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ICT, Information Asymmetry and Market Power in the African Banking Industry

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Abstract

This study assesses how market power in the African banking industry is affected by the complementarity between information sharing offices and information and communication technology (ICT). The empirical evidence is based on a panel of 162 banks consisting of 42 countries for the period 2001-2011. Four estimation techniques are employed, namely: (i) instrumental variable Fixed effects to control for the unobserved heterogeneity; (ii) Tobit regressions to control for the limited range in the dependent variable; and (iii) Instrumental Quantile Regressions (QR) to account for initial levels of market power. Whereas results from Fixed effects and Tobit regressions are not significant, with QR: (i) the interaction between internet penetration and public credit registries reduces market power in the 75th quartile and (ii) the interaction between mobile phone penetration and private credit bureaus increases market power in the top quintiles. Fortunately, the positive net effects are associated with negative marginal effects from the interaction between private credit bureaus and mobile phone penetration. This implies that mobile phones could complement private credit bureaus to decrease market power when certain thresholds of mobile phone penetration are attained. These thresholds are computed and discussed.

JEL Classification: G20; G29; L96; O40; O55
Keywords: Financial access; Information asymmetry; ICT

1. Introduction

The positioning of this inquiry is motivated by four main tendencies in scholarly and policy circles, namely, the: (i) high penetration potential of information and communication (ICT) in Africa; (ii) recent introduction of information sharing offices throughout the continent; (iii) evidence of high market power in the African banking industry and (iv) gaps in the literature. We substantiate the points in chronological order.

First, compared to other regions of the world (e.g. North America, Europe & Asia) which have reached saturation points in terms of ICT penetration, there is still a great room for ICT penetration in Africa (see Penard et al., 2012; Tchamyou, 2016). This implies that policy makers can leverage on the underlying ICT penetration potential to address development challenges, *inter alia*: limited financial access and excessive market power owing to high informational rents.

Second, the advent ICT liberalisation has coincided with the introduction of information sharing offices (public credit registries and private credit bureaus) in developing countries (Mylenko, 2008). Such information sharing offices were previously concentrated in the Organisation for Economic Cooperation and Development (OECD) countries. Information sharing offices which are also known as 'credit reference agencies' refer to institutions which collect data on commercial and individual borrowers' obligations from a plethora of sources, notably: banks, credit card companies, retail lenders, direct investigation, supplies and public sources.

Information sharing offices are necessary for financial access within an economy because they help to address information asymmetry between lenders and borrowers. On the one hand, data from credit histories address concerns of adverse selection ex-ante of lending. On the other hand, ex-post of lending, information sharing offices serve as a market disciplining channel by preventing borrowers from defaulting on their debts. By reducing informational rents in the banking sector and rendering credit markets contestable, information sharing offices also have a theoretical role of reducing market power in the banking industry.

Third, a recent stream of literature has built on the underpinning that financial institutions in Africa may be enjoying a 'quiet life'[1] or abusing their market power (Boateng

[1]According to the Quiet Life Hypothesis (QLH), banks with substantial market power would devote fewer resources to enhancing access to finance. In other words, the hypothesis postulates that instead of powerful banksusing their favourable market position to consolidate intermediation efficiency, they would tend to exploit such 'market power' to increase their gains or enjoy a 'quiet life' (see Coccorese & Pellecchia, 2010). From a

et al., 2016; Asongu et al., 2016a). Unfortunately, despite being the continent with the most severe financial access constraints, Africa has not received the scholarly attention it deserves. As summarised in Appendix 1, apart from Ariss (2010) who has sampled some African countries, the bulk of literature on market power in the banking industry has failed to engage the continent.

This study contributes to the extant literature by assessing whether complementing information sharing offices (discussed in the second strand) with ICT (covered in the first strand) can address the concern of market power (raised in the third strand). It is important to reduce market power because prior studies have shown that it: lowers the volume of investment and savings; increases the cost of financial intermediation and ultimately decreases economic growth (Stiglitz & Weiss, 1981; Djankov et al., 2007). Conscious of the deleterious impacts of market power on economic prosperity, policy makers in both developing and developed nations have over the past decades implemented policies with the purpose of enhancing banking competition and reducing market power. Under the auspices of the World Bank and the International Monetary Fund, liberalisation of the banking sector has been the most prominent of these policies in Africa. These policy reforms have substantially affected the competitive landscape in the African banking industry, especially with the increasingly realisation that the introduction of credit information systems and ICT are facilitating financial access.

The main premise for reducing market power is that when lenders monopolise dominant positions within the market they may use these positions to increases their financial gains instead of improving the fundamental role of banks which is to transform mobilised deposits into credit for economic operators. It is relevant to note that, the policy of establishing credit registries and information sharing offices across Africa is expected to consolidate credit expansion, reduce information asymmetry, increase competition and boost financial intermediation efficiency within a market environment that is substantially dominated by large multinational financial institutions like Standard Chartered, Barclays Bank, BNP Paribas and Société Générale (Boateng et al., 2016).

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theoretical standpoint, it is expected that financial institutions with considerable market power will be associated with lower profit margins owing to economies of scale on the one hand and other advantages associated with banks of large size, on the other hand. However, in contradiction to these expectations, big banks can devote more resources to stifling intermediation efficiency and increasing their profits margins (Mitchell & Onvural, 1996).

The rest of the study is structured as follows.The arguments and theoretical underpinnings are presented in Section 2. Section 3 discusses the data and methodology. Empirical results and corresponding discussions are covered in Section 4 while Section 5 concludes with implications and future research directions.

2. Arguments, intuition and theoretical underpinnings

There is a substantial bulk of the literature maintaining that consolidation and mergers are positive in improving bank efficiency (see Berger & Humphrey, 1994; Peristiani, 1997; Rhoades, 1998; Fethi & Pasiouras 2010). Unfortunately, there is a growing body of African literature on the position that interest rate margins are lower in small banks compared to larger banks which may be abusing their market power (Beck & Hesse, 2006; Ahokpossi, 2013)[2]. Accordingly, compared to small banks, financial institutions with substantial market power should decrease interest margins because of internalities and externalities from economies of scale. From a broad perspective, it has been established that larger banks are becoming more inefficient (see Mitchell & Onvural, 1996. Karray & Chichti, 2013)[3]. This paradox has led to growing concerns about the role of market power and bank size in improving financial access within the banking sector (Karray & Chichti, 2013).

Three arguments have been put forward to elucidate the paradox. First, it is argued that big banks could be using their market power to enjoy a 'quiet life' instead of increasing financial access (Mitchell & Onvural, 1996). The second argument is that some large banks may be associated with substantial diseconomies of scale which engender inefficiencies, especially on the need for better organisation, management and coordination (Berger et al., 1987; Noulas et al., 1990; Mester, 1992; Clark, 1996; Karray & Chichti, 2013). Third, a recent stream of African business literature is motivated by the assumption that big banks may be exploiting information sharing offices to increase their profit margins instead of increasing financial allocation efficiency (see Asongu et al., 2016a; Tchamyou& Asongu, 2017). The present study is closest to the third argument.

[2]Beck and Hesse (2006, p.1) have established that bank size significantly contributes to variations in margins and spreads in the banking sector. For example, in Kenya the high cost of loans is favorable to big banks compared to small lenders (Ngigi, 2013a, 2013b). Ahokpossi (2013, p. 1) has concluded that policies designed to reduce market concentration and promote competition would help lower interest margins in Sub-Saharan Africa (SSA).

[3]Karray and Chichti (2013) have recently investigated a panel of 402 commercial banks from 15 developing countries for the period 2000-2003 to establish that there are high levels of scale inefficiency among the largest banks.

On the theoretical linkages between information sharing offices and market power, the former increases interbank competition by making the banking sector contestable, since information that was formerly enjoyed by a privileged set of big banks can beavailable to all financial institutions (Jappelli & Pagano, 2002). In essence, by reducing market power and rendering credit markets contestable, financial access is enhanced. Information sharing offices serve as market brokers by enabling *inter alia*: relaxation of credit constraints, efficiency in capital allocation and enhanced credit competition. In what follows, we discuss how ICT can complement information sharing offices to reduce market power.

First and foremost, ICT has been documented to be a natural instrument of information sharing offices (see Asongu et al., 2017). This is essentially because the latter uses the former in its information sharing activities. Such information sharing can reduce informational rents or data privileges that were previously enjoyed by powerful banks within the financial industry. Accordingly, large banks can use such privileged information to set the prices of loans above marginal costs with the purpose of boosting their profit margins. This theoretical narrative is in accordance with a stream of recent literature, notably: Bergemanny et al. (2015) who posit that the complementarity between information and market power is essential in understanding the distribution of prices and quantities which lead to economic equilibrium.

Second, the complementary role of ICT in deceasing market power within the banking industry is similar to the relevance of ICT in stifling the abuse of power by the governing elite. The theoretical framework within which market power is reduced by ICT is consistent with Snow (2009, pp. 337-339). According to the author, the historic dearth of information technology endowed the elite in positions of authority with the power of using privileged information to achieve personal gains. From the perspective of banking, such personal gains reflect a 'quite life': a concept already clarified in the introduction.

In the light of the above, the sharing of information by means of ICT can substantially reduce rents and secrecy barriers by *inter alia*: boosting transparency, increasing oversight and altering cost-benefit computations. The basis of this assertion is that the monopoly of information either by the elite in government (and by extension powerful banks within the banking sector) offers opportunities for abuse of power. Therefore, the liberalisation and/or decentralisation of information by means of ICT networks theoretically limit such opportunities for abuse of power. This partly explains the intuition motivating the study given that the introduction of information sharing offices in Africa has coincided with the liberalisation of the ICT sector. In a nutshell, the underlying postulations are broadly

consistent with the evolving literature on the linkages between governance, ICT and the abuse of power by the elite with privileged information on the one hand (Boulianne, 2009; Diamond, 2010; Grossman et al., 2014) and the growing body of studies on the importance of ICT in garnering collective action against the abuse of power, on the other hand (Pierskalla & Hollenbach, 2013; Weidmann & Shapiro, 2015; Manacorda & Tesei, 2016).

Motivated by the above underpinnings, over the past decades information sharing offices have been introduced across Africa in order to reduce information asymmetry between lenders and borrowers in the banking industry. Unfortunately, most of the literature has focused on the role of information sharing offices on financial access (Barth et al., 2009; Triki & Gajigo, 2014; Asongu et al., 2017), with little scholarly focus on market power. This study complements the existing literature by examining how information and communication technology (ICT) complements information sharing offices to affect market power in the African banking industry.

3. Data and Methodology

3.1 Data

This paper investigates a panel of 162 banks in 42 countries with data from Bankscope and World Bank Development Indicators for the period 2001-2011. The number of countries, banks and periodicity are due to data availability constraints. Accordingly, data on information sharing offices is only available from 2001.

In accordance with Ariss (2010), market power is measured with the Lerner index. The computation of the index which measures the magnitude at which banks set prices above marginal costs is discussed in the methodology section. Higher Lerner indices indicate greater market power.

In line with Triki and Gajigo (2014), information sharing offices are measured with public credit registries and private credit bureaus. ICT is measured with internet penetration and mobile phone penetration. The choice of these ICT variables is motivated by the conclusions of Asongu and Moulin (2016) on their relevance in complementing information sharing offices to reduce information asymmetry for financial access.

The study controls for market-level features (*GDP per capita growth*, *inflation* and *population density*), bank-oriented characteristics (*Deposits/Assets*, *Bank branches*, *loan price and loan quantity*) and the unobserved heterogeneity in banks: ownership (domestic versus

(vs) foreign), size (small vs. large) and '*compliance with Sharia finance*' (Non-Islamic vs. Islamic).

With regards to expected signs from bank-related characteristics, the following signs are anticipated. (1) Loan price should increase market power because higher interest margins also indicate the abuse of market power by large banks. (2) Whereas increasing loan quantity may be a reflection of reducing market power because interbank competition drives-down prices while increasing the quantity of loans, it is difficult to establish the expected sign since increasing loan quantity may also be the result of a cartel of banks deciding the amount of loans in circulation. (3)The 'Deposit to asset' ratio can either increase or decrease market power because it can simultaneously increase the quantity and price of loans. In essence, since the principal sources of financing for banks are deposits, a higher proportion of deposits among liquid liabilities could simultaneously increase the quantity of loans and interest rate margin. (4) Whereas an increasing number of 'bank branches' is a measurement of competition within the banking sector, the branches could also be from a cartel of big banks dictating the laws in the banking sector. Hence, it is difficult to establish the expected sign of bank branches on market power.

As concerns market-oriented features, the following are worthwhile. (1) GDP per capita growth is used to control for business cycle fluctuations[4]. Unfortunately, the expected sign cannot be established with certainty because it is contingent on market dynamism and expansion. (2) Whereas high inflation may push some banks to leave the banking industry, low and stable inflation that are essential for investment can be an incentive for banks to set branches within an economy. In essence, inflation increases ambiguities in the economic environment and investors have been documented to prefer less ambiguous investment climates (see Le Roux & Kelsey, 2016; Kelsey & Le Roux, 2016).(3) Population density is likely to reduce market power because it offers investment opportunities in the banking sector for other banks.

On the signs of the dummy variables used to control the unobserved heterogeneity, (1) an increasing number of small banks is logically expected to reduce market power while (2) a growing number of domestic banks could either increase or decrease market power because the effect on market power is contingent on the co-ordination and organisation of issues that are related to inefficiencies. (3) The effect of compliance with *Sharia finance*' (Non-Islamic

[4] The relationship between finance and growth has been substantially documented in the literature (Owosu & Odhiambo, 2014; Nyasha & Odhiambo, 2015a, 2015b).

vs. Islamic) is also difficult to establish because the influence of banks in the financial industry depends on *inter alia*: (i) constraints in meeting customer needs and requirements and (ii) organizational capabilities of staff as well as the expansion and dynamism of markets.

The definitions and sources of variables are provided in Appendix 2. Appendix 3 discloses the summary statistics while the correlation matrix is presented in Appendix 4.

3.2 Methodology

3.2.1 Estimation of Market Power (Lerner Index),

In order to estimate market power or the Lerner index, we use the stochastic frontier model of Battese and Coelli (1992). As argued by Coccorese and Pellecchia (2010), the model is better compared to other estimation approaches, especially techniques that are based on deterministic frontiers (Farrell, 1957; Aigner & Chu, 1968). The adopted model controls for the possibility that, apart from the firm's own inefficiency, deviations between the frontier output and observed output could originate from other factors (e.g. measurement errors and stochastic shocks).

Let us assume that, for firm i at time t, productions costs are a function of output (Q), input prices (W), inefficiency (u) and random error (v). With the last two terms independent and identically distributed (iid), the logarithmic specification of the cost function can be written 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 $N(\mu, \sigma_u{}^2)$.

In order to model the cost, we employ a translog function with three inputs and one output. The function first proposed by Christensen et al. (1971) and then extended to a multiproduct framework (Brown et al., 1979), has been substantially employed for the assessment of the market power in the banking literature (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 $i=1,\ldots\ldots N$ and $t=1\ldots\ldots T$, are subscripts of banks and time respectively. C is the total cost, Q is the output, W_h are factor prices, while u_{it} and v_{it} are respectively the error and inefficiency terms.

In order to estimate the cost, three inputs and one output are specified. Total operating cost is measured by overheads, output by total assets and inputs by the price of deposits, price of labor and price of capital[5]. The Lerner index is computed from the price and marginal cost (see Eq. 4). While the latter is computed from the translog cost function output (see Eq. (3)), the former is the price charged by banks on their output (total assets), computed as the ratio between total revenues (interest income plus net noninterest income) and total assets.

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

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

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

Four estimation techniques are employed, namely: (i) instrumental variable Fixed Effects to control for the unobserved heterogeneity; (ii) Tobit regressions to control for the limited range in the dependent variable; and (iii) instrumental Quantile regressions to account for initial levels of market power. The employment of multiple estimation techniques is consistent with data behaviour.

The concern about endogeneity in the independent variables of interest is addressed by instrumenting the underlying variables with their first lags. The instrumentation procedure for an information sharing office (e.g. private credit bureaus) and an ICT indicator (e.g. Internet penetration) are respectively in Eqs. (5) and (6) below.

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

[5] The price of deposits is computed by dividing interest expenses by the sum of deposits, money market plus short term funding. 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.

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.

$Internet_{i,t} = \alpha + \delta_j\left(Internet_{i,t-1}\right) + \varepsilon_{i,t}$,(6)where, $Internet_{i,t}$, is the internet penetration rate of bank i at period t, α is a constant, $Internet_{i,t-1}$, represents internet penetration rate in bank i at period $t-1$, and $\varepsilon_{i,t}$ the error term. The procedure of instrumentation in Eq. (5) consists of regressing the information sharing offices on their first lags. The corresponding fitted values are then saved and later used as the independent variables of interest in Fixed Effects, Tobit and Quantile Regression specifications. The instrumentation process is Heteroscedasticity and Autocorrelation Consistent (HAC) in standard errors.

The panel Fixed Effects model is presented as follows:

$$L_{i,t} = \partial_0 + \partial_1 ISO_{i,t} + \partial_2 ICT_{i,t} + \partial_3 ISOICT_{i,t} + \sum_{h=1}^{7} \omega_h W_{h,i,t-\tau} + \eta_i + \varepsilon_{i,t} ,(7)$$

where, $L_{i,t}$ is the Lerner index of bank i at period t; ∂ is a constant; ISO, is an information sharing office (public credit registries or private credit bureaus); ICT represents information and communication technology (mobile phone penetration or internet penetration); $ISOICT$, is the interaction between an information sharing office and an information and communication technology; W is the vector of control variables (*public credit registries, private credit bureaus, ICT, loan price, loan quantity, GDP per capita growth, Inflation, Population density, Deposit/Assets* and *Bank Branches*); η_i is the country-specific effect and $\varepsilon_{i,t}$ the error term.

3.2.3 Instrumental Tobit regressions

Given that the Lerner index theoretically falls between 0 and 1, Ordinary Least Squares (OLS) may be inappropriate. Many authors have used a double-censored Tobit model to account for the limited range in the dependent variable (see Kumbhakar & Lovell, 2000; Koetter et al., 2008; Coccorese & Pellecchia, 2010; Ariss, 2010). Consistent with recent literature (McDonald, 2009; Coccorese & Pellecchia, 2010; Asongu & Nwachukwu, 2016; Asongu & Le Roux, 2017), if there are no observations of either 0 or 1 for the Lerner index (which is the case here), estimating by a double-censored Tobit model is similar to estimating by a linear regressions model since the two likelihood functions coincide.

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

$$y_{i,t}^{*} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t}, \quad (8)$$

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 $y_{i,t}$:

$$y_{i,t} = \begin{cases} y_{i,t,}^{*} \; if \; y_{i,t}^{*} > \gamma \\ 0, \; if \; y_{i,t}^{*} \leq \gamma, \end{cases} \quad (9)$$

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.

3.2.4 Instrumental Quantile regressions

The specifications above are based on mean values of the Lerner index. Unfortunately, blanket policies which result from estimations based on mean values may not be effective unless they are contingent on initial levels of market power and tailored differently across banks with low, intermediate and high market power. We address the concerns of modelling exclusively on the conditional mean of the Lerner index with Quantile Regressions (QR) which enables the study to assess the investigated relationships throughout the conditional distributions of the Learner index (see Keonker & Hallock, 2001; Billger &Goel, 2009; Okada & Samreth, 2012; Asongu, 2013, 2017).

Furthermore, studies based on mean impacts with Ordinary Least Squares (OLS) rely on the assumption of normally distributed error terms. Unfortunately, this assumption does not hold when employing the QR technique because it is not founded on assumption that error terms are normally distributed. This technique which is robust in the presence of outliers enables the investigation of parameter estimates at multiple points of the conditional distribution of the Lerner index (Koenker & Bassett, 1978).

The θ^{th} quintile estimator of the Lerner index is obtained by solving for the following optimization problem, which is presented without subscripts for simplicity in Eq. (10)

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i: y_i \geq x_{i'}\beta \}} \theta \left| y_i - x_{i'}\beta \right| + \sum_{i \in \{i: y_i < x_{i'}\beta \}} (1-\theta) \left| y_i - x_{i'}\beta \right| \right], \quad (10)$$

where $\theta \in (0,1)$. Contrary to OLS which is fundamentally based on minimizing the sum of squared residuals, with QR, the weighted sum of absolute deviations are minimised. For example, the 25th or 75th quartiles (with θ=0.25 or 0.75 respectively) are examined by approximately weighing the residuals. The conditional quintile of the Lerner index or y_i given x_i is:

$$Q_y(\theta / x_i) = x_{i'}\beta_\theta, \qquad (11)$$

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 investigated only at the mean of the conditional distribution of the Lerner index. For the model in Eq. (11), the dependent variable y_i is the market power indicator while x_i contains a constant term, *public credit registries, private credit bureaus, ICT, loan price, loan quantity, GDP per capita growth, Inflation, Population density, Deposit/Assets, Bank Branches, Small banks, domestic banks* and *Islamic banks*.

Given that all estimation approaches are based on interactive regressions, we briefly engage some drawbacks that are linked to these types of regressions. Consistent with Brambor et al. (2006), all constitutive terms should be involved in the specifications. Furthermore, the corresponding estimates from interactions should be considered as marginal or conditional effects.The theoretical and practical underpinnings of Brambor et al. (2006) are broadly consistent with the suggestions with Balli and Sorensen (2013). Given that, squared terms of the interactive variables are not articulated in the problem statement we are investigating, quadratic terms have not been further considered in order to assess whether the purported interaction terms are not spuriously capturing left-out squared terms.

4. Empirical results

Table 1 presents findings on Fixed Effects and Tobit regressions on the left-hand-side and right-hand-side respectively. Each modelling has two sets of specifications: the first on public credit registries and the second on private credit bureaus. Each set of specifications has two sub-sets of specifications pertaining to mobile phone penetration and internet penetration. No net effects of ICT in complementing information sharing offices to reduce market power are computed for Table 1 because of the insignificance of marginal impacts. Most of the significant control variables have the expected signs.

Table 1: Reducing Information Asymmetry, ICTand Market Power (FE and Tobit)

	Dependent variable: Lerner Index							
	Fixed Effects (FE)				Tobit			
	PCR		PCB		PCR		PCB	
	Mobile	Internet	Mobile	Internet	Mobile	Internet	Mobile	Internet
Constant	**-2.536*** **	**-2.317*** **	**-2.705*** **	**-2.015*** **	0.188	0.204	0.247	0.251
	(0.000)	**(0.001)**	**(0.000)**	**(0.004)**	(0.286)	(0.253)	(0.160)	(0.148)
Mobile Phones(IV)	**-0.004** **	---	**-0.006*** **	---	0.001	---	0.00009	---
	(0.034)		**(0.008)**		(0.260)		(0.500)	
Internet (IV)	---	-0.010	---	-0.009	---	-0.003	---	-0.005
		(0.220)		(0.209)		(0.470)		(0.336)
PCR (IV)	-0.014	-0.014	---	---	0.013	0.005	---	---
	(0.585)	(0.384)			(0.549)	(0.711)		
PCB (IV)	---	---	0.001	0.002	---	---	0.001	-0.0002
			(0.828)	(0.694)			(0.819)	(0.949)
PCR(IV) ×Mobile Phones(IV)	0.0001	---	---	---	-0.00009	---	---	---
	(0.582)				(0.661)			
PCB(IV) ×Mobile Phones(IV)	---	---	0.00007	---	----	---	-0.000005	----
			(0.136)				(0.921)	
PCR(IV) ×Internet(IV)	---	0.0004	---	---	---	-0.0001	---	---
		(0.340)				(0.814)		
PCB(IV) ×Internet(IV)	---	---	---	0.0003	---	---	---	0.0001
				(0.265)				(0.724)
GDPpcg	0.006	0.009	0.004	0.005	0.001	-0.001	0.002	0.0005
	(0.436)	(0.333)	(0.611)	(0.515)	(0.884)	(0.897)	(0.737)	(0.942)
Inflation	-0.007	-0.007	**-0.008***	**-0.008***	-0.005	-0.006	-0.006	**-0.008***
	(0.120)	(0.112)	**(0.073)**	**(0.071)**	(0.282)	(0.149)	(0.142)	**(0.089)**
Pop. density	**-0.014** **	**-0.013***	**-0.013***	**-0.016** **	-0.0001	-0.0001	0.00001	0.00002
	(0.019)	**(0.083)**	**(0.060)**	**(0.039)**	(0.551)	(0.540)	(0.945)	(0.924)
Deposit/Assets	0.111	0.152	-0.047	0.001	0.139	0.173	0.136	0.170
	(0.659)	(0.561)	(0.854)	(0.995)	(0.333)	(0.241)	(0.347)	(0.256)
Bank Branches	-0.016	-0.021	-0.022	-0.035	0.004	**0.016***	0.006	**0.017***
	(0.531)	(0.477)	(0.385)	(0.285)	(0.585)	**(0.065)**	(0.322)	**(0.050)**
Price of Loan	**7.382*** **	**7.846*** **	**8.107*** **	**8.539*** **	**2.231*** **	**2.191*** **	**1.851*** **	**1.877*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.002)**	**(0.006)**	**(0.006)**
Quantity of Loan	**0.953*** **	**0.821*** **	**0.992*** **	**0.827*** **	-0.020	-0.017	-0.023	-0.019
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	(0.337)	(0.416)	(0.271)	(0.358)
Small Banks	---	---	---	---	**-0.156** **	-0.123	**-0.145***	-0.121
					(0.040)	(0.123)	**(0.045)**	(0.125)
Domestic Banks	---	---	---	---	**0.202*** **	**0.197*** **	**0.205*** **	**0.196*** **
					(0.001)	**(0.001)**	**(0.001)**	**(0.001)**
Islamic Banks	---	---	---	---	0.071	0.016	0.069	0.017
					(0.668)	(0.936)	(0.678)	(0.933)
Net effect of the Mobile Phone	na	---	na	---	na	---	Na	---
Net effect of the Internet	---	na	---	na	---	na	---	na
R^2 within/Pseudo R^2	0.157	0.158	0.166	0.165	0.027	0.027	0.026	0.027
LR Chi-Square					**36.07*** **	**35.10*** **	**34.82*** **	**35.17*** **
Log Likelihood					-628.508	-619.736	-630.097	-620.661
Fisher	**9.45*** **	**9.17*** **	**10.06*** **	**9.61*** **				
Banks	137	137	137	137				
Observations	651	633	651	633	650	632	650	632

*,**,***: significance levels of 10%, 5% and 1% respectively. PCR: Public Credit Registries. PCB: Private Credit Bureaus. IV: Instrumental Variable. na: not applicable due to the insignificance of marginal effects.

Tables 2 and 3 present QR findings corresponding respectively to public credit registries and private credit bureaus Each table has two sets of specifications corresponding to mobile phone penetration and internet penetration. Consistent differences in information

sharing offices estimated coefficients between OLS and quintiles (in terms of sign, significance and magnitude of significance) justify the relevance of complementing the Fixed Effects and Tobit regressions with estimations throughout the conditional distribution of the Lerner index.

The following findings can be established from Table 2. In the 75^{th} quartile on the right-hand-side for regressions pertaining to internet penetration, the net effect on market power from the interaction between public credit registries and internet penetration is -0.005 (([0.0002 × 7.809] + (-0.007)). In the computation, 7.809 is the mean value of instrumented internet penetration, -0.007 is the unconditional effect of public credit registries while -0.0002 is the corresponding conditional impact from the interaction between public credit registries and internet penetration. In Table 3, positive net effects are apparent from the 50^{th} quartile to the 90^{th} decile on left-hand-side. It follows that the interaction between mobile phones and private credit bureaus has positive net effects on market power in top quintiles of the Lerner index. The mean value of instrumented mobile phone required for the computation of net effects is 37.019.

Table 2: Public Credit Registries, ICT and Market Power (IV QR)

	Dependent variable: Lerner Index											
	Mobile Phones						Internet					
	OLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**OLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	0.195	-0.001	**0.422*** **	**0.675*** **	**0.740*** **	**0.778*** **	0.218	0.181	**0.418*** **	**0.622*** **	**0.714*** **	**0.818*** **
	(0.429)	(0.991)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.364)	(0.276)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Mobile Phones(IV)	0.001	**0.001***	0.0007	0.0003	0.0001	0.0002	---	---	---	---	---	---
	(0.104)	**(0.053)**	(0.335)	(0.418)	(0.767)	(0.436)						
Internet (IV)	---	---	---	---	---	---	-0.004	-0.002	**-0.005** **	**-0.004*** **	**-0.005*** **	**-0.005*** **
							(0.285)	(0.667)	**(0.044)**	**(0.001)**	**(0.000)**	**(0.000)**
PCR (IV)	0.014	0.015	0.0004	-0.006	-0.004	-0.001	0.006	-0.002	-0.008	**-0.006***	**-0.007** **	-0.005
	(0.440)	(0.276)	(0.971)	(0.335)	(0.382)	(0.770)	(0.604)	(0.774)	(0.306)	**(0.079)**	**(0.020)**	(0.221)
PCR(IV) ×Mobile Phones(IV)	-0.0001	-0.0001	-0.00002	0.00006	0.00004	0.00002	---	---	---	---	---	---
	(0.440)	(0.298)	(0.848)	(0.381)	(0.426)	(0.585)						
PCR(IV) ×Internet(IV)	---	---	---	---	---	---	-0.0001	-0.0001	0.0001	0.0001	**0.0002** **	0.0001
							(0.736)	(0.709)	(0.667)	(0.147)	**(0.015)**	(0.174)
GDPpcg	0.001	0.0006	-0.0006	0.0002	-0.00009	-0.00007	-0.00006	-0.003	-0.003	-0.0002	0.001	-0.001
	(0.650)	(0.897)	(0.883)	(0.916)	(0.968)	(0.974)	(0.855)	(0.568)	(0.409)	(0.879)	(0.468)	(0.357)
Inflation	-0.005	-0.002	-0.0001	0.00008	0.001	0.0006	-0.007	-0.005	0.002	-0.0003	**0.002** **	0.001
	(0.235)	(0.423)	(0.957)	(0.954)	(0.161)	(0.568)	(0.166)	(0.192)	(0.410)	(0.771)	**(0.042)**	(0.434)
Pop. density	-0.0001	0.00001	-0.0002	**-0.0001***	-0.0001	0.00002	-0.0001	-0.00008	-0.0001	-0.00006	-0.0001	0.00006
	(0.340)	(0.960)	(0.304)	**(0.079)**	(0.154)	(0.761)	(0.234)	(0.758)	(0.438)	(0.319)	(0.122)	(0.468)
Deposit/Assets	0.138	-0.017	-0.072	**-0.126*** **	**-0.110*** **	**-0.094*** **	0.170	-0.035	-0.001	**-0.099*** **	**-0.095*** **	**-0.068***
	(0.528)	(0.887)	(0.445)	**(0.009)**	**(0.005)**	**(0.005)**	(0.448)	(0.812)	(0.983)	**(0.006)**	**(0.003)**	**(0.064)**
Bank Branches	0.002	0.003	0.004	**0.005** **	**0.006*** **	**0.004*** **	**0.014*** **	**0.016** **	**0.014*** **	**0.013*** **	**0.013*** **	-0.021
	(0.562)	(0.595)	(0.407)	**(0.033)**	**(0.000)**	**(0.008)**	**(0.008)**	**(0.018)**	**(0.001)**	**(0.000)**	**(0.000)**	(0.419)
Price of Loan	2.221	**1.718*** **	0.427	-0.208	**-0.505** **	-0.352	2.180	1.067	-0.018	-0.086	**-0.432** **	**-0.685** **
	(0.105)	**(0.007)**	(0.328)	(0.363)	**(0.029)**	(0.157)	(0.122)	(0.211)	(0.962)	(0.615)	**(0.020)**	**(0.016)**
Quantity of Loan	-0.021	0.0003	0.001	-0.005	0.002	**0.013** **	-0.018	0.003	-0.001	0.001	**0.009***	0.006
	(0.330)	(0.981)	(0.916)	(0.455)	(0.637)	**(0.017)**	(0.399)	(0.872)	(0.930)	(0.807)	**(0.071)**	(0.330)
Small Banks	**-0.153** **	**-0.086***	-0.076	-0.033	-0.019	**-0.048** **	**-0.117***	-0.079	-0.004	-0.012	-0.006	-0.021
	(0.025)	**(0.093)**	(0.106)	(0.182)	(0.388)	**(0.020)**	**(0.074)**	(0.215)	(0.906)	(0.527)	(0.728)	(0.419)
Domestic Banks	**0.203** **	**0.125*** **	**0.105*** **	**0.063*** **	0.025	0.021	**0.199***	**0.127** **	**0.068** **	**0.051*** **	0.007	0.024
	(0.034)	**(0.003)**	**(0.004)**	**(0.00)**	(0.125)	(0.168)	**(0.051)**	**(0.021)**	**(0.035)**	**(0.000)**	(0.585)	(0.184)
Islamic Banks	0.069	0.091	-0.038	-0.084	0.029	-0.001	0.010	0.026	-0.174	**-0.166*** **	**-0.077***	0.036
	(0.412)	(0.402)	(0.717)	(0.121)	(0.535)	(0.971)	(0.898)	(0.893)	(0.101)	**(0.000)**	**(0.093)**	(0.584)
Net effect of the Mobile Phone	Na	na	na	na	na	na	---	---	---	---	---	---
Net effect of the Internet	---	---	---	---	---	---	na	na	na	na	-0.005	na
Pseudo R^2/R^2	0.053	0.059	0.037	0.050	0.058	0.081	0.052	0.054	0.039	0.051	0.064	0.082
Fisher	**3.65*** **						**3.07*** **					
Observations	650	650	650	650	650	650	632	632	632	632	632	632

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. OLS: Ordinary Least Squares. R^2 (Pseudo R^2) for OLS (Quantile Regressions). Lower quantiles (e.g., Q 0.1) signify nations where Market Power is least.

Table 3: Private Credit Bureaus, ICT and Market Power (IV QR)

	Dependent variable: Lerner Index											
	Mobile Phones						Internet					
	OLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**OLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	0.243	-0.044	**0.391*** **	**0.676*** **	**0.754*** **	**0.817*** **	0.247	0.024	**0.379*** **	**0.641*** **	**0.748*** **	**0.822*** **
	(0.294)	(0.752)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.276)	(0.870)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Mobile Phones(IV)	0.001	0.001	-0.00001	**0.0004***	0.0001	0.0003	---	---	---	---	---	---
	(0.238)	(0.110)	(0.984)	**(0.081)**	(0.798)	(0.350)						
Internet (IV)	---	---	---	---	---	---	-0.005	-0.002	-0.002	**-0.003** **	**-0.002***	-0.001
							(0.139)	(0.558)	(0.462)	**(0.013)**	**(0.094)**	(0.151)
PCB (IV)	0.001	0.001	0.003	**0.003*** **	**0.003*** **	**0.002** **	-0.0002	0.004	0.002	0.001	**0.001** **	**0.001***
	(0.505)	(0.432)	(0.115)	**(0.000)**	**(0.003)**	**(0.015)**	(0.846)	(0.132)	(0.257)	(0.247)	**(0.048)**	**(0.064)**
PCB(IV) ×Mobile Phones(IV)	-0.000005	-0.00001	-0.00001	**-0.00002** **	**-0.00003** **	**-0.00002***	---	---	---	---	---	---
	(0.764)	(0.644)	(0.532)	**(0.020)**	**(0.038)**	**(0.074)**						
PCB(IV) ×Internet(IV)	---	---	---	---	---	---	0.0001	-0.0002	-0.00001	0.000002	-0.0001	-0.0001
							(0.336)	(0.330)	(0.941)	(0.977)	(0.174)	(0.259)
GDPpcg	0.002	0.001	0.0006	0.0001	0.0008	0.0003	0.0005	-0.004	-0.0008	0.0008	0.001	-0.0006
	(0.488)	(0.800)	(0.855)	(0.906)	(0.732)	(0.884)	(0.885)	(0.474)	(0.834)	(0.656)	(0.475)	(0.741)
Inflation	-0.006	-0.002	0.001	0.0006	**0.003** **	0.001	-0.008	-0.001	0.001	0.0001	**0.002** **	**0.002** **
	(0.229)	(0.479)	(0.543)	(0.428)	**(0.013)**	(0.286)	(0.181)	(0/724)	(0.629)	(0.891)	**(0.030)**	**(0.044)**
Pop. density	-0.000003	0.0001	0.0001	0.0000001	0.00004	**0.0001***	0.000002	0.0001	0.0001	-0.000003	0.000001	**0.0001** **
	(0.979)	(0.325)	(0.355)	(0.998)	(0.528)	**(0.082)**	(0.985)	(0.347)	(0.343)	(0.957)	(0.987)	**(0.049)**
Deposit/Assets	0.141	-0.020	-0.046	**-0.074*** **	**-0.105*** **	-0.051	0.175	-0.071	-0.014	**-0.060***	**-0.085** **	**-0.053***
	(0.514)	(0.875)	(0.559)	**(0.006)**	**(0.009)**	(0.128)	(0.442)	(0.614)	(0.867)	**(0.098)**	**(0.014)**	**(0.086)**
Bank Branches	**0.006** **	0.007	0.005	**0.003** **	**0.004** **	**0.002** **	**0.016*** **	**0.013***	0.007	**0.009*** **	**0.009*** **	**0.006*** **
	(0.025)	(0.133)	(0.137)	**(0.018)**	**(0.015)**	**(0.044)**	**(0.001)**	**(0.077)**	(0.141)	**(0.000)**	**(0.000)**	**(0.000)**
Price of Loan	1.874	**1.493** **	0.158	**-0.373*** **	**-0.799*** **	**-0.699*** **	1.898	0.959	0.239	**-0.312***	**-0.745*** **	**-0.721*** **
	(0.154)	**(0.012)**	(0.659)	**(0.003)**	**(0.001)**	**(0.003)**	(0.146)	(0.193)	(0.551)	**(0.064)**	**(0.000)**	**(0.002)**
Quantity of Loan	-0.023	0.009	0.0006	**-0.012*** **	-0.003	0.001	-0.020	0.021	0.001	-0.005	0.0006	0.001
	(0.276)	(0.480)	(0.949)	**(0.002)**	(0.593)	(0.736)	(0.370)	(0.226)	(0.892)	(0.342)	(0.912)	(0.809)
Small Banks	**-0.147** **	**-0.099***	-0.041	**-0.044*** **	-0.004	**-0.055*** **	**-0.123***	-0.065	-0.036	-0.022	-0.011	**-0.040** **
	(0.024)	**(0.065)**	(0.272)	**(0.002)**	(0.836)	**(0.006)**	**(0.053)**	(0.213)	(0.386)	(0.256)	(0.587)	**(0.038)**
Domestic Banks	**0.207** **	**0.145*** **	**0.070** **	**0.056*** **	0.029	0.021	**0.199***	**0.163*** **	**0.062***	**0.045*** **	0.016	0.020
	(0.038)	**(0.000)**	**(0.019)**	**(0.000)**	(0.113)	(0.188)	**(0.053)**	**(0.001)**	**(0.061)**	**(0.002)**	(0.316)	(0.229)
Islamic Banks	0.069	0.106	0.0006	**-0.060** **	0.021	0.014	0.017	0.092	**-0.152***	**-0.169*** **	**-0.108** **	**0.041***
	(0.373)	(0.325)	(0.994)	**(0.049)**	(0.668)	(0.706)	(0.839)	(0.600)	**(0.089)**	**(0.001)**	**(0.033)**	**(0.096)**
Net effect of the Mobile Phone	Na	na	na	0.003	0.004	0.001	---	---	---	---	---	---
Net effect of the Internet	---	---	---	---	---	---	na	na	na	na	na	na
Pseudo R^2/R^2	0.052	0.061	0.043	0.060	0.073	0.100	0.054	0.059	0.044	0.058	0.071	0.098
Fisher	**4.12*** **						**4.14*** **					
Observations	650	650	650	650	650	650	632	632	632	632	632	632

***,**,*: significance levels of 1%, 5% and 10% respectively. IV: Instrumented Variable. OLS: Ordinary Least Squares. R^2 (Pseudo R^2) for OLS (Quantile Regressions). Lower quantiles (e.g., Q 0.1) signify nations where Market Power is least.

5. Concluding implications and future research directions

This study has assessed how market power in the African banking industry is affected by the complementarity between information sharing offices and ICT. The empirical evidence is based on a panel of 162 banks from 42 countries for the period 2001-2011. Four estimation techniques are employed, namely: (i) instrumental variable Fixed Effects to control for the unobserved heterogeneity; (ii) Tobit regressions to control for the limited range in the dependent variable; and (iii) instrumental Quantile Regressions(QR) to account for initial levels of market power. Whereas results from Fixed Effect and Tobit regressions are not significant, with QR: (i) the interaction between internet penetration and public credit registries reduces market power in the 75^{th} quartile and (ii) the interaction between mobile phone penetration and private credit bureaus increases market power in the top quintiles. Fortunately, the positive net effects are associated with negative marginal effects from the interaction between private credit bureaus and mobile phone penetration. This implies that mobile phones could complement private credit bureaus to decrease market power when certain thresholds of mobile phone penetration are attained. We briefly discuss these thresholds.

In order for mobile phones to change the unconditional positive effects of private credit bureaus to negative impacts in the top quintiles of the Lerner index, the following mobile phone thresholds are essential: respectively, 150 (0.003/0.00002), 100 (0.003/0.00003) and 100 (0.002/0.00002) for the 50^{th}, 75^{th} quartiles and 90^{th} decile. The last-two thresholds make economic sense because they are within the range of mobile phone penetration disclosed by the summary statistics (0.000 to 147.202). It follows that in top quintiles of market power, the negative marginal effects from the interaction between mobile phones and private credit bureaus can convert the unconditional positive effect of private credit bureaus on the Lerner index into overall negative effects on market power, once certain thresholds in mobile phone penetration are reached, notably: 100 mobile phone subscriptions (per 100 people).

It is also important to provide some explanation on why a substantial part of the findings is insignificant. Accordingly, the insignificant results invite us to infer that information sharing offices are still not significantly reducing market power. Two arguments can be advanced to substantiate this insignificance. On the one hand, information sharing offices may not be fulfilling the anticipated objectives of rendering credit markets contestable,

sharing information to boost competition and decreasing informational rents (Pagano & Jappelli, 1993, p. 2019). On the other hand, ICT may not be effective in disclosing accurate and timely information.

In the light of the above, the insignificant findings which can be explained should not be viewed in the light of publication bias or a file drawer concern in social sciences, where strong findings are favoured in placed of null or insignificant results (Franco et al., 2014; Rosenberg, 2005).Future studies can enrich the extant literature by examining whether the established relationships are apparent within comparative frameworks, notably, in terms of bank: size (large vs. small); ownership (foreign versus (vs) domestic) and '*compliance with Sharia finance*' (Islamic vs. non-Islamic).

Appendices

Appendix 1: Summary of empirical literature on the abuse of market power

Author(s)	Regions (Period)	Abuse of market power?
Tu & Chen (2000)	Taiwan (1986-1999)	Yes
Weill (2004)	Europe (1994-1999)	No
Maudos & de Guevara (2007)	Europe (1993-2002)	No
Koetter & Vins (2008)	Germany (1996-2006)	Yes
Koetter et al. (2008)	USA (1986-2006)	No
Pruteanu-Podpiera et al. (2008)	Czech Republic (1994-2005)	No
Schaeck & Cihak (2008)	Europe & USA (1995-2005)	Yes
Al-Jarrah & Gharaibeh (2009)	Jordan (2001-2005)	No
Solis & Maudos (2008)	Mexico (1993-2005)	No (for deposit market) Yes (for loans market)
Al-Muharrami & Mathews (2009)	Arab Gulf (1993-2002)	No
Fan & Marton (2011)	SEE (1998-2008)	No
Fu & Heffernan (2009)	China (1985-2002)	No
Delis & Tsionas (2009)	Europe (1996-2006)	Yes
Fu & Heffernan (2009)	China (1985-2002)	No
Punt &van Rooij(2009)	EU (1992-1997)	No
Ariss (2010)	A sample of developing countries (1999-2005)	Yes (cost efficiency) No (profit efficiency)
Coccorese & Pellecchia (2010)	Italy (1992-2007)	Yes
Tetsushi et al. (2012)	Japan (1974-2005)	Yes
Titko & Dauylbaev (2015)	Baltic countries (2007-2013)	No

Sources: Coccorese and Pellecchia (2010); Titko and Dauylbaev (2015) and Authors. SEE: South East European countries. EU: Europe Union.

Appendix 2: Variable Definitions

Variables	Signs	Variable Definitions	Sources
Market Power	Lerner	The ratio of the 'difference between the Marginal Cost and Price' on the Price	Authors' calculation and BankScope
Mobile Phones	Mobile	Mobile phone subscriptions (per 100 people)	WDI (World Bank)
Internet Penetration	Internet	Internet penetration (per 100 people)	WDI (World Bank)
Quantity	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 3: Summary Statistics

		Mean	S.D	Minimum	Maximum	Observations
Market Power	Lerner Index	0.513	0.587	0.032	0.969	893
Information Asymmetry	Public credit registries	2.056	6.206	0.000	49.800	1240
	Private credit bureaus	7.496	18.232	0.000	64.800	1235
ICT	Mobile phones	34.107	32.409	0.000	147.202	1776
	Internet	7.268	8.738	0.037	51.000	1757
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	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. Indep: Independent. Vble: Variable.

Appendix 4: Correlation Matrix (Uniform sample size : 684)

Market-Level Controls			Bank-Level Controls				Dummy-Controls						ICT		Info. Sharing		Lerner	
GDP	Infl.	Pop.	D/A	Bbrchs	Price	Quantity	Ssize	Lsize	Dom.	Foreign	Islam	NonIsl.	Mobile	Internet	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	-0.261	-0.122	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	-0.315	-0.238	-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	0.056	0.335	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	-0.087	-0.036	-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	0.610	0.747	0.602	0.139	0.109	Bbrchs
					1.000	-0.075	0.094	-0.094	0.016	-0.016	-0.097	0.097	-0.206	-0.219	-0.342	0.094	0.082	Price
						1.000	-0.171	0.171	0.052	-0.052	-0.067	0.067	-0.096	-0.118	-0.096	0.007	-0.038	Quantity
							1.000	-1.000	0.026	-0.026	-0.020	0.020	0.146	0.089	-0.084	0.080	-0.056	Ssize
								1.000	-0.026	0.026	0.020	-0.020	-0.146	-0.089	0.084	-0.080	0.056	Lsize
									1.000	-1.000	0.089	-0.089	0.151	0.039	0.010	0.187	0.147	Dom.
										1.000	-0.089	0.089	-0.151	0.039	-0.010	-0.187	-0.147	Foreign
											1.000	-1.000	-0.045	-0.039	-0.014	-0.071	0.006	Islam
												1.000	0.045	-0.032	0.014	0.071	-0.006	NonIsl.
													1.000	0.634	0.304	0.519	0.099	Mobile
														1.000	0.513	-0.010	0.045	Internet
															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 closeness. Domestic: Domestic banks. Foreign: Foreign banks. Islam: Islamic banks. NonIsl: Non-Islamic banks. Price: Price of Loans. Quantity: Quantity of Loans. ICT: Information and Communication Technology. Mobile: mobile phone penetration. Internet: internet penetration.
5% critical value (two-tailed) = 0.0750 for n = 684.

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