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Information Sharing and Financial Sector Development in Africa

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Vanessa S. Tchamyou
African Governance and Development Institute,
P.O. Box 8413 Yaoundé, Cameroon.
E-mail: simenvanessa@yahoo.com / simenvanessa@afridev.org

Simplice A. Asongu
African Governance and Development Institute
P.O. Box 8413 Yaoundé, Cameroon.
E-mail : asongusimplice@yahoo.com / asongus@afridev.org

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Vanessa S. Tchamyou & Simplice A. Asongu

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Abstract

This study investigates the effect information sharing has on financial sector development in 53 African countries for the period 2004-2011. Information sharing is measured with private credit bureaus and public credit registries. Hitherto unexplored dimensions of financial sector development are employed, namely: financial sector dynamics of formalization, informalization and non-formalization. The empirical evidence is based on Ordinary Least Squares (OLS) and Generalised Method of Moments (GMM). The following findings are established. Information sharing bureaus increase (reduce) formal (informal/non-formal) financial sector development. In order to ensure that information sharing bureaus improve (decrease) formal (informal/non-formal) financial development, public credit registries should have between 45.45 and 50 percent coverage while private credit bureaus should have at least 26.25 percent coverage.

JEL Classification: G20; G29; L96; O40; O55
Keywords: Information sharing; Banking ; Africa

1. Introduction

There are at least two motives for investigating the relationship between information sharing and financial sector development in Africa: (i) introduction of hitherto unexplored notions of financial informalization, financial formalization and financial non-formalization in the financial sector development literature[1] and (ii) gaps in the information asymmetry literature.

Recent literature accords with the view that access to finance in the continent has been constrained by issues of surplus liquidity (Saxegaard, 2006; Fouda, 2009; Asongu et al., 2016). It is in response to this policy syndrome that over the past twelve years, information sharing bureaus have been introduced to reduce concerns of moral hazard and adverse selection in the financial industry (see Triki & Gajigo, 2014). In essence, information sharing bureaus with instruments of private credit bureaus and public credit registries have been introduced to reduce information asymmetry between borrowers and lenders in order to ease constraints in access to finance[2]. Public credit registries and private credit bureaus are institutions that collect positive (e.g. repayment behaviour) and negative (e.g. default rates) information on borrowers' obligations. The six distinctive features (in terms of access, data sources used, ownership, status, coverage and purpose) between public credit registries and private credit bureaus are discussed in the data section. As documented by Batuo and Kupukile (2010) and Allen et al. (2011), the policies motivating the initiation of information sharing bureaus have built on the evidence that lending by banks is limited by a number of factors that are indirectly or directly connected to the underlying information asymmetry, namely: eligibility to bank lending, physical access and affordability.

Information sharing bureaus are theoretically expected to serve as brokers in banking intermediation. Moreover, by sharing information, information sharing bureaus enable *inter alia*: efficient allocation of capital; reduce constraints in credit and increase interbank competition (see Jappelli & Pagano, 2002). This study is more concerned with the role of information sharing bureaus in financial sector development. Unfortunately, recent African literature on information

[1] Here we define 'financial formalization' as the propensity of the formal banking system to absorb money in circulation. It appreciates the degree at which the formal financial sector is developing to the detriment of informal and semi-formal sectors. Financial informalization is the rate at which the informal financial is developing at the expense of the formal and semi-formal financial sectors. Financial non-formalization appreciates the degree at which the informal and semi-formal financial sectors are progressing to the detriment of the formal financial sector. It is interesting to note that the non-formal financial sector includes the informal and semi-formal financial sectors.

[2] In this study information sharing bureaus and 'public credit registries and private credit bureaus' are used interchangeably throughout.

asymmetry has concluded that information sharing bureaus may not be stimulating inter-bank competition for enhanced credit access (Asongu et al., 2015). The authors have further emphasised that is it possible that instead of using information from information sharing bureaus to improve financial access, because of lack of competition, financial institutions have been using information sharing bureaus to enjoy a 'quiet life'[3].

The literature on information asymmetry related to broad and African-specific studies has not engaged the dimension of financial sector development (Ivashina, 2009; Houston et al., 2010; Tanjung et al., 2010). A reason for this missing link may be that data on information sharing bureaus is not available before 2004. Moreover, from the perspective of interbank competition, according to O'Toole (2014) and Asongu (2015a), a great chunk of studies has been limited to aspects of banking institutions like bank concentration and bank participation. We deviate from this stream of the literature by engaging financial sector development in the perspective of financialization. Accordingly, while a substantial bulk of studies has investigated the incidence of financial reforms on financial access (Arestis et al., 2002; Batuo & Kupukile, 2010), this study presents a case for the imperative of introducing the previously missing informal financial sector into the conception and definition of the financial system on the one hand and the notion of financialization on the other hand.

By introducing the notion of financial sector financialization (which are proposed and discussed in Section 2), the inquiry unites two streams of research by simultaneously contributing to the macroeconomic literature on the measurement of financial development and responding to an evolving field of economic development through informal finance and microfinance. Furthermore, the study suggests a practical way of disentangling the impact of information sharing on various financial sectors. Accordingly, the empirical exercise introduces hitherto unexplored concepts of financial sector non-formalization, informalization, semi-formalization and formalization.

Consistent with Asongu et al. (2016), in spite of the acute concerns about financial access in Africa, the literature on information sharing has not given the continent the scholarly attention it deserves. According to the narrative, the limited scholarly focus on the continent has been

[3] 'Quiet life' denotes the Quiet Life Hypothesis. With regards to Coccorese and Pellecchia (2010), the Quiet Life Hypothesis is a an assumption that banks with substantial influence in the financial industry would use their advantages to grant less credit to borrowers and instead exploit such opportunities for a 'quiet life' or high profit margins.

restricted in scope because very limited and selected countries have been engaged. Some studies have included: no African country (Galindo & Miller, 2001); four nations (Love & Mylenko, 2003) and nine countries (Barth et al., 2009). Triki and Gajigo (2014) have focused on 42 nations for the period 2006-2009, while Asongu et al. (2015, 2016) have investigated 53 African nations for the period 2004-2011. The last-three studies which have employed public credit registries and private credit bureaus in the measurement of information sharing are closest to the present inquiry. Unfortunately, these studies have focused on financial access and not on financial sector development. Our extension is also motivated by recommendations for more research on the incidence of information sharing bureaus (Singh et al., 2009, p. 13).

In order to address the research gap, we use Ordinary Least Squares and the Generalised Method of Moments with data from 53 African countries for the period 2004-2011. The findings show that information sharing bureaus increase (reduce) formal (informal/non-formal) financial sector development and increasing information sharing bureaus leads to negative (positive) net effects on formal (informal/non-formal) financial sector development. We determine policy thresholds at which such counterintuitive effects can be avoided. The rest of the study is structured as follows. Section 2 discusses the theoretical underpinnings, propositions and related literature. The data and methodology are covered in Section 3. Empirical results and policy implications are presented in Section 4. Section 5 concludes and suggests future research directions.

2. Background, theoretical underpinnings, propositions and related literature

2.1 Background

Information sharing bureaus also known as 'credit reference agencies' refer to institutions that collect information on an individual or commercial borrowers' obligations from multiple sources, namely: retails lenders, credit card companies and banks (for individuals) and supplies, direct investigation and public sources (for businesses). Upon data collection, the information is merged for a comprehensive credit report after cross-checking. The report can then be used by future creditors. Information from a credit history report can entail both negative and positive information: (i) negative information (or information on defaults for the most part) and (ii) positive information (consisting of details on all closed and opened credit amounts, closed credit accounts and repayment behaviour).

Information sharing offices are crucial to the growth of credit in any economy because they overcome some asymmetries in information that restrict lenders from investigating risk profiles. On the one hand, information from credit histories ease concerns about adverse selection from the part of creditors because they enable good creditors to conclude collateral in reputation (in situations where complete information is taken into account). On the other hand, information sharing bureaus mitigate moral hazard by addressing the unappealing financial behaviour from borrowers, hence, consolidating repayment and default rates. The resulting expansion of volume in lending is essentially important to underserved sectors such as medium, small and micro enterprises.

Consistent with Mylenko (2008), before 2008, information sharing bureaus were predominantly in a few countries in Latin America and the Organisation for Economic Cooperation and Development. Fortunately, the advent of information and communication technology has dramatically increased the availability of information sharing bureaus in the Middle East and North Africa, Eastern Europe and Sub-Saharan Africa.

With the exception of South Africa, only a few countries in Sub-Saharan Africa had well functioning credit reporting offices before 2008. Some countries like Nigeria, Rwanda and Mozambique had established credit registries with the primary purpose of consolidating supervision at the banking sector. More emphasis was laid on substantial loans and owing to the absence of adequate incentives and technology, these credit registries often did not provide accurate and timely information. A couple of years prior to 2008, several initiatives were implemented across Africa in view of developing private credit bureaus because of requests for information by supervisors to enhance practices in risk management on the one hand and financial establishments on the other hand. In response, several countries initiated information sharing offices, namely: Zambia, Tanzania, Uganda, Ghana and Nigeria. As shown in Appendix 1, whereas many countries now posses public credit registries, only few have private credit bureaus.

2.2 Theoretical underpinnings and propositions

There are two dominants views on the theoretical nexus between the sharing of information and financial development (see Claus & Grimes, 2003). Whereas the first focuses on the transformation of bank assets' risk features, the second is concerned with the mechanisms by

which liquidity provided by banks can be boosted. In addition, the two streams in the literature are in accordance with the perspective that the core mission of banks is to enhance financial access through reduction of cost and optimal channelling of financial resources from banks to economic operators. The highlighted streams are consistent with foremost literature on the importance of reducing information asymmetry for financial intermediary allocation efficiency, notably, on: ex-ante and ex-post information asymmetry (Diamond & Dybvig, 1983); communication by banks to investors on potential borrowers (Leland & Pyle, 1977); diversification with financial intermediaries (Diamond, 1984) and credit rationing models (Jaffee & Russell, 1976; Stiglitz & Weiss, 1981; Williamson, 1986).

More contemporary literature suggests that information sharing bureaus are theoretically expected to boost financial access by improving financial sector development (Triki & Gajigo, 2014; Asongu et al., 2015). We measure financial sector development by addressing some shortcomings in the appreciation of financial development. In essence, the International Monetary Fund's International Financial Statistics (IFS, 2008) definition of the financial system has failed to incorporate the informal financial sector (Asongu, 2014a).

The propositions in Table 1 which incorporate the informal financial sector into the financial system definition are being increasingly employed in the financial sector development literature (see Asongu, 2015ab). Whereas Panel A shows indicators of financial sector based on Gross Domestic Product (GDP), the measurements of Panel B are linked to competition for shares in money supply in the financial sector. The financial sector development concept builds on the notions of informalization, formalization, non-formalization and semi-formalization. For example, financial informalization is the progress of the informal financial sector at the expense of the formal and semi-formal financial sectors whereas financial formalization is the growth of the formal financial sector to the detriment of the other financial sectors (semi-formal and informal). The concept of 'financial sector development' is based on shares in money supply. Within this framework, one financial sector improves to the detriment of other sectors by increasing the quantity of money supply circulating within its sector. It is interesting to note that the non-formal financial sector includes the informal and semi-formal financial sectors.

Table 1: Summary of propositions

Propositions	Name(s)	Formula	Elucidation
Panel A: GDP-based financial development indicators			
Proposition 1	Formal financial development	Bank deposits/GDP	Bank deposits[4] here refer to demand, time and saving deposits in deposit money banks.
Proposition 2	Semi-formal financial development	(Financial deposits – Bank deposits)/ GDP	Financial deposits[5] are demand, time and saving deposits in deposit money banks and other financial institutions.
Proposition 3	Informal financial development	(Money Supply – Financial deposits)/GDP	
Proposition 4	Informal and semi-formal financial development	(Money Supply – Bank deposits)/GDP	
Panel B: Measures of financial sector importance[6]			
Proposition 5	Financial intermediary formalization	Bank deposits/ Money Supply (M2)	From 'informal and semi-formal' to *formal* financial development (formalization)[7] .
Proposition 6	Financial intermediary 'semi-formalization'	(Financial deposits - Bank deposits)/ Money Supply	From 'informal and formal' to *semi-formal* financial development (Semi-formalization)[8].
Proposition 7	Financial intermediary 'informalization'	(Money Supply – Financial deposits)/ Money Supply	From 'formal and semi-formal' to *informal* financial development (Informalisation)[9].
Proposition 8	Financial intermediary 'semi-formalization and informalization'	(Money Supply – Bank Deposits)/Money Supply	Formal to '*informal and semi-formal'* financial development: (Semi-formalization and informalization) [10]

N.B: Propositions 5, 6, 7 add up to unity (one); arithmetically spelling-out the underlying assumption of sector importance. Hence, when their time series properties are considered in empirical analysis, the evolution of one sector is to the detriment of other sectors and vice-versa.
Source: Asongu (2015a).

[4] Lines 24 and 25 of the International Financial Statistics (October 2008).
[5] Lines 24, 25 and 45 of the International Financial Statistics (2008).
[6] Given that money supply is influenced by a country's central bank, a question might arise as to how money supply increased by the central bank affects the informal and non-formal financial sectors. In essence, money supply is used as a denominator, so if the central bank increases the supply of the national currency, it decreases the informal and non-formal financial sectors because the denominator increases.
[7] "*Accordingly, in undeveloped countries money supply is not equal to liquid liabilities or bank deposits. While in undeveloped countries bank deposits as a ratio of money supply is less than one, in developed countries this ratio is almost equal to 1. This indicator appreciates the degree by which money in circulation is absorbed by the banking system. Here we define 'financial formalization' as the propensity of the formal banking system to absorb money in circulation*" (Asongu, 2015a, p. 432).
[8] "*This indicator measures the rate at which the semi-formal financial sector is evolving at the expense of formal and informal sectors*" (Asongu, 2015a, p. 432).
[9] "*This proposition appreciates the degree by which the informal financial sector is developing to the detriment of formal and semi-formal sectors*" (Asongu, 2015a, p. 432).
[10] "*The proposition measures the deterioration of the formal banking sector in the interest of other financial sectors (informal and semi-formal). From common sense, propositions 5 and 8 should be almost perfectly antagonistic, meaning the former (formal financial development at the cost of other financial sectors) and the latter (formal sector deterioration) should almost display a perfectly negative degree of substitution or correlation*" (Asongu, 2015a, p. 432).

Emphasis on the informal financial sector is important because of the substantially documented neglect of this sector in the financial development literature (Aryeetey, 2005; Adeusi et al., 2012; Meagher, 2013). The propositions challenge mainstream narrative in three key areas, namely: (i) disentanglement of the existing financial system definition into its semi formal and formal components; (ii) a definition of the financial system that incorporates the informal financial sector and (iii) introduction of the concept of financialization within the framework of financial sector development.

2.3 Related literature

In accordance with recent information sharing literature (Asongu et al., 2015, 2016), empirical studies have been oriented for the most part towards: the incidence of information sharing among creditors on the one hand and the effects of creditors' rights on improved mechanisms of sharing information. In essence, one strand has been mainly concerned with the relevance of stronger creditors' rights in: bankruptcy (Claessens & Klapper, 2005; Djankov et al., 2007; Brockman & Unlu, 2009) and risk-taking by banks (Houston et al., 2010; Acharya et al., 2011). The other strand is focused on investigating how mitigating asymmetric information could *inter alia*: boost financial access (Djankov et al., 2007; Brown et al., 2009; Asongu, 2015; Triki & Gajigo, 2014); mitigate rates of defaults (Jappelli & Pagano, 2002); influence syndicated bank loans (Ivashina, 2009; Tanjung et al., 2010); reduce the cost of credit (Brown et al., 2009); influence corrupt-related lending (Barth et al., 2009) and affect antitrust intervention (Coccorese, 2012).

Noticeably, the highlighted literature has been focused on developed and developing nations where concerns about surplus liquidity are not so severe, for the most part. In essence, while most of the literature has been oriented towards the Organisation of Economic Cooperation and Development countries and developing nations in Asia and Latin America, the African continent has not received the scholarly attentions it deserves because it comparatively has more severe concerns of financial access, due to information asymmetry (Asongu et al., 2015).

A macroeconomic perspective of the concern about information sharing has been engaged by Galindo and Miller (2001) who have concluded that compared to less developed nations, developed countries with information sharing bureaus are endowed with less restrictions to financial access. In essence, private credit registries that are performing contribute considerably to the decreasing sensitivity by corporations to decisions on investment for 'cash

flows availability' which is a proxy of financial constraint. The authors have also established that credit registries have experienced a 50% reduction in performance, notably: as concerns how investment decisions are sensitive to internal funds.

A combination of private and public credit registries and corporation-related data from the World Bank Business Environment Survey has been used by Love and Mylenko (2000) to investigate two principal issues, notably whether: owing to reduced information asymmetry between perception managers and banks, credit registries are negatively associated with financial credit constraints. The authors conclude that whereas public credit registries do not significantly mitigate financial constraints, private credit bureaus are linked to higher financial access.

The role of information sharing bureaus in reducing information asymmetry on the one hand and borrower (and lender competition) on 'lending corruption' on the other hand, have been examined by Barth et al. (2009) to arrive at two main conclusions. First, lending-related corruption is reduced by interbank competition and reducing information asymmetry plays a fundamental role in the negative nexus. Second, 'corrupt lending' is also substantially affected by the legal environment, firm competition and the ownership structure of banks and firms.

Two main concerns related to information sharing and financial access have been investigated by Triki and Gajigo (2014), notably: the impact of information sharing bureaus on access to finance by firms and the effect of the design of private credit registries on constraints in financial access. Their findings show that: (i) access to finance is comparatively higher in countries which have private credit bureaus, relative to those with public credit registries or no information sharing bureaus and (ii) considerable cross-country differences are apparent in financial access and the design of information sharing bureaus with public credit registries.

Information sharing policy thresholds in financial development have been investigated by Asongu et al. (2015) to establish conflicting findings related to the effects of information sharing bureaus on financial development dynamics of depth, efficiency, activity and size. Asongu et al. (2016) have examined the effects of information sharing bureaus throughout the conditional distributions of financial development to conclude that existing levels of financial development are important in the materialisation of incremental rewards from information sharing bureaus.

As articulated in the introduction, this study complements the existing literature by engaging the missing dimensions of financial sector development and introducing hitherto unexplored concepts of financial formalization, informalization and non-formalization.

3. Data and Methodology

3.1 Data

This paper investigates 53 African countries with data from African Development Indicators and the Financial Development and Structure Database of the World Bank for the period 2004-2011. Information sharing bureaus data is only available from 2004 while the end date of information from the Financial Development and Structure Database is 2011. The focus on Africa is consistent with the stylized facts in the motivation, notably: a stark contrast between severe constraints in financial access in the continent and scarce literature on the nexus between information sharing and financial development.

The propositions in Table 1 are computed from the Financial Development and Structure Database. In accordance with recent African information sharing literature (Triki & Gajigo, 2014), information sharing is measured with public credit registries and private credit bureaus as percentage of adults covered. Six distinctive features between public credit registries and private credit bureaus are apparent, namely, in terms of access, data sources used, ownership, status, coverage and purpose. (1) Public credit bureaus access is restricted to information providers (open to all types of lenders). (2) Whereas information used by public credit registries is sourced from both bank and non-bank activities, that used by private credit bureaus also includes courts and tax authorities in addition to the sources of public credit registries. (3) Public credit registries belong to the government or central banks whereas private credit bureaus involve other independent parties and associations of lending. (4) Private credit bureaus are essentially profit-making while public credit registries are not for profit. (4) While the coverage by public credit registries is provided for the most part on big enterprises and limited with respect to the nature data, private credit bureaus extend beyond big corporations to businesses with rich data and longer histories like small and medium size enterprises. (5) Whereas public credit registries embody public institutions that are founded with the principal goal of banking sector supervision, the creation of private credit bureaus is motivated by the need of and demand for borrowers' information in the market.

Three financial sector measurements are used namely: formal financial development (Propositions 1 and 5); informal financial development (Propositions 3 and 7) and non-formal financial development (Propositions 4 and 8). Semi-formal financial development (Propositions 2 and 6) is not employed because of constraints in degrees of freedom.

Five control variables are used in order to account for variable omission bias, namely: foreign aid, public investment, trade, GDP growth and inflation. This choice of these variables is in accordance with the financial development literature (Huang, 2005; Osabuohein & Efobi, 2013; Asongu, 2014b). After a pilot investigation, it is apparent that accounting for more than five control variables leads to the proliferation of instruments: the number of cross-sections is lower than the corresponding number of instruments in the Generalised Method of Moments specifications.

With regards to the expected signs, from a theoretical standpoint, development assistance is expected to increase financial development because it is anticipated to bridge the saving-investment gap in less developed countries (Easterly, 2005). From a practical angle however, the underlying effect of foreign aid depends on the amount of aid that actually reaches the destination or recipient country. While a substantial bulk of the aid may be spent in donor countries, corrupt officials in recipient countries may siphon some and redeposit in tax havens that are under the jurisdictions of donor countries. The positive relationship between economic growth and financial development has been substantially documented in the literature (see Jaffee & Levonian 2001; Levine, 1997; Saint-Paul, 1992; Greenwood & Jovanovic, 1992). In essence, economic growth is linked to financial intermediation because of more interbank competition and increased availability of resources for productive investments. There is a positive relationship between investment and financial development (see Huang, 2011). Both theoretical (Huybens & Smith, 1999) and empirical (Boyd et al., 2001) literature are consistent with the perspective that chaotic inflation is linked to less active and inefficient financial institutions. Huang and Temple (2005) and Do and Levchenko (2004) have shown that trade openness positively affects financial development. It is important to also note that the engaged variables in the conditioning information set may affect the formal and informal financial sectors differently.

The definition of variables is provided in Appendix 2, Appendix 3 presents the summary statistics while Appendix 4 discloses the correlation matrix. It is apparent from Appendix 3 that the indicators are quite comparable from mean values. Furthermore, from corresponding standard deviations, reasonable estimated linkages can emerge. The purpose of Appendix 4 is to control for potential concerns of multicollinearity. From a preliminary assessment, the concerns are apparent between financial sector development variables. Fortunately, such concerns are not

of relevant nature because the financial sector development variables are employed exclusively as dependent variables in distinct specifications.

3.2 Methodology

3.2.1 Baseline specification

The Ordinary Least Squares specification is as follows in Eq. (1)

$$FSD_{i,t} = \sigma_0 + \sigma_1 PCR_{i,t} + \sigma_2 PCB_{i,t} + \sigma_3 Inter_{i,t} + \sum_{j=1}^{5} \sum_{h=1}^{5} \delta_j W_{h,i} + \varepsilon_{i,t} \quad (1)$$

Where: $FSD_{i,t}$ is the financial sector development (financial formalization, informalization and non-formalization) of country i at period t; σ is a constant; PCR, Public Credit Registries; PCB, Private Credit Bureaus; $Inter$, interaction between either PCR ($PCR \times PCR$) or PCB ($PCB \times PCB$); W is the vector of five control variables (*inflation, public investment, GDP growth, trade* and *foreign aid*), and $\varepsilon_{i,t}$ the error term. The specification is robust to heteroscedasticity and autocorrelation consistent standard errors.

3.2.2Robustness Specification

The study adopts the Generalised Method of Moments with forward orthogonal deviations as empirical strategy for robustness check. The specification is the Roodman (2009ab) extension of Arellano and Bover (1995) which has been documented to limit instrument proliferation and control for cross sectional dependence (see Love & Zicchino, 2006; Baltagi, 2008). The two primary conditions for the implementation of the Generalised Method of Moments technique are satisfied because: (i) the financial sector development dependent variables are persistent, given that their correlations with corresponding lags are higher than the rule of thumb threshold of 0.800 (see Appendix 5) and (ii) the number of time series (T=8) is less than the number of cross sections (N=53). Hence, N>T.

The following equations in levels (2) and first difference (3) summarize the estimation procedure.

$$FSD_{i,t} = \sigma_0 + \sigma_1 FSD_{i,t-\tau} + \sigma_2 PCR_{i,t} + \sigma_3 PCB_{i,t} + \sigma_4 Inter_{i,t} + \sum_{j=1}^{5} \sum_{h=1}^{5} \delta_j W_{h,i,t-\tau} + \eta_i + \xi_t + \varepsilon_{i,t} \quad (2)$$

$$FSD_{i,t} - FSD_{i,t-\tau} = \sigma_0 + \sigma_1(FSD_{i,t-\tau} - FSD_{i,t-2\tau}) + \sigma_2(PCR_{i,t} - PCR_{i,t-\tau}) + \sigma_3(PCB_{i,t} - PCB_{i,t-\tau}) + \sigma_4(Inter_{i,t} - Inter_{i,t-\tau}) + \sum_{j=1}^{5}\sum_{h=1}^{5}\delta_j(W_{h,i,t-\tau} - W_{h,i,t-2\tau}) + (\xi_t - \xi_{t-\tau}) + \varepsilon_{i,t-\tau} \quad (3)$$

Where: $FSD_{i,t}$ is the financial sector development (financial formalization, informalization and non-formalization) of country i at period t; σ is a constant; τ represents tau ; PCR, Public Credit Registries; PCB, Private Credit Bureaus; $Inter$, interaction between either PCR ($PCR \times PCR$) or PCB ($PCB \times PCB$); W is the vector of five control variables (*inflation, public investment, GDP growth, trade* and *foreign aid*), η_i is the country-specific effect, ξ_t is the time-specific constant and $\varepsilon_{i,t}$ the error term. In the specification, a *two-step* instead of a *one-step* procedure is adopted because it controls for heteroscedasticity. In accordance with Brambor et al. (2006) on the pitfalls in interactive regressions: (i) all constitutive terms are included in the specifications and (ii) the effect of the modifying variables (or information sharing bureaus) is interpreted as a conditional marginal effect.

3.2.3 Identification and exclusion restrictions

In accordance with recent literature (Dewan & Ramaprasad, 2014; Asongu & De Moor, 2016), all independent indicators are predetermined or suspected endogenous variables. Hence, while the *gmmstyle* is adopted for the predetermined variables, only years are treated as strictly exogenous and the method for treating the *ivstyle* (years) is 'iv(years, eq(diff))' because it is highly unfeasible for the years to become endogenous in first-difference (see Roodman, 2009b).

In order to address the issue of simultaneity, lagged regressors are used as instruments for forward-differenced indicators. In essence, in order to remove fixed effects that are susceptible of influencing the assessed relationships, Helmet transformations are performed for the regressors (see Asongu & De Moor, 2016). These transformations embody forward mean-differencing of the indicators: the mean of future observations is subtracted from the variables instead of subtracting the previous observations for the contemporaneous one (Roodman, 2009b, p. 104). These transformations ensure parallel or orthogonal conditions between forward-differenced variables and lagged values. Irrespective of the number of lags, in order to minimise the loss of data, with the exception of the last observation for each country, the underlying

transformations are computable for all observations. "*And because lagged observations do not enter the formula, they are valid as instruments*" (Roodman (2009b, p. 104).

The study further argues that the years (also used as instruments) that are treated as strictly exogenous, influence the outcome indicator only through the endogenous explaining variables. The statistical relevance underlying this exclusion restriction is investigated with the Difference in Hansen Test for instrument exogeneity. Accordingly, the alternative hypothesis of the test should be rejected for the instruments to elucidate the dependent variable exclusively via the endogenous explaining variables.

It is important to note that in a standard instrumental variable procedure, rejecting the alternative hypothesis of the Sargan Overidentifying Restrictions test reveals that the instruments explain the outcome variable exclusively through investigated channels or explaining variables. Whereas this information criterion has been employed in the literature using an instrumental variable estimation technique (see Beck et al., 2003; Asongu & Nwachukwu, 2016), in the Generalised Method of Moments procedure (with forward orthogonal deviations) the Difference in Hansen Test is employed to investigate whether years exhibit strict exogeneity by explaining financial sector development exclusively through the proposed mechanisms (or endogenous explaining variables). Therefore, in the reported findings, we confirm the validity of the exclusion restriction test when the alternative hypothesis of Difference in Hansen Test related to instrumental variable (year, eq(diff)) is rejected.

4. Empirical results

4.1 Baseline results with Ordinary Least Squares (OLS)

Table 2 and Table 3 present baseline Ordinary Least Squares findings. While Table 2 presents findings related to formal financial development, the results of informal (Panel A) and non-formal (Panel B) financial development are presented in Table 3. The findings are discussed in two levels, notably: (i) effects without interactions and (ii) impacts with interactions where marginal and unconditional effects are discussed. For instance, in the second-to-the last column of Table 2, the marginal effect of public credit registries on financial formalization is 0.0001 whereas the unconditional impact of public credit registries is -0.005. The corresponding net effect from increasing public credit registries is -0.004 ([2.155×0.0001] + [-0.005])[11].

[11] 2.155 is the mean value of public credit registries.

The following findings are established from the baseline findings. Both information sharing bureaus increase (reduce) formal (informal/non-formal) financial sector development and increasing public credit registries leads to negative (positive) net effects on formal (informal/non-formal) financial sector development. The control variables are significant with the expected signs.

Table 2: Financial Formalization and Information Sharing

	Formal Financial Development					
	Formal Financial Development (Prop.1)			**Financial Dev. Formalization (Prop. 5)**		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**25.451*** **	**31.850*** **	**28.109*** **	**0.657*** **	**0.779*** **	**0.683*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	**1.419*** **	0.728	---	**0.004*** **	**-0.005** **	---
	(0.000)	(0.171)		**(0.000)**	**(0.048)**	
Private Credit Bureaus (PCB)	**0.429*** **	---	0.446	**0.006*** **	---	**0.006*** **
	(0.000)		(0.326)	**(0.000)**		**(0.001)**
PCR*PCR	---	0.013	---	---	**0.0001*** **	---
		(0.216)			**(0.003)**	
PCB*PCB	---	---	-0.002	---	---	0.000
			(0.725)			(0.807)
GDP growth	-0.251	-0.362	-0.367	0.002	0.0001	0.001
	(0.223)	(0.136)	(0.132)	(0.428)	(0.957)	(0.521)
Inflation	**-0.024***	**-0.047*** **	**-0.058*** **	**0.0004*** **	0.0001	**0.0003** **
	(0.089)	**(0.003)**	**(0.001)**	**(0.003)**	(0.520)	**(0.012)**
Public Investment	0.270	0.316	0.331	**0.005*** **	**0.005*** **	**0.005*** **
	(0.270)	(0.275)	(0.277)	**(0.000)**	**(0.000)**	**(0.000)**
Foreign Aid	**-0.383** **	**-0.686*** **	**-0.594*** **	-0.0004	**-0.005*** **	-0.001
	(0.011)	**(0.000)**	**(0.000)**	(0.638)	**(0.000)**	(0.234)
Trade	-0.015	-0.009	0.036	-0.000	0.00007	0.0001
	(0.631)	(0.766)	(0.357)	(0.995)	(0.804)	(0.487)
Net Effect of ISB	na	na	na	na	-0.004	na
Adjusted R^2	0.330	0.235	0.162	0.438	0.096	0.407
Fisher	**30.74*** **	**20.94*** **	**19.04*** **	**22.42*** **	**6.23*** **	**19.05*** **
Observations	293	295	296	293	295	296

*,**,***: significance levels of 10%, 5% and 1% respectively. GDP: Gross Domestic Product. ISB: Information Sharing Bureaus. Dev: Development. na: net effects cannot be computed because of the insignificance of marginal effects and/or unconditional effects.

Table 3: Financial Informalization/Nonformalization and Information Sharing

Panel A: Informal Financial Development

	Informal Financial Dev. (Prop.3)			**Financial Dev. Informalization (Prop. 7)**		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**8.803*** **	**5.576*** **	**8.779*** **	**0.319*** **	**0.215*** **	**0.311*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	0.023	**0.496*** **	---	**-0.004*** **	**0.005** **	---
	(0.440)	**(0.000)**		**(0.000)**	**(0.040)**	
Private Credit Bureaus (PCB)	**-0.214*** **	---	0.045	**-0.006*** **	---	**-0.005*** **
	(0.000)		(0.656)	**(0.000)**		**(0.001)**
PCR*PCR	---	**-0.010*** **	---	---	**-0.0002*** **	---
		(0.000)			**(0.003)**	
PCB*PCB	---	---	**-0.004** **	---	---	-0.00001
			(0.015)			(0.766)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Net Effect of ISB	na	0.474	na	na	0.004	na
Adjusted R^2	0.355	0.080	0.376	0.422	0.090	0.392
Fisher	**24.18*** **	**26.00*** **	**31.98*** **	**21.25*** **	**7.25*** **	**19.16*** **
Observations	308	310	311	293	295	296

Panel B: Non-formal Financial Development

	Non-formal Financial Dev. (Prop.4)			**Financial Dev. Non-formalization (Prop. 8)**		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**9.349*** **	**6.085*** **	**9.317*** **	**0.324*** **	**0.220*** **	**0.316*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	0.020	**0.500*** **	---	**-0.004*** **	**0.005** **	---
	(0.521)	**(0.000)**		**(0.000)**	**(0.048)**	
Private Credit Bureaus (PCB)	**-0.220*** **	---	0.033	**-0.006*** **	---	**-0.006*** **
	(0.000)		(0.746)	**(0.000)**		**(0.001)**
PCR*PCR	---	**-0.011*** **	---	---	**-0.0001*** **	---
		(0.000)			**(0.003)**	
PCB*PCB	---	---	**-0.004** **	---	---	-0.000
			(0.018)			(0.807)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Net Effect of ISB	na	0.476	na	na	0.004	na
Adjusted R^2	0.368	0.080	0.388	0.438	0.096	0.407
Fisher	**27.00*** **	**30.20*** **	**27.11*** **	**22.42*** **	**6.23*** **	**19.05*** **
Observations	308	310	311	293	295	296

*,**,***: significance levels of 10%, 5% and 1% respectively. GDP: Gross Domestic Product. ISB: Information Sharing Bureaus. Dev: Development. na: net effects cannot be computed because of the insignificance of marginal effects and/or unconditional effects.

4. 2 Robustness checks with Generalised Method of Moments (GMM)

Table 4, Table 5 and Table 6 respectively present robust findings with GMM corresponding to formal, informal and non-formal financial developments. Consistent with the

baseline findings, the tables are presented in two categories: the left-hand-side shows results related to GDP-based indicators while the right-hand-side presents findings linked to 'money supply'-oriented measurements of financialization. Four post-estimation diagnostic tests are used to assess the validity of models (Asongu & De Moor, 2016)[12].

The findings are discussed in two levels, notably with regards to: (i) effects without interactions and (ii) impacts with interactions where marginal and unconditional effects are discussed. The net effects are computed with the marginal and unconditional effects. For example, in the last column corresponding to Table 5, the marginal effect of private credit bureaus on financial informalization is -0.00001 while the unconditional impact of private credit bureaus is 0.0007. The corresponding net effect of private credit bureaus is 0.0006 ([4.223×-0.00001] + 0.0007)[13].

The following findings are established from Table 4 on linkages between financial formalization and information sharing bureaus. First, valid inferences cannot be derived from the right-hand-side of Table 4 because at the 1% significance level, there is post-estimation presence of autocorrelation in the residuals. Second, public credit registries negatively affect formal financial development. Third, increasing public credit registries has a negative marginal effect on formal financial development. Hence, the corresponding net effect is negative. Fourth, the significant control variables have expected signs for the most part.

[12] "*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 isalso employed to assess the validity of results from the Hansen OIR test. Fourth, a Fischer test for the joint validity of estimated coefficients is also provided*" (Asongu & De Moor, 2016, p.9).

[13] 4.223 is the mean value of private credit bureaus.

Table 4: Financial Formalization and Information Sharing

	Formal Financial Development					
	Formal Financial Development (Prop.1)			Financial Dev. Formalization (Prop. 5)		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**-3.178***	**-5.012****	**-3.334****	0.040	0.028	0.017
	(0.077)	**(0.014)**	**(0.014)**	(0.189)	(0.296)	(0.588)
Prop.1 (-1)	**1.075*****	**1.097*****	**1.036*****	---	---	---
	(0.000)	**(0.000)**	**(0.000)**			
Prop.2 (-1)	---	---	---	**0.949*****	**0.974*****	**0.966*****
				(0.000)	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	**-0.183*****	**-0.128*****	---	**0.0003***	-0.00005	---
	(0.000)	**(0.001)**		**(0.087)**	(0.912)	
Private Credit Bureaus (PCB)	-0.041	---	-0.040	0.0003	---	-0.00001
	(0.123)		(0.226)	(0.121)		(0.956)
PCR*PCR	---	**-0.001*****	---	---	-0.000	---
		(0.006)			(0.438)	
PCB*PCB	---	---	0.0008	---	---	0.000002
			(0.179)			(0.579)
GDP growth	**-0.059***	**-0.077****	**-0.080*****	**0.0008*****	**0.0008*****	**0.001*****
	(0.065)	**(0.038)**	**(0.003)**	**(0.003)**	**(0.001)**	**(0.000)**
Inflation	-0.003	-0.008	-0.004	-0.0001	-0.0001	-0.00008
	(0.704)	(0.410)	(0.599)	(0.415)	(0.342)	(0.661)
Public Investment	-0.021	**0.075****	0.022	0.0006	0.0001	0.00004
	(0.559)	**(0.011)**	(0.523)	(0.168)	(0.673)	(0.904)
Foreign Aid	0.060	**0.083***	0.066	**0.001*****	**0.001*****	**0.001*****
	(0.178)	**(0.084)**	(0.103)	**(0.000)**	**(0.001)**	**(0.000)**
Trade	**0.036***	**0.035***	**0.033*****	**-0.0001***	**-0.0001****	-0.000001
	(0.067)	**(0.099)**	**(0.001)**	**(0.086)**	**(0.044)**	(0.993)
Net Effects of ISB	na	-0.130	na	na	na	na
AR(1)	(0.001)	(0.001)	(0.001)	**(0.484)**	**(0.563)**	**(0.690)**
AR(2)	**(0.611)**	**(0.556)**	**(0.292)**	(0.046)	(0.043)	(0.031)
Sargan OIR	(0.010)	(0.023)	(0.006)	(0.002)	(0.002)	(0.013)
Hansen OIR	**(0.326)**	**(0.147)**	**(0.388)**	**(0.546)**	**(0.397)**	**(0.546)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.294)**	**(0.230)**	(0.088)	**(0.270)**	**(0.474)**	**(0.122)**
Dif(null, H=exogenous)	**(0.385)**	**(0.189)**	**(0.765)**	**(0.692)**	**(0.349)**	**(0.867)**
(b) IV (years, eq(diff))						
H excluding group	**(0.204)**	**(0.274)**	**(0.239)**	**(0.413)**	**(0.285)**	**(0.446)**
Dif(null, H=exogenous)	**(0.672)**	**(0.124)**	**(0.725)**	**(0.676)**	**(0.624)**	**(0.603)**
Fisher	**3038.79*****	**15360.4*****	**13841.2*****	**1938.02*****	**1369.84*****	**40870.6*****
Instruments	37	37	37	37	37	37
Countries	45	45	45	45	45	45
Observations	258	260	260	258	260	260

*,**,***: 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) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. GDP: Gross Domestic Product. ISB: Information Sharing Bureaus na: net effects cannot be computed because of the insignificance of marginal effects and/or unconditional effects.

Table 5: Financial Informalization and Information Sharing

	Informal Financial Development					
	Informal Financial Dev. (Prop.3)			Financial Dev. Informalization (Prop. 7)		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**-2.256*** **	**-2.265*** **	0.041	-0.014	-0.006	-0.006
	(0.001)	**(0.001)**	(0.943)	(0.252)	(0.539)	(0.513)
Prop.3 (-1)	**1.059*** **	**1.108*** **	**0.985*** **	---	---	---
	(0.000)	**(0.000)**	**(0.000)**			
Prop.7 (-1)	---	---	---	**0.989*** **	**0.972*** **	**1.003*** **
				(0.000)	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	**-0.046*** **	**-0.042** **	---	**-0.0004** **	-0.0003	---
	(0.000)	**(0.032)**		**(0.046)**	(0.302)	
Private Credit Bureaus (PCB)	-0.001	---	**0.021***	-0.0001	---	**0.0007** **
	(0.905)		**(0.072)**	(0.413)		**(0.010)**
PCR*PCR	---	0.0002	---	---	-0.000	---
		(0.477)			(0.936)	
PCB*PCB	---	---	**-0.0008*** **	---	---	**-0.00001*** **
			(0.004)			**(0.001)**
GDP growth	**-0.055*** **	**-0.059*** **	**-0.037** **	-0.00007	-0.0003	-0.0004
	(0.005)	**(0.000)**	**(0.022)**	(0.792)	(0.292)	(0.116)
Inflation	-0.000	0.000	0.000002	**0.0004** **	0.0002	0.0002
	(0.502)	(0.521)	(0.759)	**(0.023)**	(0.284)	(0.237)
Public Investment	**-0.064*** **	**-0.043** **	**-0.042***	**-0.001** **	**-0.0006***	-0.0003
	(0.005)	**(0.031)**	**(0.062)**	**(0.020)**	**(0.056)**	(0.252)
Foreign Aid	0.014	0.019	**-0.035***	**-0.001*** **	**-0.001*** **	**-0.001*** **
	(0.546)	(0.420)	**(0.056)**	**(0.000)**	**(0.000)**	**(0.000)**
Trade	**0.037*** **	**0.030*** **	**0.013***	**0.0003*** **	**0.0002** **	**0.0001***
	(0.000)	**(0.000)**	**(0.078)**	**(0.009)**	**(0.014)**	**(0.068)**
Net Effects of ISB	na	na	0.017	na	na	0.0006
AR(1)	(0.024)	(0.024)	(0.016)	**(0.484)**	**(0.552)**	**(0.883)**
AR(2)	**(0.188)**	**(0.168)**	**(0.243)**	(0.069)	(0.071)	(0.048)
Sargan OIR	**(0.709)**	**(0.824)**	**(0.328)**	(0.034)	(0.023)	**(0.168)**
Hansen OIR	**(0.543)**	**(0.811)**	**(0.692)**	**(0.362)**	**(0.345)**	**(0.640)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.532)**	**(0.664)**	**(0.638)**	**(0.640)**	**(0.710)**	**(0.472)**
Dif(null, H=exogenous)	**(0.482)**	**(0.744)**	**(0.598)**	**(0.235)**	**(0.194)**	**(0.642)**
(b) IV (years, eq(diff))						
H excluding group	**(0.411)**	**(0.710)**	**(0.574)**	**(0.311)**	**(0.240)**	**(0.444)**
Dif(null, H=exogenous)	**(0.672)**	**(0.729)**	**(0.691)**	**(0.482)**	**(0.614)**	**(0.814)**
Fisher	**1484.73*** **	**5227.53*** **	**27847.1*** **	**3093.32*** **	**1091.63*** **	**11136.1*** **
Instruments	37	37	37	37	37	37
Countries	45	45	45	45	45	45
Observations	275	277	277	258	260	260

*,**,***: 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) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. GDP: Gross Domestic Product. ISB: Information Sharing Bureaus. Dev: Development. na: net effects cannot be computed because of the insignificance of marginal effects and/or unconditional effects.

Table 6: Financial Non-formalization and Information Sharing

	Non-formal Financial Development					
	Non-formal Financial Dev. (Prop.4)			**Financial Dev. Non-formalization (Prop. 8)**		
	Baseline	PCR	PCB	Baseline	PCR	PCB
Constant	**-2.594*** **	**-2.680*** **	-0.287	-0.002	-0.009	-0.012
	(0.001)	**(0.000)**	(0.584)	(0.851)	(0.387)	(0.279)
Prop.4 (-1)	**1.037*** **	**1.089*** **	**0.973*** **	---	---	---
	(0.000)	**(0.000)**	**(0.000)**			
Prop.8 (-1)	---	---	---	**0.998*** **	**0.988*** **	**1.012*** **
				(0.000)	**(0.000)**	**(0.000)**
Public Credit Registries (PCR)	**-0.040*** **	-0.032	---	-0.0001	-0.0003	---
	(0.000)	(0.169)		(0.352)	(0.460)	
Private Credit Bureaus (PCB)	0.004	---	0.018	-0.00009	---	**0.0009*** **
	(0.664)		(0.135)	(0.704)		**(0.001)**
PCR*PCR	---	0.0001	---	---	0.000001	---
		(0.799)			(0.838)	
PCB*PCB	---	---	**-0.0006** **	---	---	**-0.00001*** **
			(0.013)			**(0.000)**
GDP growth	**-0.074*** **	**-0.077*** **	**-0.056*** **	**-0.0008*** **	**-0.0008*** **	**-0.0006***
	(0.000)	**(0.000)**	**(0.000)**	**(0.009)**	**(0.002)**	**(0.064)**
Inflation	0.00001	**0.00002** **	**0.00002** **	**0.0003***	0.0002	0.0002
	(0.285)	**(0.013)**	**(0.015)**	**(0.076)**	(0.195)	(0.207)
Public Investment	**-0.043***	-0.022	-0.023	-0.0007	-0.0003	-0.0006
	(0.068)	(0.292)	(0.315)	(0.189)	(0.273)	(0.146)
Foreign Aid	0.023	0.033	-0.022	**-0.001*** **	**-0.001*** **	**-0.001*** **
	(0.352)	(0.198)	(0.177)	**(0.000)**	**(0.000)**	**(0.000)**
Trade	**0.040*** **	**0.033*** **	**0.015** **	0.0001	**0.0002** **	**0.0002***
	(0.000)	**(0.000)**	**(0.021)**	(0.189)	**(0.026)**	**(0.060)**
Net Effects of ISB	na	na	na	na	na	0.00004
AR(1)	(0.019)	(0.021)	(0.012)	**(0.438)**	**(0.484)**	**(0.733)**
AR(2)	**(0.204)**	**(0.204)**	**(0.243)**	(0.048)	(0.043)	(0.030)
Sargan OIR	**(0.457)**	**(0.582)**	**(0.217)**	(0.015)	(0.006)	(0.071)
Hansen OIR	**(0.444)**	**(0.669)**	**(0.632)**	**(0.357)**	**(0.234)**	**(0.545)**
DHT for instruments						
(a)Instruments in levels						
H excluding group	**(0.242)**	**(0.387)**	**(0.410)**	**(0.375)**	**(0.561)**	**(0.157)**
Dif(null, H=exogenous)	**(0.593)**	**(0.739)**	**(0.677)**	**(0.364)**	**(0.150)**	**(0.818)**
(b) IV (years, eq(diff))						
H excluding group	**(0.316)**	**(0.651)**	**(0.448)**	**(0.256)**	**(0.147)**	**(0.292)**
Dif(null, H=exogenous)	**(0.660)**	**(0.739)**	**(0.791)**	**(0.600)**	**(0.605)**	**(0.914)**
Fisher	**2442.05*** **	**6450.46*** **	**25789.4*** **	**898.81*** **	**3066.06*** **	**12722.4*** **
Instruments	37	37	37	37	37	37
Countries	45	45	45	45	45	45
Observations	275	277	277	258	260	260

*,**,***: 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) and AR(2) tests and; b) the validity of the instruments in the Sargan OIR test. GDP: Gross Domestic Product. ISB: Information Sharing Bureaus. Dev: Development. na: net effects cannot be computed because of the insignificance of marginal effects and/or unconditional effects.

From Table 5 on nexuses between financial informalization and information sharing, the following findings are apparent. First, non valid inferences can be derived from the right-hand-side because at the 1% significance level, there is post-estimation presence of autocorrelation in the residuals. Second, public credit registries have a negative impact on informal financial development. Third, the net effect of private credit bureaus is positive, albeit with negative marginal effects and positive unconditional impacts. Fourth, on the control variables, the negative signs of GDP growth and public investment are consistent with intuition. Public investment is channelled through formal banking institutions for the most part. The two decades of growth resurgence in Africa have been characterised by exclusive development. This is the reason an April 2015 World Bank report has revealed that from the 1990s poverty has been decreasing in all regions of the world with the exception of Africa (World Bank, 2015). The findings of Table 6 on non-formal financial development are broadly consistent with those of Table 5 with the exception that the unconditional positive effect of private credit bureaus is not significant[14].

4.2 Further discussion and policy implications

Comparing and contrasting the findings from Ordinary Least Squares and Generalised Method of Moments yields the following conclusions. Information sharing bureaus increase (reduce) formal (informal/non-formal) financial sector development and increasing information sharing offices leads to negative(positive) net effects on formal (informal/non-formal) financial sector development. Whereas the first strand of the findings is broadly consistent with theoretical underpinnings and intuition for introducing information sharing offices, the second strand on decreasing marginal effects is an indication that increasing information sharing offices beyond a specific threshold leads to undesired effects or impacts that are not consistent with theoretical underpinnings. In the paragraphs that follow, we first discuss implications for the first strand of the findings, then implications for the second strand.

In the first strand, findings from non-interactive specifications are consistent with theoretical underpinnings because, information sharing bureaus are primarily designed to increase financial access in the formal financial sector and discourage financial access in the

[14] It is important to note that there is a high degree of substitution between informal and non-formal financial development as a result of concerns in the degrees of freedom in semi-formal financial development.

informal/non-formal financial sectors. From the formal financial development perspective, information sharing bureaus reduce information asymmetry notably: by mitigating adverse selection on the part of lenders and moral hazard on the part of borrowers. From the informal financial development angle, information sharing bureaus also act as disciplining devices by discouraging borrowers from defaulting on their debts because they think they can rely on the informal and non-formal financial sectors as viable and sustainable alternatives to the formal financial sector.

In the second strand of the findings, we have observed that increasing information sharing office leads to undesired effects. In other words, we have broadly established that: (i) in Ordinary Least Squares, increasing public credit registries leads to negative (positive) net effects on formal (informal/non-formal) financial sector development and (ii) in Generalised Methods of Moments, increasing public credit registries leads to negative net effects on formal financial development while increasing private credit bureaus leads to positive net impacts on informal financial development. It follows that increasing information sharing offices beyond certain levels lead to counterintuitive findings. We determine policy thresholds at which such counterintuitive results can be avoided. This is done at three-stages, namely: clarification of the notion of threshold, calculation of thresholds and threshold implications.

The notion of threshold is in accordance with Cummins (2000) on a certain level in language proficiency before second-language speakers can begin enjoying the advantages from a given language. In addition, the conception of threshold is also consistent with the theory of critical mass that has been considerably documented in the economic development literature (see Roller & Waverman, 2001; Ashraf & Galor, 2013). A very recent application of the threshold or critical mass theory from interaction empirical specifications can be found in Batuo (2015). In essence, in this narrative, the notion of threshold is not different from: (i) critical mass for positive impacts (Roller & Waverman, 2001; Batuo, 2015); (ii) minimum requirement for enjoying of positive impacts (Cummins, 2000) and (iii) conditions for Kuznets and U shapes (Ashraf & Galor, 2013).

In the light of the above discussion, a negative (positive) threshold of an information sharing bureau is the level of the information sharing bureau at which an initial or unconditional positive (negative) effect becomes negative (positive). Two scenarios are apparent from our findings. On the one hand, on informal/non-formal financial development, a negative threshold is

the point at which the positive effect of an information sharing bureaus on informal/non-formal financial development becomes negative. On the other hand, on formal financial development, a positive threshold is the point at which the negative effect of an information sharing bureau on formal financial development changes from negative to positive. Hence, these are thresholds of information sharing offices for which the desired effects of increasing (reducing) formal (informal/non-formal) financial development can be achieved. Moreover, for the computed thresholds to make economic sense or have economic meaning, they should be within the minimum and maximum ranges disclosed by the summary statistics.

From the baseline findings: (i) the positive threshold of public credit registries in financial development formalization is 50 (0.005/0.0001) percent coverage (Table 2); (ii) the negative threshold of public credit registries is 49.6 (0.496/0.010) percent coverage in informal financial development and 25 (0.005/0.0002) percent coverage in financial development informalization and (iii) the negative threshold of public credit registries is 45.45 (0.500/0.011) in non-formal financial development and 50 (0.005/0.0001) percent coverage in financial development non-formalization (Table 3). The thresholds are within range for the most part because they are between 0.000 percent coverage (minimum) to 49.8 percent coverage (maximum) for public credit registries. From the robust findings: the negative threshold of private credit bureaus is 26.25 (0.0.21/0.0008) percent coverage in informal financial development (Table 5). The private credit bureaus threshold is also within range. It follows that in order to ensure that information sharing bureaus improve (decrease) formal (informal/non-formal) financial development, public credit registries should have between 45.45 and 50 percent coverage while private credit bureaus should have at least 26.25 percent coverage. This would go a long way to contribute towards addressing the substantially documented concerns of financial access in the African business literature (see Biekpe, 2004; Bartels et al., 2009; Tuomi, 2011; Darley, 2012; Asongu, 2012, 2013).

5. Conclusion and future research directions

This study has investigated the effect information sharing has on financial sector development in 53 African countries for the period 2004-2011. Information sharing is measured with private credit bureaus and public credit registries. Hitherto unexplored dimensions of financial sector

development are employed, namely: financial sector dynamics of formalization, informalization and non-formalization. The empirical evidence is based on Ordinary Least Squares (OLS) and Generalised Method of Moments (GMM). The following findings are established. Information sharing bureaus increase (reduce) formal (informal/non-formal) financial sector development and increasing information sharing bureaus leads to negative (positive) net effects on formal (informal/non-formal) financial sector development. The latter results are apparent in OLS from public credit registries and GMM from: (i) private credit bureaus in informal/non-formal financial development and (ii) public credit registries for formal financial development. We have determined policy thresholds at which counterintuitive effects can be avoided. In order to ensure that information sharing bureaus improve (decrease) formal (informal/non-formal) financial development, public credit registries should have between 45.45 and 50 percent coverage while private credit bureaus should have at least 26.25 percent coverage.

By introducing the concept of financial sector development, the study has united two streams of research by simultaneously contributing to the macroeconomic literature on the measurement of financial development and responding to an evolving field of economic development through informal finance and microfinance. Furthermore, the study has suggested a practical means of disentangling the impact of information sharing on various financial sectors.

The findings can be extended by assessing the established linkages throughout the conditional distribution of financial sector development. The intuition for this future research direction is that the role of information sharing on financial sector development may be contingent on the level of financial sector development, such that differing impacts are apparent in countries with low, intermediate and high levels of financial sector development.

Appendices

Appendix 1: Country-specific average PCR, PCB and financial propositions

	Information sharing		Propositions			
	PCR	PCB	Prop.1	Prop.3	Prop.5	Prop.7
1) Algeria	0.216	0 .000	41.148	9.269	0.820	0.179
2) Angola	2.412	0.000	18.7486	2.148	0.882	0.117
3) Benin	8.037	0.000	21.937	9.841	0.688	0.311
4) Botswana	0 .000	48.150	37.694	1.747	0.952	0.047
5) Burkina Faso	1.750	0.000	18.340	6.235	0.741	0.258
6) Burundi	0.212	0.000	18.463	4.624	0.806	0.193
7) Cameroon	2.312	0.000	15.215	3.816	0.798	0.201
8) Cape Verde	17.042	0.000	72.242	7.190	0.909	0.090
9) Central African Republic	1.412	0.000	6.304	9.268	0.403	0.596
10) Chad	0.400	0.000	4.727	6.744	0.409	0.590
11) Comoros	0.000	0.000	18.489	4.548	0.749	0.191
12) Congo Democratic Republic	0.000	0.000	5.066	2.378	na	na
13) Congo Republic	3.400	0.000	10.682	7.555	0.571	0.428
14) Côte d'Ivoire	2.487	0.000	17.962	10.656	0.629	0.370
15) Djibouti	0.200	0.000	65.312	7.539	na	na
16) Egypt	2.062	5.271	73.307	9.701	0.859	0.115
17) Equatorial Guinea	2.566	0.000	7.3484	1.706	0.807	0.192
18) Eritrea	0.000	0.000	na	0	na	na
19) Ethiopia	0.087	0.000	30.850	5.135	na	na
20) Gabon	12.716	0.000	14.309	3.812	0.788	0.211
21) The Gambia	0.000	0.000	30.796	7.962	0.791	0.208
22) Ghana	0.000	1.700	18.919	6.383	0.748	0.251
23) Guinea	0.000	0.000	14.189	7.659	na	na
24) Guinea-Bissau	1.000	0.000	7.979	13.314	0.349	0.650
25) Kenya	0.000	1.750	36.319	4.472	0.869	0.107
26) Lesotho	0.000	0.000	29.358	4.382	0.868	0.131
27)Liberia	0.280	0.000	20.892	7.293	0.715	0.284
28) Libya	na	na	21.759	4.008	na	na
29) Madagascar	0.162	0.000	15.217	5.971	0.718	0.281
30) Malawi	0.000	0.000	15.570	3.325	0.716	0.159
31) Mali	2.812	0.000	18.272	9.166	0.667	0.332
32) Mauritania	0.187	0.000	19.275	6.463	na	na
33) Mauritius	27.866	0.000	88.152	9.711	0.907	0.092
34) Morocco	1.200	4.812	77.168	18.347	0.807	0.192
35) Mozambique	1.637	0.000	26.547	4.339	0.857	0.14
36) Namibia	0.000	50.362	44.530	0.911	0.975	0.024
37) Niger	0.825	0.000	9.428	6.802	0.579	0.420
38) Nigeria	0.025	0.000	22.728	3.517	0.849	0.150
39) Rwanda	0.425	0.275	13.300	0.761	na	na
40) Sao Tome & Principe	0.000	0.000	28.957	4.998	0.851	0.148
41) Senegal	3.787	0.000	26.308	8.552	0.753	0.246
42) Seychelles	0.000	0.000	64.038	8.113	0.900	0.099
43) Sierra Leone	0.000	0.000	15.716	3.822	na	na
44) Somalia	na	na	na	0.000	na	na
45) South Africa	0.000	57.312	57.972	-15.475	1.363	-0.363
46) Sudan	0.000	0.000	11.217	4.503	na	na
47) Swaziland	0.000	40.216	22.444	1.376	0.940	0.059

48) Tanzania	0.000	0.000	21.909	4.065	0.841	0.151
49) Togo	2.550	0.000	26.491	8.881	0.750	0.249
50) Tunisia	15.975	0.000	46.424	9.636	0.803	0.167
51) Uganda	0.000	0.512	14.319	3.943	0.782	0.217
52)Zambia	0.000	0.975	15.414	1.760	na	na
53) Zimbabwe	0.000	0.000	17.770	0.689	na	na

PCR: Public Credit Registries. PCB: Private Credit Bureaus. Prop.1: Formal Financial Sector Development. Prop.3: Informal Financial Sector Development. Prop.5: Financial Sector Formalization. Prop.7: Financial Sector Informalization. na: not applicable because of missing observations.

Appendix 2: Variable Definitions

Variables	Signs	Variable Definitions	Sources
Formal Financial Development	Prop.1	Bank deposits/GDP. Bank deposits here refer to demand, time and saving deposits in deposit money banks (Lines 24 and 25 of International Financial Statistics (IFS); October 2008).	
Semi-formal financial development	Prop.2	(Financial deposits – Bank deposits)/ GDP. Financial deposits are demand, time and saving deposits in deposit money banks and other financial institutions. (Lines 24, 25 and 45 of IFS, October, 2008).	
Informal financial development	Prop.3	(Money Supply – Financial deposits)/GDP	
Informal and semi-formal financial development	Prop.4	(Money Supply – Bank deposits)/GDP	Asongu (2014a; 2015ab)
Financial intermediary formalization	Prop.5	Bank deposits/ Money Supply (M2). From 'informal and semi-formal' to *formal* financial development (formalization)	
Financial intermediary 'semi-formalization'	Prop.6	(Financial deposits - Bank deposits)/ Money Supply. From 'informal and formal' to *semi-formal* financial development (Semi-formalization)	
Financial intermediary 'informalization'	Prop.7	(Money Supply – Financial deposits)/ Money Supply. From 'formal and semi-formal' to *informal* financial development (Informalisation).	
Financial intermediary 'semi-formalization and informalization'	Prop.8	(Money Supply – Bank Deposits)/Money Supply. Formal to '*informal and semi-formal'* financial development: (Semi-formalization and informalization)	
Information Asymmetry	PCR	Public credit registry coverage (% of adults)	World Bank (WDI)
	PCB	Private credit bureau coverage (% of adults)	World Bank (WDI)
Economic Prosperity	GDPg	GDP Growth (annual %)	World Bank (WDI)
Inflation	Infl	Consumer Price Index (annual %)	World Bank (WDI)
Public Investment	PubIvt	Gross Public Investment (% of GDP)	World Bank (WDI)
Development Assistance	NODA	Total Net Official Development Assistance (% of GDP)	World Bank (WDI)
Trade openness	Trade	Imports plus Exports in commodities (% of GDP)	World Bank (WDI)

WDI: World Bank Development Indicators. FDSD: Financial Development and Structure Database.

Appendix 3: Summary Statistics (2004-2011)

	Variables	Mean	S.D	Min.	Max.	Obs.
Financial Sector Development	Formal Financial Development (Prop.1)	28.037	20.970	2.926	92.325	377
	Semi-formal Financial Development (Prop. 2)	0.199	0.715	0.000	4.478	424
	Informal Financial Development (Prop. 3)	5.350	5.106	-18.89	25.674	424
	Non-formal Financial Development (Prop. 4)	5.550	5.171	-18.89	25.674	424
	Financial Formalization (Prop. 5)	0.773	0.168	0.235	1.469	377
	Financial Semi-formalization (Prop. 6)	0.007	0.029	0.000	0.244	377
	Financial Informalization (Prop. 7)	0.219	0.168	-0.469	0.764	377
	Financia Non-formalization (Prop. 8)	0.226	0.168	-0.469	0.764	377
Information Asymmetry	Public Credit registries (PCR)	2.155	5.812	0.000	49.8	381
	Private Credit Bureaus (PCB)	4.223	13.734	0.000	64.8	380
Control Variables	Economic Prosperity (GDPg)	4.996	4.556	-17.66	37.998	404
	Inflation	7.801	4.720	0	43.011	357
	Public Investment	74.778	1241.70	-8.974	24411	387
	Development Assistance	10.396	12.958	0.027	147.05	411
	Trade Openness (Trade)	80.861	32.935	24.968	186.15	392

S.D: Standard Deviation. Min: Minimum. Max: Maximum. GDPg: GDP growth. Obs: Observations.

Appendix 4: Correlation Analysis (Uniform sample size : 293)

Financial Sector Competition								Info. Asymmetry		Control Variables					
Prop.1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8	PCR	PCB	GDPg	Inflation	PubIvt	NODA	Trade	
1.000	0.110	0.127	0.142	0.565	-0.052	-0.556	-0.565	0.411	0.310	-0.094	-0.071	0.058	-0.311	0.141	Prop.1
	1.000	-0.013	0.130	-0.031	0.872	-0.128	0.031	-0.023	-0.100	-0.060	0.260	-0.040	0.007	-0.086	Prop.2
		1.000	0.989	-0.604	-0.068	0.617	0.604	0.127	-0.569	-0.083	-0.082	-0.054	0.033	-0.006	Prop.3
			1.000	-0.604	0.057	0.593	0.604	0.123	-0.579	-0.091	-0.044	-0.059	0.034	-0.018	Prop.4
				1.000	-0.092	-0.983	-1.000	0.094	0.613	-0.004	0.008	0.128	-0.246	0.119	Prop.5
					1.000	-0.091	0.092	-0.059	-0.084	-0.077	0.289	-0.012	0.123	-0.074	Prop.6
						1.000	0.983	-0.083	-0.598	0.018	-0.061	-0.125	0.224	-0.105	Prop.7
							1.000	-0.094	-0.613	0.004	-0.008	-0.128	0.246	-0.119	Prop.8
								1.000	-0.140	-0.026	-0.081	0.068	-0.154	0.207	PCR
									1.000	-0.101	-0.035	-0.047	-0.329	0.084	PCB
										1.000	-0.169	0.129	0.122	0.037	GDPg
											1.000	-0.081	-0.0004	-0.006	Inflation
												1.000	0.059	0.130	PubIvt
													1.000	-0.309	NODA
														1.000	Trade

Info: Information. Prop.1: Formal Financial Sector Development. Prop.2: Semi-Formal Financial Sector Development. Prop.3: Informal Financial Sector Development. Prop. 4: Non-Formal Financial Development. Prop.5: Financial Sector Formalization. Prop.6: Financial Sector Semi-Formalization. Prop.7: Financial Sector Informalization. Prop.8: Financial Sector Non-Formalization. PCR: Public Credit Registries. PCB: Private Credit Bureaus. GDPg: GDP growth. Popg: Population growth. PubIvt: Public Investment. NODA: Net Official Development Assistance. I

Appendix 5: Persistence of the dependent variables

	Prop.1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8
Prop.1(-1)	0.9900							
Prop.2(-1)		0.8801						
Prop.3(-1)			0.9096					
Prop.4(-1)				0.9105				
Prop.5 (-1)					0.9841			
Prop.6(-1)						0.8775		
Prop.7(-1)							0.9855	
Prop.8(-1)								0.9841

Prop.1 (-1): Lagged value of Proposition.

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