interest margins. The third point on loan prices is consistent with the conception and definition of market power: the setting of prices above marginal cost.

Table 2 presents GMM results. The table entails six specifications, with one set of two specifications for public credit registries, private credit bureaus and information sharing offices. Each set of specification involves both a full sample and a partial sample. The full sample is from 2001-2011 whereas the partial sample is from 2005-2011. Two reasons motivate the adoption of the partial sample. On the one hand, it enables the inquiry to restrict over-identification or limit instrument proliferation given that T (time) is reduced. On the other hand, information from private credit bureaus and public credit registries in most of the sampled nations are available from the year 2005. Four principal information criteria are employed to assess the validity of the GMM model with forward orthogonal deviations[6]. Based on the information criteria, public credit registries increase market power.

Table 1: Market Power Effects of Reducing Information Asymmetry

[6] "*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 overidentification 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, 2017, p.200).

	Dependent Variable: Lerner Index								
	Two Stage Least Squares			Instrumental Variable Fixed Effects			Instrumental Variable Tobit		
	PCR	PCB	ISO	PCR	PCB	ISO	PCR	PCB	ISO
Constant	0.244	0.270	0.229	**-1.707*** **	**-1.550*** **	**-1.709*** **	0.234	0.274	0.219
	(0.269)	(0.203)	(0.320)	**(0.001)**	**(0.006)**	**(0.002)**	(0.172)	(0.100)	(0.209)
PCR (IV)	0.003	---	0.004	-0.0002	---	0.0004	0.003	---	0.004
	(0.224)		(0.164)	(0.959)		(0.934)	(0.469)		(0.403)
PCB (IV)	---	**0.001** **	**0.001*** **	---	0.005	0.006	---	0.001	0.001
		(0.016)	**(0.007)**		(0.340)	(0.345)		(0.387)	(0.360)
GDPpcg	-0.0004	0.0009	0.0007	0.005	0.004	0.004	-0.0009	0.0009	0.0003
	(0.879)	(0.781)	(0.821)	(0.554)	(0.634)	(0.621)	(0.904)	(0.896)	(0.969)
Inflation	-0.007	-0.007	-0.006	-0.007	**-0.008***	**-0.008***	-0.006	-0.007	-0.005
	(0.188)	(0.214)	(0.254)	(0.107)	**(0.068)**	**(0.083)**	(0.163)	(0.112)	(0.250)
Pop. Density	**-0.0002***	-0.00001	-0.0001	**-0.016*** **	**-0.017** **	**-0..017** **	-0.0002	0.000007	-0.0001
	(0.080)	(0.924)	(0.218)	**(0.008)**	**(0.012)**	**(0.013)**	(0.339)	(0.973)	(0.490)
Deposit/Assets	0.133	0.140	0.152	0.119	-0.020	-0.002	0.134	0.135	0.153
	(0.537)	(0.511)	(0.501)	(0.636)	(0.938)	(0.993)	(0.348)	(0.348)	(0.301)
Bank Branches	**0.009*** **	**0.009*** **	**0.007*** **	-0.038	**-0.042***	**-0.044***	**0.010***	**0.009***	0.008
	(0.000)	**(0.000)**	**(0.002)**	(0.119)	**(0.083)**	**(0.084)**	**(0.069)**	**(0.061)**	(0.145)
Price of Loans	2.158	1.794	2.080	**7.610*** **	**8.093*** **	**8.193*** **	**2.170*** **	**1.773*** **	**2.096*** **
	(0.107)	(0.155)	(0.127)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.008)**	**(0.003)**
Quantity of Loans	-0.019	-0.023	-0.022	**0.760*** **	**0.755*** **	**0.767*** **	-0.019	-0.023	-0.021
	(0.330)	(0.264)	(0.297)	**(0.000)**	**(0.000)**	**(0.000)**	(0.362)	(0.274)	(0.326)
Small Banks	**-0.128** **	**-0.131** **	**-0.133** **	---	---	---	**-0.132***	**0.207*** **	**-0.137***
	(0.027)	**(0.021)**	**(0.025)**				**(0.074)**	**(0.000)**	**(0.069)**
Domestic Banks	**0.211** **	**0.210** **	**0.211** **	---	---	---	**0.210*** **	0.077	**0.210*** **
	(0.028)	**(0.032)**	**(0.035)**				**(0.000)**	(0.647)	**(0.001)**
Islamic Banks	0.064	0.076	0.080	---	---	---	0.067	0.001	0.082
	(0.430)	(0.348)	(0.340)				(0.686)	(0.387)	(0.629)
Fisher	**3.80*** **	**4.92*** **	**4.35*** **	**11.44*** **	**11.84*** **	**10.22*** **			
R^2/R^2 within/Pseudo R^2	0.052	0.053	0.054	0.152	0.157	0.158	0.027	0.027	0.028
LR Chi-Square							**35.49*** **	**35.12*** **	**35.92*** **
Log Likelihood							-631.181	-632.351	-620.846
Banks				137	137	137			
Observations	652	652	633	653	653	634	652	652	633

*, **, ***: significance levels of 10%, 5% and 1% respectively. IV: Instrumented Variable. PCR: Public Credit Registries. PCB: Private Credit Bureaus. ISO: Information Sharing Offices.

Table 3 presents QR findings corresponding respectively to public credit registries, private credit bureaus and information sharing offices in three blocks of specifications. Apparent differences in estimation coefficients of the independent variables of interest (in terms of sign, significance and magnitude of significance) justify the relevance of complementing the Two-Stage Least Squares, Fixed effects, Tobit and GMM regressions with estimations throughout the conditional distribution of the Lerner index. It is apparent from the results that private credit bureaus consistently increase market power throughout the conditional distribution of market power. Most of the significant control variables have the expected signs.

Table 2: Market Power Effects of Reducing Information Asymmetry (GMM)

	Dependent Variable: Lerner Index					
	Public Credit Registries (PCR)		Private Credit Bureaus (PCB)		Information Sharing Offices	
	Full Sample	Partial Sample	Full Sample	Partial Sample	Full Sample	Partial Sample
Constant	**0.304***	-0.821	**0.322****	0.109	**0.436*****	0.032
	(0.060)	(0.243)	**(0.034)**	(0.374)	**(0.001)**	(0.944)
Lener Index (-1)	**0.194*****	**0.546*****	**0.176*****	**0.584*****	**0.168*****	**0.556*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
PCR	0.0005	-0.0006	---	---	**0.001***	-0.001
	(0.475)	(0.703)			**(0.063)**	(0.353)
PCB	---	---	-0.00003	-0.0002	-0.0001	-0.0001
			(0.978)	(0.654)	(0.922)	(0.865)
GDPpcg	-0.003	0.002	**-0.004***	0.001	-0.003	0.004
	(0.183)	(0.409)	**(0.070)**	(0.499)	(0.155)	(0.121)
Inflation	-0.001	-0.001	-0.001	-0.0009	-0.001	-0.001
	(0.476)	(0.487)	(0.152)	(0.663)	(0.162)	(0.281)
Pop. density	-0.00003	0.00008	-0.0001	0.00004	-0.0001	0.0001
	(0.776)	(0.568)	(0.410)	(0.620)	(0.210)	(0.190)
Deposit/Assets	-0.125	-0.068	-0.108	0.064	-0.153	-0.062
	(0.327)	(0.771)	(0.384)	(0.691)	(0.131)	(0.702)
Bank Branches	**0.005****	0.002	**0.008*****	0.004	**0.009*****	**0.004****
	(0.023)	(0.305)	**(0.002)**	(0.161)	**(0.000)**	**(0.040)**
Price of Loans	0.610	0.300	**1.231****	0.231	**1.202****	0.308
	(0.371)	(0.644)	**(0.033)**	(0.609)	**(0.011)**	(0.652)
Quantity of Loans	**0.058****	**0.058*****	0.018	**0.041*****	0.014	**0.045*****
	(0.049)	**(0.002)**	(0.447)	**(0.005)**	(0.550)	**(0.001)**
AR(1)	**(0.166)**	**(0.134)**	**(0.139)**	**(0.134)**	**(0.147)**	**(0.690)**
AR(2)	**(0.561)**	**(0.161)**	**(0.530)**	**(0.629)**	**(0.483)**	**(0.964)**
Sargan OIR	(0.000)	(0.101)	(0.000)	**(0.156)**	(0.000)	**(0.173)**
Hansen OIR	**(0.195)**	**(0.534)**	**(0.120)**	**(0.732)**	**(0.149)**	**(0.519)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.885)**	**(0.930)**	**(0.215)**	**(0.912)**	**(0.835)**	**(0.494)**
Dif(null, H=exogenous)	(0.082)	**(0.307)**	**(0.151)**	**(0.522)**	(0.058)	**(0.478)**
(b) IV (years, eq(diff))						
H excluding group	**(0.175)**	**(0.577)**	**(0.151)**	**(0.607)**	**(0.205)**	**(0.503)**
Dif(null, H=exogenous)	**(0.352)**	**(0.383)**	**(0.222)**	**(0.707)**	**(0.210)**	**(0.453)**
Fisher	**26.09*****	**13.84*****	**20.07*****	**27.21*****	**27.07*****	**26.44*****
Instruments	34	33	34	32	38	37
Banks	133	99	133	98	133	93
Observations	603	124	594	122	584	117

*,**,***: 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 Sargan and Hansen OIR tests.

Table 3: Market Power and Reducing Information Asymmetry (IV QR)

Dependent Variable: Lerner Index

	Public Credit Registries (PCR)					Private Credit Bureaus (PCB)					Information Sharing Offices				
	Q.10	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	0.110	**0.405*** **	**0.670*** **	**0.732*** **	**0.783*** **	-0.014	**0.397*** **	**0.690*** **	**0.802*** **	**0.817*** **	-0.056	**0.400*** **	**0.689*** **	**0.739*** **	**0.787*** **
	(0.555)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.907)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.645)	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**
PCR (IV)	-0.002	-0.003	-0.0005	-0.0003	0.001	---	---	---	---	---	0.002	0.0005	-0.0008	-0.0003	0.0005
	(0.620)	(0.197)	(0.669)	(0.762)	(0.276)						(0.253)	(0.866)	(0.383)	(0.781)	(0.598)
PCB (IV)	---	---	---	---	---	0.001	**0.002*** **	**0.001*** **	**0.001*** **	**0.001*** **	**0.002** **	**0.002** **	**0.001*** **	**0.0009** **	**0.001*** **
						(0.136)	**(0.008)**	**(0.000)**	**(0.005)**	**(0.003)**	**(0.038)**	**(0.041)**	**(0.000)**	**(0.010)**	**(0.000)**
GDPpcg	-0.004	-0.001	-0.0009	0.00008	-0.0003	-0.004	0.0008	-0.0002	0.00005	-0.00003	-0.003	-0.0002	0.0001	0.001	0.0008
	(0.548)	(0.757)	(0.599)	(0.967)	(0.859)	(0.378)	(0.847)	(0.849)	(0.981)	(0.986)	(0.519)	(0.963)	(0.922)	(0.627)	(0.627)
Inflation	-0.005	-0.0007	0.000003	0.001	0.0006	-0.002	0.001	0.00004	**0.002** **	0.001	0.0001	0.0008	-0.00006	**0.003*** **	**0.002*** **
	(0.175)	(0.806)	(0.998)	(0.094)	(0.593)	(0.515)	(0.696)	(0.958)	**(0.029)**	(0.311)	(0.973)	(0.786)	(0.940)	**(0.006)**	**(0.006)**
Pop. density	-0.0001	-0.0002	**-0.0001***	**-0.0001***	0.00001	0.0001	0.0001	-0.00002	0.00004	**0.0001***	0.0001	-0.00006	-0.00006	-0.00007	0.00009
	(0.665)	(0.244)	**(0.057)**	**(0.051)**	(0.829)	(0.395)	(0.391)	(0.617)	(0.566)	**(0.070)**	(0.565)	(0.757)	(0.225)	(0.371)	(0.266)
Deposit/Assets	0.023	-0.068	**-0.113*** **	**-0.108*** **	**-0.081** **	-0.015	-0.054	**-0.092*** **	**-0.124*** **	-0.038	-0.043	-0.044	**-0.102*** **	**-0.119*** **	-0.042
	(0.886)	(0.465)	**(0.001)**	**(0.002)**	**(0.017)**	(0.900)	(0.556)	**(0.002)**	**(0.002)**	(0.221)	(0.703)	(0.659)	**(0.000)**	**(0.001)**	(0.162)
Bank Branches	**0.011***	**0.008** **	**0.006*** **	**0.007*** **	**0.004*** **	**0.009** **	0.005	**0.005*** **	**0.004*** **	**0.004*** **	**0.008*** **	0.004	**0.005*** **	**0.005*** **	**0.004*** **
	(0.053)	**(0.020)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.030)**	(0.148)	**(0.000)**	**(0.003)**	**(0.000)**	**(0.002)**	(0.659)	**(0.000)**	**(0.000)**	**(0.000)**
Price of Loans	1.494	0.333	-0.219	**-0.479** **	-0.335	**1.189** **	0.169	**-0.364** **	**-0.851*** **	**-0.614** **	**1.460** **	0.254	**-0.291** **	**-0.556** **	**-0.554** **
	(0.117)	(0.439)	(0.192)	**(0.013)**	(0.175)	**(0.039)**	(0.690)	**(0.009)**	**(0.000)**	**(0.011)**	**(0.026)**	(0.586)	**(0.032)**	**(0.010)**	**(0.015)**
Quantity of Loans	-0.002	0.003	-0.004	0.003	**0.010***	0.019	0.0008	**-0.009** **	-0.005	0.0001	0.018	-0.0003	**-0.009** **	0.002	0.002
	(0.916)	(0.817)	(0.363)	(0.564)	**(0.069)**	(0.210)	(0.946)	**(0.027)**	(0.416)	(0.985)	(0.214)	(0.981)	**(0.027)**	(0.712)	(0.692)
Small Banks	0.074	-0.035	**-0.033***	-0.006	**-0.048** **	**-0.083***	-0.045	**-0.040*** **	-0.019	**-0.053*** **	-0.072	-0.047	**-0.039*** **	-0.019	**-0.054*** **
	(0.287)	(0.422)	**(0.061)**	(0.735)	**(0.015)**	**(0.090)**	(0.293)	**(0.008)**	(0.386)	**(0.004)**	(0.123)	(0.324)	**(0.006)**	(0.313)	**(0.002)**
Domestic Banks	**0.125** **	**0.109*** **	**0.064*** **	**0.026***	0.023	**0.174*** **	**0.074** **	**0.060*** **	**0.035***	0.021	**0.155*** **	**0.094** **	**0.057*** **	**0.029***	0.015
	(0.039)	**(0.002)**	**(0.000)**	**(0.066)**	(0.136)	**(0.000)**	**(0.036)**	**(0.000)**	**(0.058)**	(0.156)	**(0.000)**	**(0.017)**	**(0.000)**	**(0.059)**	(0.296)
Islamic Banks	0.053	-0.027	**-0.074***	0.033	0.003	0.089	0.001	**-0.056***	0.013	0.021	0.111	-0.009	**-0.054***	0.025	0.027
	(0.734)	(0.796)	**(0.074)**	(0.409)	(0.925)	(0.416)	(0.988)	**(0.095)**	(0.782)	(0.555)	(0.287)	(0.936)	**(0.087)**	(0.532)	(0.445)
Pseudo R^2	0.052	0.036	0.045	0.057	0.079	0.059	0.042	0.058	0.070	0.096	0.058	0.041	0.055	0.065	0.088
Observations	652	622	652	622	652	652	652	652	652	652	633	633	633	633	633

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. Lower quantiles (e.g., Q 0.1) signify nations where Market Power is least.

3.2 Extended assessment: increasing information sharing offices

Given that the effects of information sharing offices on market power are overwhelmingly positive, we extend the investigation by interacting information sharing to assess whether increasing information sharing offices could lead to the anticipated theoretical negative effects. Hence, we replicate the regressions with interactive specifications and compute the corresponding net effects. In Table 4 for instance, the net effect corresponding to the first GMM specification is -0.0047 (([0.0001 × 2.056] + (-0.005)). In the computation, 2.056 is the mean value of public credit registries, -0.005 is the unconditional effect of public credit registries while 0.0001 is the corresponding unconditional impact from the interaction between public credit registries.

Table 4: Market Power Effects of Reducing Information Asymmetry

	Dependent Variable: Lerner Index									
	2SLS		IV Fixed Effects		IV Tobit		GMM			
	PCR	PCB	PCR	PCB	PCR	PCB	PCR	PCR	PCB	PCB
Constant	0.248	0.273	**-1.702*** **	**-1.521*** **	0.239	**0.277***	**0.411*** **	0.204	**0.414*** **	-0.042
	(0.312)	(0.192)	**(0.001)**	**(0.007)**	(0.171)	**(0.097)**	**(0.000)**	(0.370)	**(0.000)**	(0.738)
Lener Index (-1)	---	---	---	---	---	---	**0.162*** **	**0.436*** **	**0.154*** **	**0.494*** **
							(0.000)	**(0.000)**	**(0.000)**	**(0.000)**
PCR	---	---	---	---	---	---	**-0.005** **	-0.002	---	---
							(0.041)	(0.475)		
PCB	---	---	---	---	---	---	---	---	-0.001	0.003
									(0.198)	(0.228)
PCR*PCR	---	---	---	---	---	---	**0.0001*** **	-0.00007	---	---
							(0.009)	(0.424)		
PCB*PCB	---	---	---	---	---	---	---	---	**0.00003***	-0.00005
									(0.064)	(0.241)
PCR (IV)	0.002	---	-0.009	---	0.002	---	---	---	---	---
	(0.787)		(0.576)		(0.846)					
PCB (IV)	---	-0.001	---	0.016	---	-0.001	---	---	---	---
		(0.767)		(0.384)		(0.903)				
PCR(IV)*PCR(IV)	0.00003	---	0.0001	---	0.0003	---	---	---	---	---
	(0.872)		(0.565)		(0.875)					
PCB(IV)*PCB(IV)	---	0.00004	---	-0.0001	---	0.00004	---	---	---	---
		(0.538)		(0.552)		(0.790)				
GDPpcg	-0.0003	0.0009	0.005	0.002	-0.0007	0.001	-0.003	0.001	-0.003	0.001
	(0.903)	(0.770)	(0.556)	(0.775)	(0.918)	(0.891)	(0.169)	(0.579)	(0.108)	(0.517)
Inflation	-0.007	-0.007	-0.007	**-0.008***	-0.006	-0.007	0.0008	0.0006	0.0007	0.0005
	(0.161)	(0.214)	(0.101)	**(0.065)**	(0.161)	(0.111)	(0.401)	(0.654)	(0.413)	(0.750)
Pop. Density	-0.0002	-0.00001	**-0.017*** **	**-0.017** **	-0.0002	0.000001	-0.00009	-0.00003	-0.0001	0.000005
	(0.111)	(0.879)	**(0.007)**	**(0.012)**	(0.338)	(0.996)	(0.332)	(0.760)	(0.243)	(0.961)
Deposit/Assets	0.131	0.140	0.129	-0.014	0.132	0.135	-0.0007	-0.169	-0.053	0.017
	(0.561)	(0.512)	(0.607)	(0.956)	(0.359)	(0.351)	(0.991)	(0.219)	(0.544)	(0.911)
Bank Branches	**0.009*** **	**0.009*** **	-0.036	**-0.045***	**0.010***	**0.009***	**0.005*** **	**0.006** **	**0.006*** **	**0.005***
	(0.001)	**(0.000)**	(0.138)	**(0.070)**	**(0.072)**	**(0.059)**	**(0.002)**	**(0.013)**	**(0.000)**	**(0.087)**
Price of Loans	2.148	1.827	**7.600*** **	**8.070*** **	**2.158*** **	**1.804*** **	-0.199	-0.075	0.276	0.436
	(0.123)	(0.159)	**(0.000)**	**(0.000)**	**(0.002)**	**(0.008)**	(0.595)	(0.803)	(0.356)	(0.116)
Quantity of Loans	-0.020	-0.023	**0.761*** **	**0.743*** **	-0.019	-0.023	0.024	**0.047*** **	0.012	**0.028** **
	(0.312)	(0.267)	**(0.000)**	**(0.000)**	(0.359)	(0.264)	(0.115)	**(0.000)**	(0.488)	**(0.018)**
Small Banks	**-0.128** **	**-0.133** **	---	---	**-0.132***	**-0.131***	---	---	---	---
	(0.023)	**(0.023)**			**(0.073)**	**(0.074)**				
Domestic Banks	**0.211** **	**0.210** **	---	---	**0.209*** **	**0.208*** **	---	---	---	---
	(0.033)	**(0.033)**			**(0.000)**	**(0.000)**				
Islamic Banks	0.063	0.074	---	---	0.066	0.075	---	---	---	---
	(0.465)	(0.351)			(0.692)	(0.656)				
Net Effects of PCR	n.a	---	n.a	---	n.a	---	-0.0047	---	n.a	---
Net Effects of PCB	---	n.a	---	n.a	---	n.a	---	n.a	---	n.a
AR(1)	---	---	---	---	---	---	**(0.360)**	(0.071)	**(0.317)**	**(0.280)**
AR(2)	---	---	---	---	---	---	**(0.702)**	**(0.108)**	**(0.616)**	**(0.274)**
Sargan OIR	---	---	---	---	---	---	(0.000)	(0.000)	(0.000)	(0.000)
Hansen OIR	---	---	---	---	---	---	**(0.112)**	**(0.382)**	**(0.071)**	**(0.828)**
DHT for instruments										
(a)Instruments in levels										
H excluding group	---	---	---	---	---	---	**(0.371)**	**(0.342)**	**(0.185)**	**(0.819)**
Dif(null, H=exogenous)	---	---	---	---	---	---	(0.092)	**(0.425)**	**(0.101)**	**(0.680)**
(b) IV (years, eq(diff))										
H excluding group	---	---	---	---	---	---	(0.060)	**(0.446)**	(0.015)	**(0.628)**
Dif(null, H=exogenous)	---	---	---	---	---	---	**(0.605)**	**(0.288)**	**(0.946)**	**(0.978)**
R^2/R^2 within/Pseudo R^2	0.052	0.053	0.153	0.157	0.027	0.027	---	---	---	---
LR Chi-Square	---	---	---	---	**35.52*** **	**35.19*** **	---	---	---	---
Log Likelihood	---	---	---	---	-631.169	-632.315	---	---	---	---
Fisher	**4.30*** **	**4.49*** **	**10.19*** **	**10.55*** **	---	---	**52.54*** **	**64.32*** **	**38.23*** **	**54.39 *** **
Instruments	---	---	---	---	---	---	46	45	46	43
Banks			137	137			133	99	133	98
Observations	652	652	653	653	652	652	603	124	594	122

*, **, ***: 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, Hausman test and the Fisher statistics. 2) The failure to reject the null hypotheses of: a) no autocorrelation in the

AR(1)andAR(2) tests and; b) the validity of the instruments in the Sargan OIR test. n.a: not applicable because at least one of the estimated coefficients needed for the computation of net effects is not significant. 2SLS: Two Stage Least Squares. IV: Instrumental Variable. PCR: Public Credit Registries. PCB: Private Credit Bureaus.

Table 5: Market Power Effects of Reducing Information Asymmetry (QR)

	Dependent Variable: Lerner Index									
	Public Credit Registries (PCR)					Private Credit Bureaus (PCB)				
	Q.10	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	0.178	**0.480*** **	**0.724*** **	**0.736*** **	**0.794*** **	-0.024	**0.389*** **	**0.695*** **	**0.793*** **	**0.833*** **
	(0.300)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.833)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
PCR (IV)	-0.009	**-0.031** **	**-0.010*** **	-0.003	-0.001	---	---	---	---	---
	(0.333)	**(0.018)**	**(0.000)**	(0.283)	(0.609)					
PCB (IV)	---	---	---	---	---	0.004	0.007	**0.003***	**0.007** **	**0.004***
						(0.377)	(0.108)	**(0.064)**	**(0.020)**	**(0.079)**
PCR(IV)*PCR(IV)	0.0002	**0.0003** **	**0.0002*** **	0.00007	0.00005	---	---	---	---	---
	(0.151)	**(0.017)**	**(0.000)**	(0.280)	(0.397)					
PCB(IV)*PCB(IV)	---	---	---	---	---	-0.00004	-0.00008	-0.00003	**-0.0001***	-0.00007
						(0.623)	(0.270)	(0.244)	**(0.052)**	(0.151)
GDPpcg	-0.005	-0.001	-0.0003	0.0003	-0.00004	-0.002	0.0008	-0.0002	0.0005	-0.000005
	(0.439)	(0.764)	(0.823)	(0.877)	(0.983)	(0.583)	(0.831)	(0.846)	(0.819)	(0.998)
Inflation	-0.005	-0.0005	-0.0004	0.001	0.0006	-0.001	0.001	0.00001	**0.003** **	0.001
	(0.143)	(0.834)	(0.625)	(0.152)	(0.638)	(0.505)	(0.558)	(0.987)	**(0.018)**	(0.382)
Pop. density	-0.0002	**-0.0003** **	**-0.0002*** **	**-0.0001***	-0.000008	0.0001	0.0001	-0.000009	0.00005	**0.0001***
	(0.379)	**(0.022)**	**(0.000)**	**(0.058)**	(0.935)	(0.256)	(0.354)	(0.836)	(0.503)	**(0.065)**
Deposit/Assets	-0.022	-0.066	**-0.146*** **	**-0.112*** **	**-0.102*** **	-0.014	-0.049	**-0.089*** **	**-0.126*** **	**-0.065***
	(0.880)	(0.419)	**(0.000)**	**(0.004)**	**(0.005)**	(0.900)	(0.556)	**(0.002)**	**(0.001)**	**(0.055)**
Bank Branches	**0.011** **	**0.009*** **	**0.006*** **	**0.007*** **	**0.005*** **	**0.009** **	0.005	**0.004*** **	**0.004*** **	**0.003*** **
	(0.043)	**(0.004)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.016)**	(0.105)	**(0.000)**	**(0.001)**	**(0.000)**
Price of Loans	1.364	0.126	**-0.336** **	**-0.498** **	-0.339	**1.007***	0.047	**-0.415*** **	**-0.926*** **	**-0.701*** **
	(0.129)	(0.744)	**(0.019)**	**(0.021)**	(0.232)	**(0.059)**	(0.903)	**(0.002)**	**(0.000)**	**(0.004)**
Quantity of Loans	-0.002	-0.001	-0.005	0.003	**0.010***	0.022	0.002	**-0.010** **	-0.002	0.002
	(0.912)	(0.928)	(0.227)	(0.584)	**(0.090)**	(0.111)	(0.863)	**(0.016)**	(0.746)	(0.737)
Small Banks	-0.085	-0.058	**-0.029** **	-0.012	**-0.044***	-0.068	-0.036	**-0.042*** **	-0.013	**-0.050** **
	(0.187)	(0.147)	**(0.056)**	(0.535)	**(0.060)**	(0.128)	(0.367)	**(0.004)**	(0.556)	**(0.010)**
Domestic Banks	**0.132** **	**0.112*** **	**0.066*** **	**0.029***	0.026	**0.161*** **	**0.067** **	**0.062*** **	0.021	0.021
	(0.021)	**(0.001)**	**(0.000)**	**(0.079)**	(0.138)	**(0.000)**	**(0.037)**	**(0.000)**	(0.236)	(0.194)
Islamic Banks	0.032	-0.052	**-0.019*** **	0.035	-0.010	0.080	0.001	**-0.056***	0.015	0.010
	(0.826)	(0.572)	**(0.008)**	(0.409)	(0.818)	(0.425)	(0.985)	**(0.085)**	(0.749)	(0.791)
Net Effects of PCR	n.a	-0.030	-0.009	n.a	n.a	---	---	---	---	---
Net Effects of PCB	---	---	---	---	---	n.a	n.a	n.a	0.007	n.a
Pseudo R^2	0.056	0.048	0.054	0.057	0.079	0.059	0.045	0.058	0.073	0.100
Observations	652	652	652	652	652	652	652	652	652	652

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. Lower quantiles (e.g., Q 0.1) signify nations where Market Power is least. n.a: not applicable because at least one of the estimated coefficients needed for the computation of net effects is not significant. PCR: Public Credit Registries. PCB: Private Credit Bureaus.

Table 4 presents Two Stage Least Squares, IV Fixed Effects, IV Tobit and GMM regressions. From the findings, only the net effect from public credit registries corresponding to the full sample is negative. It is important to note that for the GMM block, like in the baseline GMM regressions, two specifications are based on the full sample whereas the two other specifications correspond to a partial sample. In Table 5, positive net effects from public credit registries are apparent in the 25^{th} and 50^{th} quartiles.

4. Conclusion and directions of future research

This study has investigated the role of information sharing offices in market power in the African banking industry. The empirical evidence is based on a panel of 162 banks from 42 countries for the period 2001-2011. Five simultaneity-robust estimation techniques have been employed, namely: (i) Two Stage Least Squares; (ii) Instrumental Fixed effects to control for the unobserved heterogeneity; (iii) Instrumental Tobit regressions to control for the limited range in the dependent variable; (iv) Generalised Method of Moments (GMM) to control for persistence in market power and (v) Instrumental Quantile Regressions (QR) to account for initial levels of market power.

The following findings have been established from non-interactive regressions. First, the effects of information sharing offices are significant in the Two Stage Least Squares, with a positive effect from private credit bureaus. Second, in GMM, public credit registries increase market power. Third, from Quintile Regressions, private credit bureaus consistently increase market power throughout the conditional distributions of market power.

Given that the above findings are contrary to theoretical postulations, we have extended the analytical framework with interactive regressions in order to assess whether the anticipated effects can be established if information sharing offices are increased. The extended findings show: (i) a negative net effect from public credit registries on market power in GMM regressions; (ii) negative net impacts from public credit registries on market power in the in the 25^{th} and 50^{th} quartiles of market power. It is important to note that insignificant effects established in the findings can be logically elicited. These insignificant results imply that information sharing offices are still not having the desire effect of the reducing market power in the African banking industry. There are two plausible arguments which may clarify this insignificance. From a direct viewpoint, information sharing offices may not be fulfilling their fundamental goal of increasing competition in the banking sector, reducing information

rents and rendering credit markets contestable (see Pagano & Jappelli, 1993, p. 2019). From an indirect perspective, complementary instruments of information sharing offices like information and communication technology and government institutions may not be adequate to enable information sharing offices to disclose time and adequate information.

The authenticity of credit bureaus can ease exchanges of information among banks in order to reduce information cost, bank risk level and credit costs when banks such as Bank of Africa, Ecobank and Attijariwafa Bank are expanding their operations to a regional market (Buch, 2003). However, African credit bureaus may not be able to provide high quality of information disclosure (e.g. in terms of correctness, accurateness, comprehensiveness; discipline of borrowers, credit availability etc). This may reflect non-significant relationship recorded in this study. In addition, this non-significant results may be due to lack of good institutional framework such as weak legal systems, lack of sufficient regulatory environments and best practice, particularistic culture, relationships network ties and use of different language (see Dacin et al., 2002). For instance, national culture oriented towards particularistic culture "*favour strong personal relationships in which there is a shared set of norms and values*" (Michailova & Hutchings, 2006, p.395). Hence, the absence of well-functioning formal credit bureaus in Africa may yield inefficiency in the banking system due to this type of national culture. If the African national culture is dominated by universalism, information sharing would be better synchronised through the application of standards, rules and legal contracts which each credit bureau has to stick to. To our best knowledge, no study has found this insignificant relationship in the African banking system. As a result, this study has remedied this deficiency and advances our understanding in the context of information sharing offices - market power in Africa (Luoto, McIntosh & Wydick, 2007). In addition to particularistic national culture coupled with embryonic development stage, information asymmetry may play a key role in market power which raises a new inquiry for further

investigation. In the light of these clarifications, the insignificant results should not be seen in the light of a file drawer problem or publication bias in social sciences, where null or insignificant results are discarded in favour of strong findings (Rosenberg, 2005; Franco et al., 2014). In essence, both significant and insignificant results make economic sense and have economic meanings.

Despite the contribution of this study, its limitation should be explicitly acknowledged. One limitation of this study could be that, since it is conducted with data from African countries which do not have fully developed financial systems, some heterogeneity could be apparent in the nature and quality of information being shared. This is essentially because some coverage bureaus may be collecting more worthwhile information (e.g. share past default and repayment history, total exposure) than comparatively less developed coverage bureaus. Consequently, investigating whether the finding in this study may withstand further empirical scrutiny, by clarifying and accounting for differences in the quality of information collected by credit bureaus is an important future research direction.

Future studies can also improve the existing literature by examining complementary policy tools that enhance the role of information sharing services in reducing market power. Moreover, given that this study is about the effect of sharing information on market power, it is also worthwhile to analyse the direct effect of information sharing on financial access and the indirect effect on other macroeconomic outcomes like investment and employment. It may also be interesting to relax the underlying assumption in this study and assess when having some market power in the banking industry may be good for an economy.

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Appendices

Appendix 1: Definitions of Variables

Variables	Signs	Definitions of Variables	Sources
Market Power	Lerner	The ratio of the 'difference between the Marginal Cost and Price' on the Price	Authors' calculation and BankScope
Quantity of Loans	Quantity	Logarithm of Loans	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, Open, Close, Dom/Foreign and Islam/NonIsl.

Appendix 2: Summary Statistics

		Mean	S.D	Minimum	Maximum	Observations
Market Power	Lerner	0.513	0.587	0.032	0.969	893
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
	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
Dummy variables	Large Size	0.804	0.396	0.000	1.000	1255
	Small 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 3 : Correlation Matrix (Uniform sample size: 684)

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. Open: Capital openness. Closed: Capital closedness. Domestic: Domestic banks. Foreign: Foreign banks. Islam: Islamic banks. NonIsl: Non-Islamic banks. Price: Price of Loans. Quantity: Quantity of Loans.

5% critical value (two-tailed) = 0.0750 for n = 684

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