Reserves Hoarding in Banking Industry: Explaining the African Paradox

Arnaud TAMINI (ptamini@unistra.fr) & Joël PETEY (joel.petey@unistra.fr)

University of Strasbourg

Abstract

In this paper, we explain why banks in Sub-Saharan Africa (SSA) are hoarding reserves while firms struggle to access to credit. We hypothesize that the lack of demand for credit, and the instability of deposits are the main drivers of reserves hoarding by banks. First, using the credit market disequilibrium framework, we find that in SSA the total supply of credit is not fully absorbed by the market suggesting a disequilibrium induced by the demand. Second, using this disequilibrium in addition to the volatility of deposits, we explain the reserves hoarding by banks in SSA. The results support our hypotheses, confirming that the weakness of demand combined with the instability of deposits lead banks to hold excess liquidity in SSA. Our results suggest that a better risk management framework, and policies allowing to soften the access to credit market may lead bank to displace the reserves towards the private sector.

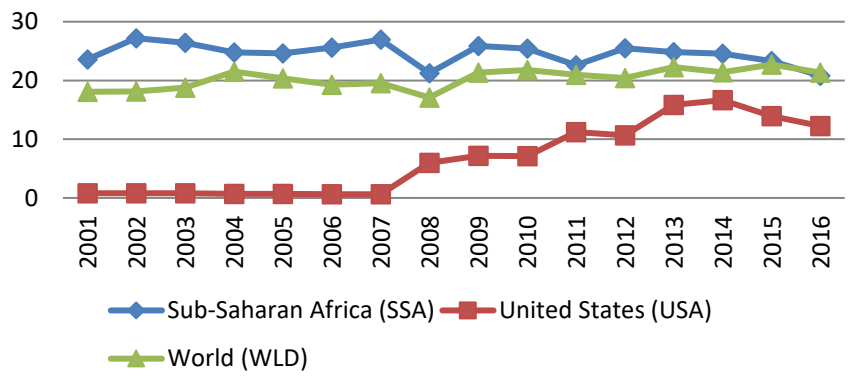
JEL Classification: G21; G32; N27; 016

Keywords: Africa; Banks Reserves; Credit Demand; Credit Supply; Deposits Volatility

1. Introduction

In Sub-Saharan Africa (SSA) countries, the financial sectors are defined by two main characteristics. First, they are underdeveloped. While the median private credit to deposit ratio is 34% in non-African developing countries, this indicator is only 18% in Africa (Beck and Cull, 2014). Second, the financial sectors are mainly bank-based. For instance, in CEMAC countries, the banking system accounts for more than 80% of the financial assets. In many countries, the banking system is more or less the only channel of financing the economy. The access to credit is a hindrance for entrepreneurs and small business, as banks are more likely to lend to large firms (Demirguc-Kunt and Klapper, 2012). However, banks hold a large part of reserves as cash, interbank deposits, central bank debt, and short-term government securities (Carpio and Honohan, 1993; Freedman and Click, 2006; Saxegaard, 2006). In fact, over the period 2001 and 2016, the average bank liquid reserves to bank assets ratio was ranged from 20% to 30%. By comparison, over the same period, the average value of this indicator for the whole World varied between 15% and 20%. Moreover, the difference is huge between the Sub-Saharan Africa and developed countries. Considering the United States of America (USA), the bank liquid reserves to bank assets ratio was 1% for a long period, before a substantial increase during the 2007's financial crisis (Figure 1). Meanwhile in Ghana the liquid funds to liabilities were 62.1%, and in Democratic Republic of Congo the liquid assets to demand liabilities reached a peak of 76.5%, in 2011 (EIB, 2013). To sum up, banks are holding reserves in SSA, and yet they are reluctant to lend. In this context, the hoarding of reserves by commercial banks in SSA is in some extent paradoxical, and then require more attention especially as this situation could be harmful to the growth (Freedman and Click, 2006) and weakens the monetary policy transmission (Saxegaard,2006).

Figure 1: Bank Liquid Reserves to Bank Assets Ratio



Sources: **Authors estimates using Word Bank data**

Regarding the literature, two hypotheses allow to explain the hoarding of reserves by commercial banks. First, banks are hoarding liquid reserves in order to hedge against the risk of liquidity related to borrowers. This hypothesis, also known as the "precautionary motive", is consistent with the modern theory of financial intermediation (Bryant, 1980; Diamond and Dybvig , 1983). In fact, banks are consistently facing liquidity risk as their main role is to grant illiquid loans to borrowers, while providing at the same time liquidity on demand to depositors. Therefore, they have to hold liquid assets in order to face potential cash withdrawals. Second, banks are hoarding reserves because there is disequilibrium between the supply and the demand on the credit market. This disequilibrium can be handled from two perspectives (Nguyen and Qian, 2014; Claessens et al., 2012). One can first assume that the disequilibrium came from credit crunches (Yuan and Zimmermann, 2004; Ikhide, 2003; Woo, 2003). Indeed, the deficiency in lending process, the lack of bankable projects, the decline in economic activity, but also the levels of interest rates can lead bank to tightening the supply of credit. Then, the disequilibrium can also be explained by a collapse in credit demand (Pazarbasioglu, 1997). Thus, tighter conditions for access to the credit market, as well as unfavorable economic context usually lead to demand shocks.

In the literature these two hypotheses are usually examined separately. In this paper, we consider both hypotheses simultaneous to explain the accumulation of reserves by commercial banks in SSA. Using the credit market disequilibrium approach (Maddala and Nelson, 1974), we first determine an indicator representing the disequilibrium between the supply and the demand of credit in the banking industry. Then, using this indicator in addition to the liquidity risk (Nketcha Nana and Samson, 2014), we explain the hoarding of excess liquidity by SSA commercial banks.

The results allow validating our prior hypotheses. In fact, on average there is disequilibrium on credit market as the total supply of loans is not absorbed by the market. Firm's inability, in particular Small and Middle Enterprises (SMEs), to guarantee their loan by the adequate collateral leads to demand collapse. Moreover, the instability of deposits constrains banks to hold liquidity in order to satisfy the regular and frequent withdrawals. Our results suggest that a better risk management framework, associated with a softening of required collateral are necessary in order to redirect the excess liquidity towards the real economy, and thus sustain the development of the private sector. To our knowledge this paper is the first to provide a complete understanding of the reserves hoarding phenomenon in developing countries.

The remainder of the paper is organized as follows. Section 2 provides the background of the research question. Section 3 focuses on the econometric framework. The results are presented in section 4. And lastly, we conclude in section 5.

2. Background

2.1.Literature review

The modern theory of financial intermediation explains the liquidity hoarding by commercial banks as a way to guard against the liquidity risk (Bryant, 1980; Diamond and Dybvig, 1983). In fact, banks use liquid deposits to grant illiquid loans. This situation exposes them to liquidity risk, especially in case of excessive cash withdrawals. Thus, the hoarding of liquidity is an insurance against an eventual bank run. Most of papers have focused on this hypothesis to explain the build-up of excess liquidity around the world, and especially in developing countries. In this perspective, Nketcha Nana and Samson (2014) investigate the reserves hoarding by African banks, under the precautionary motive by using the volatility of the deposits as main proxy for the liquidity risk. The results show that the deposits' volatility has a positive and significant impact on banks reserve ratio. A reduction of the deposit volatility is associated with a significant decrease of banks' reserves for precautionary motive. Therefore, the results confirm that the liquidity hoarding by African banks can be explained, at least partially, by a precautionary strategy to guard against the traditionally risk associated with liquidity services to depositors.

However, the hoarding of reserves by commercial banks cannot be explained by the only precautionary motive. Saxegaard (2006), by investigating the phenomenon of excess liquidity in Sub Saharan Africa made a distinction between excess liquidity held for precautionary motive, and involuntary excess liquidity. Basically, a demand function for excess reserves which includes precautionary motive is first estimated. Then, the involuntary excess liquidity is determined as the gap between statutory excess liquidity and the level of excess liquidity declined by the demand function. Therefore, in addition to liquidity held for precautionary motive, commercial banks in SSA build-up involuntary excess liquidity. Overall, the results suggest that the deficiency in lending process and the increase in deposits, especially government deposits, contribute to explain this involuntary excess liquidity.

The build-up of reserves could also be inducing by the levels of interest rates and the objective of banks in terms of profitability. Frost (1971) investigates the causes of large accumulation of reserves in 1930s. The main conclusion links this phenomenon to the low interest rates over the

period. Indeed, as point out, “banks find it profitable to hold excess reserves at very low interest rates because the costs associated with constantly adjusting reserves position is greater than the interests earned on short term securities”. As consequences, their demand for reserves curve is kinked at very low interest rates. Khemraj (2010) also reaches the same conclusions by showing that in Less Developing Countries (LDCs) the liquidity preference curve is flat at a very high loan rate. In fact banks require a minimum interest rate before lending to borrowers. They continue to lend as long as borrowers are able to pay the minimum interest rate. However, when borrowers fail to pay the minimum required interest, banks begin to accumulate excess reserves. Generally, in those countries, the flatness occurs at a very high interest rate. For example, concerning Guyana, Jamaica, Uganda and Namibia, the liquidity preference curve becomes flat at respectively 14.5%, 17%, 19% and 11%. Generally, by assumption, in these countries the credit market is oligopolistic and noncompetitive. Dow (2001) finds that for US banks, the demand of excess reserves tends to decrease when the interest rates are high.

Furthermore, the future behavior of the central bank in terms of monetary policy may also have an impact on banks’ demand for reserves. Indeed, using an extended reserves management model in German money market, Nautz (1998) shows that banks tend to increase their reserves if (1) refinancing is expected to be more expensive, and if (2) future refinancing conditions become more uncertain. Additional estimates confirm that banks reduce their demand for borrowed reserves in case of high uncertainty. As consequences, interest rates decrease in the interbank money market.

According to Freedman and Click (2006), concerning the developing countries this accumulation of excess liquidity can be explained by the following reasons: “(i) higher reserve requirements due to greater macroeconomic risk and volatility; (ii) significant deficiencies in the legal and regulatory environment which make it difficult to enforce contracts and foreclose on collateral; (iii) widespread availability of government bonds which crowds-out private investment; (iv) substantial asymmetric information due to the fact that lenders often know little about prospective borrowers; and (v) inadequate skills for assessing risk and managing non-sovereign loans.”. Therefore, some reforms have to be undertaken in these domains in order to redirect the excess liquidity towards the private sector.

The consequences of reserves hoarding on economy are diverse. However such consequences could be highlighted through two main channels: the opportunity cost of holding excess liquidity, and the negative impact on the monetary policy.

The accumulation of large parts of reserves by commercial banks has an important opportunity cost on the economy. In the developing countries, the financial markets are underdeveloped. The economy is financing by the banking system. Usually, only the large firms have access to credit line. The SMEs suffer of lack of credit. Funds which could be used to finance the private sector are hoarding by banks as reserves. This fact has an important impact on growth by hampering the financial development. And yet, as point out by Levine et al. (2000) the financial development has a positive impact on the growth rate. Freedman and Click (2006) investigate the potential consequences on growth of transferring the excess liquidity to private sector through lending channel. By examining the results from Levine et al. (2000) concerning the link between financial intermediation and growth, Freedman and Click (2006) note that bank credit to private sector has more important impact on growth than deposits. Indeed, a 10% increase in credit to private sector is associated with a 0.25% higher per capita growth rate, versus only 0.17% in the case of deposits. Using this conclusion, they investigate the potential additional growth rate if bank's excess reserves were transferred to private sector by the channel of lending. The estimates indicate that on average the additional growth rate would be 1.1% in developing countries, with a cap of 2.8% for Jamaica. Therefore, the hoarding of excess reserves hampers the economic development in developing countries by reducing significantly the growth rate.

Another consequence of reserves hoarding is the impact on monetary policy transmission. This consequence is widely explored by the studies on excess reserves. Overall, most of studies conclude that the excess reserves have a negative impact on the monetary policy transmission. Saxegaard (2006) examines the phenomenon of excess liquidity in SSA and the implications for the effectiveness of monetary policy. The results suggest that the excess reserves weaken the monetary policy transmission mechanism, and therefore the ability of the monetary authorities to influence demand conditions in the economy. Khemraj (2010) also points out that in the case of Less Developing Countries (LDCs) the indirect monetary policy on loan market becomes effective only when the loan rate is high. This is explained by the fact that for these countries, the flatness of the liquidity preference curve occurs at a very high interest rate. Nguyen and Boateng (2013) study the mechanism of lending channel in China, and in what extent bank-specific characteristics affect monetary policy transmission in presence of excess reserve beyond the precautionary levels. The results shows that banks with large involuntary reserves tend to be less respond in the tightening of the monetary policy. Moreover, in presence of involuntary excess reserve, large banks and liquid banks are more likely to take greater risk.

As consequences, when monetary policy is tightened, their capacity to extent credit is curtailed. And finally, Carpio and Honohan (1993) warn that in the case of credit crunch and socialist economies' monetary overhang, the conventional tightening of the monetary policy in order to resolve the issue of excess reserves would be particularly inappropriate.

2.2. Reserves hoarding in Sub-Saharan Africa banking industry: An overview

In the 80's, African banking systems went through fragility periods, partly because banks were under-capitalized and illiquid. Nowadays, the trend has been reversed. African banking industry is sounder. Particularly, banks are characterized by excess liquidity (Honohan and Beck, 2007; Beck et al., 2011; EIB, 2013). From 2000 to 2015, on average banks reserves to deposits have varied between 19% and 30%[1]. In Ghana, the ratio of liquid funds to liabilities went from 41.6% in 2008 to 62.1% in 2011, while the ratio of liquid funds to assets reached 53.6%. Over the same period, in Democratic Republic of Congo, the liquid assets to demand liabilities were averaged a peak of 76.5%, largely superior to the regulatory minimum limit of 20% (EIB, 2013).

In the wake of global financial crisis, analyses show the resilience of SSA banks. In fact, given low leverage, healthy capitalizations levels, but especially excess liquidity, sub-Saharan Africa banks were well-prepared to handle the 2008's financial turmoil (Beck et al., 2011; EIB, 2013). Therefore, in some extent, the hoarding of reserves by SSA banks contributes to the soundness of the banking system. However, in those countries, the excess liquidity usually goes hand to hand with a decrease in lending. The access to credit remains the main challenge for firms, and especially SMEs (Demirguc-Kunt and Klapper, 2012). Banks tend to finance big firms, while the SMEs are left out. Thus, while the reserves hoarding allows reducing the volatility and the fragility of financial system, it is also prejudicing bank ability to supply credit. In others words, the hoarding of excess reserves by SSA banks can be consider as inefficiency of their fundamental role, namely the financial intermediation.

Many reasons are usually advanced to explain the persistent excess liquidity in SSA countries. These reasons diverge in accordance with the lenders or the borrowers. On the one hand, banks consider the lack of bankable projects as the main reason of holding high liquidity (Mecagni et al., 2015; EIB, 2015; Honohan and Beck, 2007). In Democratic Republic of Congo, the difficulties face by banks in enforcing their legal rights as lenders, the volatility of deposits and

[1] Authors' estimates using International Financial Statistics (IFS) data.

cash preference contribute to the build-up of excess liquidity (EIB, 2013). On the other hand, firms and especially SMEs are discouraged to apply for credit because they cannot satisfy banks' requirements in terms of collateral and documentation (Beck et al., 2011). Overall, the reasons of reserves hoarding in SSA banks can be synthesized in two main hypotheses. First, banks are holding reserves because there is a deficiency on the credit market. More specifically, there is disequilibrium between the supply and the demand for credit. And second, the build-up of liquidity by SSA banks is conforming to the necessity to guard against the volatility of deposits in those countries.

3. Econometric framework

We rely on two fundamental hypotheses to explain the build-up of reserves in SSA banking industry:

Hypothesis 1: Banks in SSA are hoarding reserves because there is a disequilibrium on the credit market between the supply and the demand.

Hypothesis 2: Banks in SSA are hoarding reserves in order to guard against the exposure to liquidity risk.

Usually, these two hypotheses are investigated separately by the literature (Nketcha Nana and Samson, 2014). In this paper, we propose to combine both in order to provide a complete explanation regarding banks behavior in terms of liquidity management in SSA countries.

3.1. Disequilibrium on the credit market

In order to test the first hypothesis, and more precisely to build the *Disequilibrium Indicator* between the supply and the demand, we rely on the general market disequilibrium model (Fair and Jaffee, 1972). This disequilibrium model is estimated using the "appropriate" Maximum Log-likelihood method suggested by Maddala and Nelson (1974). With such method, the estimations do not depend on the sample separation, but also allow estimating the probabilities with which each observation lies on the demand or supply function. However, the method is based on the assumption of serial independence for the residuals. The disequilibrium model allows distinguishing between periods of excess supply or excess demand because there is

assumption that the credit market does not clear at any time period. In period of excess supply, the observed credit represents the demand for loans. Thus, the total supply of loans is not absorbed by the market. Conversely, in the presence of excess demand, the observed credit is equal to the supply. In this context, banks are unable to satisfy the demand for loans. These relations are formalized by the following equation:

$$C_t = \min\left(C_t^d, C_t^s\right) \quad (1)$$

Where: C_t is the quantity of credit observed at time *t*. C_t^d is the quantity of credit demanded during the period *t*. And C_t^s, the quantity of credit supplied during the period *t*.

C_t^d and C_t^s are unobservable, and can be written as:

$$C_t^d = X'_{1t}\beta_1 + u_{1t} \quad (2)$$

$$C_t^s = X'_{2t}\beta_2 + u_{2t} \quad (3)$$

Where: X'_{1t} and X'_{2t} denote the variables that influence C_t^d and C_t^s respectively; β_1 and β_2 are the parameters, while u_{1t} and u_{2t} are the residuals.

Given the assumption that u_{1t} and u_{2t} are independently and normally distributed with variances σ_1 and σ_2, the density functions and the distribution functions are expressed as follow:

$$f_1(C_t) = \frac{1}{\sqrt{2\pi\sigma_1}} exp\left[-\frac{1}{2\sigma_1^2}(C_t - \beta_1 X'_{1t})^2\right] \quad (4)$$

$$f_2(C_t) = \frac{1}{\sqrt{2\pi\sigma_1}} exp\left[-\frac{1}{2\sigma_2^2}(C_t - \beta_2 X'_{2t})^2\right] \quad (5)$$

$$F_1(C_t) = \frac{1}{\sqrt{2\pi\sigma_1}} \int_{C_t}^{\infty} exp\left[-\frac{1}{2\sigma_1^2}(C_t^d - \beta_1 X'_{1t})^2\right] dC_t^d \quad (6)$$

$$F_2(C_t) = \frac{1}{\sqrt{2\pi\sigma_2}} \int_{C_t}^{\infty} exp\left[-\frac{1}{2\sigma_2^2}(C_t^s - \beta_2 X'_{2t})^2\right] dC_t^s \quad (7)$$

When $C_t^d < C_t^s$, C_t is determined by the demand equation. Therefore, the conditional density of C_t is given by:

$$\frac{f_1(C_t).F_2(C_t)}{pr(C_t^d < C_t^s)} \quad (8)$$

When $C_t^s < C_t^d$, C_t is determined by the supply equation. In this case, the conditional density of C_t is given by:

$$\frac{f_2(C_t).F_1(C_t)}{1 - pr(C_t^d < C_t^s)} \quad (9)$$

Given that C_t is determined by either demand with probability $pr(C_t^d < C_t^s)$, or supply with probability $1 - pr(C_t^d < C_t^s)$, the unconditional density of C_t is given by:

$$f(C_t|X'_{1t}, X'_{2t}) = pr(C_t^d < C_t^s)\left[\frac{f_1(C_t).F_2(C_t)}{pr(C_t^d < C_t^s)}\right] + \left(1 - pr(C_t^d < C_t^s)\right)\left[\frac{f_2(C_t).F_1(C_t)}{1 - pr(C_t^d < C_t^s)}\right] \quad (10)$$

And then:

$$f(C_t|X'_{1t}, X'_{2t}) = [f_1(C_t).F_2(C_t) + f_2(C_t).F_1(C_t)] \quad (11)$$

If L is the log-likelihood, then:

$$L = \sum_{t=1}^{n} \log[f(C_t|X'_{1t}, X'_{2t})] \quad (12)$$

Therefore:

$$L = \sum_{t=1}^{n} \log[f_1(C_t).F_2(C_t) + f_2(C_t).F_1(C_t)] \quad (13)$$

At this stage, the model is estimated using Maximum Log-likelihood method, allowing to display the determinants of supply and demand of credit, as well as the estimated supply and the estimated demand of credit. Prior to the estimates, we follow the literature to identify the determinants of credit demand and supply in Sub-Saharan African banking industry. However, countries in this region differ from developed countries, and even from non-African developing countries, especially regarding the structure of their economy. Indeed, in most of African countries, the economy is based on agriculture, as well as in exporting raw materials and importing finished products. Thus, we take into account these specificities in selecting demand and supply drivers of credit.

We assume that in Sub-Saharan Africa banking industry, the credit demand is potentially driven by the following variables:

The *lending rate* is used as cost of credit for borrowers (Hurlin and Kierzenkowski, 2007; Poghosyan, 2011; Adolfo and Roberto, 2002; Laffont and Garcia, 1977). Under rationality assumption, households and companies aim to borrow at the lowest interest rate. Therefore, the

lending rate is expected to be negatively correlated with the demand of credit. To account for the dynamic of the economic activity we use the *GDP, the import of goods and services*, the *export of goods and services* (Vouldis, 2015; Adolfo and Roberto, 2002; Schmidt and Zwick, 2012; Hurlin and Kierzenkowski, 2007). In periods of strong economic activity, the demand of credit from households and companies is expected to go up. Companies need funds to support their importations and exportations. In the case of SSA, these variables could play an important role as countries are widely dependent on importations for household's products, and exportations for flowing out agricultural and mineral products. As the previous variables, we also introduced the *aggregate raw materials index* as proxy for the economic activity. Indeed, in SSA countries, most of countries are producers of raw materials. In some countries, the economy is mainly based on this activity. Therefore, this variable is common and specific for SSA countries, where the economic activity is not diversified. We include the *lagged loans* as determinant in the demand function (Baek, 2005; Schmidt and Zwick, 2012). Basically, with this variable, we make assumption that the demand of credit for actual period depends on the quantity of credit obtained in the previous period. This variable allows capturing the dynamic effects on the credit market. And lastly, the *inflation* accounts for the potential instability of the macroeconomic framework due to a sustained increase in general price level of goods and services. The inclusion of this variable in the case of Sub-Saharan Africa could make sense as in many countries those in charge of monetary policies have difficulties to control the inflation rate. However, the effects of inflation on demand of credit are questionable. For Pazarbasioglu (1997), this variable should be positively correlated to the demand for credit, while Ghosh and Ghosh (1999) sustain that in presence of inflation, the demand for credit tend to go down.

Concerning the supply function, we consider the following variables as determinants:

The *lending rate* already includes in the demand function, may also influence banks behavior in supplying credit (Poghosyan, 2011; Bauwens and Lubrano, 2007; Adolfo and Roberto, 2002; Kim, 1999). In fact, we are expected banks to extent credit as long as the interest rate matches their expectations. We introduce in the supply function the *lending capacity*, a key variable in the context of credit market disequilibrium model (Oulidi and Allain, 2009; Adolfo and Roberto, 2002; Vouldis, 2015; Ikhide, 2003; Poghosyan, 2011). This variable captures bank's ability to extend credit. Banks' lending capacity is estimated as the total collected deposits, adjusted by the required reserves from Central Bank. Thus, we make an implicit assumption that after having fulfilled the required reserves constraint, the remaining funds are available for lending. A higher lending capacity strengthens bank's ability to expand credit. We take into

account the cost of borrowed funds with the *deposit rate* (Hurlin and Kierzenkowski, 2007). The holders of liquidity are looking for the best investment opportunities. Thus, there is a positive correlation between the quantity of collected deposits and the level of proposed deposit rate. A high deposit rate enables banks to collect more deposits. As consequence, their lending capacity also increases, and thus their ability to expand credit. The *JP Morgan agricultural index is* introduced to account for the volatility related to the agricultural products on the market. We are expected a negative sign for this variable. In fact, the exportation of agricultural products is an important economic activity in many SSA countries. A high level of volatility represents an uncertainty for the related revenues. This could have an impact on deposits, on bank's lending capacity, and thus on credit supply. As in the demand function, we also include the *Lagged Loans* in the specification of the supply function. The amount of current supply credit may be determined by the previous granted loans (Baek, 2005; Schmidt and Zwick, 2012). And finally, the *Return on Equity (RoE)* and the *Return on Assets (RoA)* are supposed to take into account bank's profitability (Čeh, Dumičić, and Zagreb, 2011). The profitability could be a key variable in credit market, especially in SSA countries where the main activity of banks consists in collecting deposits and potentially granting loans. Therefore, with a higher profitability, banks should be more willing to increase the supply of credit.

Knowing respectively the estimated supply and the estimated demand, the *disequilibrium indicator* is therefore estimated as the difference between these two variables divided by the *claims to private sector*[2]. However such variable does not allow distinguishing between periods of excess demand or excess supply. To fill the gap, we introduce two additional variables: the *excess supply* and the *excess demand*. Indeed, we first create two dummy variables: *positive disequilibrium dummy and negative disequilibrium dummy*. The first one is equal to 1 if the *disequilibrium indicator* is positive and 0 otherwise. The second dummy takes 1 as value if the *disequilibrium indicator* is negative and 0 otherwise. Finally, the multiplicative interaction terms *disequilibrium indicator*positive disequilibrium dummy* and *disequilibrium indicator*negative disequilibrium dummy* represent respectively the *excess supply* and the *excess demand.*

[2] $Disequilibrium\ Indicator = \frac{(Estimated\ Supply - Estimated\ Demand)}{Claims\ on\ Private\ Sector}$

3.2. Liquidity risk

To implement the second hypothesis regarding banks exposure to liquidity risk, we refer to the modern theory of financial intermediation stating banks usually hold liquidity in order to guard against the liquidity risk (Bryant, 1980; Diamond and Dybvig, 1983). Indeed, banks are in charge of providing a dual service: first make illiquid loans to borrowers, and then provide liquidity on demand to depositors. However, this traditional activity exposes them to liquidity risk given that demand for cash withdrawals may occur before loans pay back. The exposure to liquidity risk is more important in SSA banking industry especially as cash is largely used rather than electronic payments. Moreover, bank run are likely to occur as in most of countries the deposits insurance is deficient. To account for the liquidity risk, we rely on Nketcha Nana and Samson (2014), and use the *volatility of deposits* as proxy. Thus, one assumes that banks will always maintain a large amount of reserves as long as the uncertainty concerning the volume of deposits in near future is high. This indicator is built from monthly data, allowing to increase its soundness in terms of time-varying. The *volatility of deposits* is replicated as follows:

$$Vol_t = \frac{\sqrt{(\frac{1}{N-2})\sum(d_{tn} - \bar{d}_{tn})^2}}{\mu_t} \qquad (14)$$

Where *t* is for years and *n* for months;

$d_{tn} = Log(D_{tn}) - Log(D_{t,n-1})$, with D_{tn} the total bank deposits of the nth-month of the period *t*.

$\bar{d}_{tn}$ is the mean of d_{tn} over the N-months period t;

And: $\mu_t = (\frac{1}{N})\sum Log(D_{tn})$

3.3. Explaining liquidity hoarding by SSA banking industry

We mainly explain the hoarding of reserves in SSA banking industry by the two fundamentals variables estimated above: the *disequilibrium indicator* and the *volatility of deposits.* Thus, we engage two theoretical frameworks in economics: markets in disequilibrium (Fair and Jaffee, 1972; Maddala and Nelson, 1974), and the modern theory of financial intermediation regarding banks' exposure to liquidity risk (Bryant, 1980; Diamond and Dybvig, 1983).

Besides, we also control for two other variables. Indeed, in order to account for the positive and negative changes in deposit inflows, and the possibility of high asymmetric changes in deposit inflows, we introduce the *skewness of deposits* in the estimates. Then, we also take into account banks' capitalization level by introducing the *equity to assets* ratio because the level of equity may influence the amount of holding reserves.

We use two indicators to capture the large amount of reserves held by SSA banks. We first consider the *reserves to deposits*. With this first indicator, we reflect the traditional definition of reserves. Indeed, reserves are defined as banks claims on central banks. Thus, they include commercial banks' currency with central banks, holding of securities issued by central banks, and other claims on central bank. However, in SSA banks use to finance States by investing in short term government securities, sometimes at the expense of SMEs. Therefore, in order to consider this characteristic, we extend our definition of reserves by adding the claims on central government, as well as claims on nonresidents, leading to the second indicator of liquidity: *extended reserves to assets*.

The following model is then estimated:

$$Liquidity = \alpha + \beta X + \varepsilon \qquad (15)$$

With: *X* the set of variables explaining reserves holding in SSA banking industry, including the *disequilibrium indicator* and the *volatility of deposits*; β the set of parameters; $Liquidity$ the *reserves to deposits* or *extended reserves to assets*, depending on the estimated model; and ε the residuals.

Besides the ordinary least squares (OLS) the model is estimated using Fixed-effects OLS estimators in order to deal with potential unobserved heterogeneity. We have double checked the estimates by clustering the standards errors. The paper deals with aggregate data at the country-level. The sample includes 26 SSA countries where data were available from 2000 to 2014. We resort to several databases: International Financial Statistics (IFS) Database, Word Development Indicators Database and Bloomberg Professional Server. Thus, variables used to estimate the supply and demand function such as *lending rate, loans, deposits, deposits rate,* are taken from the IFS Database, while the *JP Morgan Agricultural Index is* from Bloomberg Professional Server. The remaining variables used in the estimates are from Word Development Indicators Database. However, it is worth to mention that we also manually collected the

required reserves rates from countries' central bank in order to build the *lending capacity* variable.

4. Results

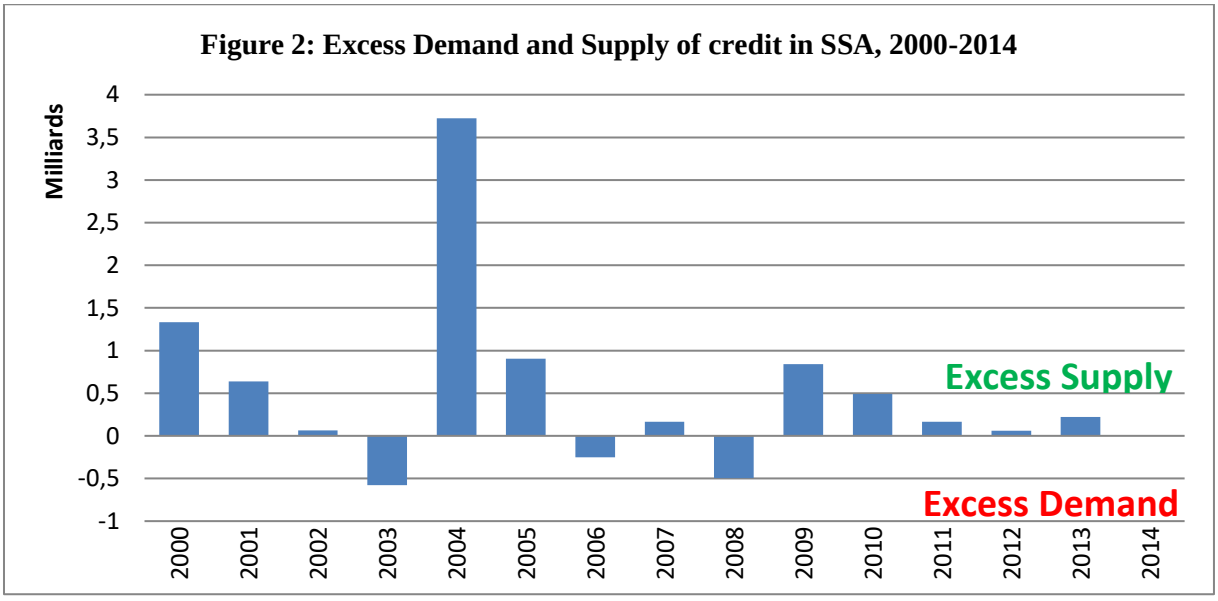
The results from the credit market disequilibrium model are reported in Table 2. All the determinants considered in the demand and supply functions are statistically significant, with the majority having the expected signs.

The dynamic of the economy measured by the *GDP* has a positive impact on the demand of credit in SSA countries. In fact, we consider the level of economy as a key driver of credit demand. As Adolfo and Roberto (2002), Vouldis (2015) and Čeh et al. (2011), we find that the demand for credit tend to increase in periods where the economy is performing better. However, given the specificity of SSA countries, we consider three others variables. Indeed, African countries are well known as specialized in out-flooding raw materials and importing finished products. Thus, we account for the *import and export of goods and services.* The results are consistent with our primary measure (*GDP*). Both variables are positively correlated with credit demand in SSA. On the one hand, firms demand for credit to support the costs associated with the importations. Such costs could be huge as African countries almost import all products related to household appliances, medicine and cars industry. On the other hand, we could expect a negative sign for the *exportations of goods and services* as firms are supposed to lower their demand for credit since they cash the receipts. However, this positive correlation between the demand of credit and the exportations can be explain by the fact that many African countries are landlocked, and therefore don't have access to the sea. Besides, the others means of transportation are deficient. This situation lead to expensive transport costs. Thus, firms need funds to finance their exportations, hence a positive association between credit demand and exportations. And lastly, the *raw materials index* confirms the previous results. We also consider the economic instability by introducing the *inflation*. In the literature, there is no clear consensus concerning the sign of this variable. Ghosh and Ghosh (1999) find that demand for credit tend to decrease in case of high inflation. In this paper, as Pazarbasioglu (1997) for the Finland, we find that inflation increases credit demand in SSA countries. On the credit supply side, the *JP Morgan agricultural index* turns out with an unexpected and significant positive sign.

The *lending rate* is also one of the key drivers of both demand supply of credit. Considered as cost of credit for borrowers, we were expecting a negative sign for this variable as several papers in the literature (Hurlin and Kierzenkowski, 2007; Poghosyan, 2011; Adolfo and Roberto, 2002; Laffont and Garcia, 1977). Conversely, the results show a positive and significant association with the demand of credit. Such results are in some extents counterintuitive as firms and households are supposed to lower their demand for credit when the lending rate goes up. However, Herrera et al. (2013) by studying the tightening of credit supply in Egypt also find an unexpected positive sign. The *lending rate* also has a positive impact on credit quantities. In fact, banks are willing to extend credit as long as they are able to charge higher interest rates. The positive sign of both *Return on Equity* (RoE), *and Return on Assets* (RoA) confirm this result.

On the supply side, we consider the *lending capacity* as the leading determinant of credit supply. Indeed, bank ability to supply credit is highly dependent to the available resources. We find that higher lending capacity lead bank to extend credit. The positive correlation between the *deposit rate* and the supply of credit allow confirming this result. In fact, higher deposit rate may lead to high collected deposits, then high lending capacity and therefore high credit supply. Finally, the *lagged loans* included in both supply and demand functions suggest dynamic effects on credit market in SSA.

Figure 2: Excess Demand and Supply of credit in SSA, 2000-2014



Overall, we find that on average there was disequilibrium on SSA credit market between 2000 and 2014 (Figure 2). More specifically, the credit supply was not fully matched by the demand during this period. Except in 2003, the main period of excess demand is located between 2006

and 2008, during the financial turmoil. The remaining period, the credit market is characterized by an excess supply. Our results are consistent with other studies on the topic in developing countries. Herrera, Hurlin, Zaki, & Bank, (2013) by studying the credit market in Egypt, find a persistence of excess supply from 2003 to 2011. Oulidi & Allain (2009) show that there was no credit rationing in Morocco during the first half of the 2000 decade. Indeed, this period was characterized by an excess supply. In Latina America countries, and more specifically in Mexico, Adolfo & Roberto (2002) find that during the credit slowdown in 1990-2000, the credit market was led by an excess supply.

The results explaining the hoarding of reserves in SSA banking industry are presented in table 3.

During our study period, disequilibrium on credit market leads banks to build-up excess reserves in SSA countries (Table 3, Model 1, 3 & 7). Indeed, the *disequilibrium indicator* is statistically significant for all the specifications except the Model 5. This disequilibrium is mainly induced by shocks on demand (Figure 2). By distinguishing between periods of excess demand and period of excess supply, we find that the variable *excess supply* is statistically significant suggesting that the lack of demand for credit increases reserves hoarding by banks in SSA (Table 3, Model 2, 4, 6 & 8). Then in period of excess demand, the variable *excess demand* has the expected negative sign inducing that banks reduce their holding of reserves when the demand for credit goes up. However, this indicator is statistically significant only when we consider the extended reserves with fixed effects (Table 3, Model 8). Overall, these results are consistent regardless the dependent variable or the econometric model. Apart from the economic context, the lack of demand can be explained by the inability of firms to provide the necessary collateral to guarantee their loans. Indeed, in many SSA countries, borrowers fail to enter the credit market because they cannot satisfy banks requirements in terms of collateral (Beck et al., 2011). As consequences, usually only large firms have access to line of credit while SMEs struggle (Demirguc-Kunt and Klapper, 2012). For instance in CEMAC zone more than 70% of SMEs do not have access to credit market (BEAC and BCEAO, 2016). Besides, the concentration of banking infrastructures in urban area, as well as the importance of informal sector leads to lower demand of credit.

The second driver of reserves hoarding by banks in SSA is the volatility related to deposits. In fact, the results show that the *volatility of deposits* is statistically significant regardless the model (Table 3). We find that banks increase their reserves when the uncertainty regarding

deposits withdrawals become greater. In SSA countries, the volatility of deposits is exacerbated by the preference for cash leading bank to constantly hold liquidity in order to face the frequent withdrawals. The preference for cash is explained by the fact that in those countries, conversely to developed ones, the electronic payment is underdeveloped, even if in recent years the mobile banking is emerging. Besides, the non-existence of deposits insurance in several countries increases the risk of a bank run, inducing banks to be more caution in managing their liquidity.

Within the estimates, we also control for the equity ratio assuming that the equity and the liquid assets could be either substitutes either complements. Indeed, one can first assume that higher liquidity (equity) may lower the need for higher equity (liquidity). Then, higher liquidity (equity) alone is not sufficient to hedge insolvency-driven (liquidity-driven) crises (Basel Committee on Banking Supervision , 2016). At the first place and regardless the statistical significance, our results indicate a substitution effect between reserves and equity in SSA. Indeed, except for the two first models, the equity ratio has a consistent negative sign throughout the models (Table 3). However, the variable is significant only when we consider the extended reserves ratio with OLS fixed effects.

Overall, our prior hypotheses are supported by the results. The liquidity risk along with the weakness of demand lead bank to hold reserves with central bank. Besides, by using an extended definition of reserves, we also find that banks have preference for lending to governments which are usually facing chronic deficit budget in SSA and are particularly risk-free. Thus, except large firms, the remaining private sector faces under-funding while bank reserves are displaced towards central bank or government securities. Our results are consistent within the main models and techniques used. We also checked the results by clustering the standard errors at the country level. We found stable results for all the models specifications considered. Apart from the statistical significance, our results are also economically significant. Indeed, by reducing the volatility of deposits by one standard deviation (Table 1), banks could reinject on average 8% points of their deposits in the economy, either more than 2% points of the assets. Moreover, if banks success to reduce the gap between the demand and the supply of credit by one standard deviation (Table 1), they will be able to decrease the hoarding of reserves by a 2% point on average. More specifically, a reduction of one standard deviation in disequilibrium between the supply and demand is likely to allow the absorption of the equivalent of 3% point of assets, either 1.7% point of the deposits.

In SSA countries, banks are major economic actors. As financial markets are underdeveloped in many countries, they are the only one channel of financing the economy. The hoarding of reserves is harmful to the growth (Freedman and Click, 2006), but also weakens the monetary policy transmission (Saxegaard, 2006). Therefore, it is important to find the suitable policies allowing displacing the reserves towards the private sector. Referring to our results, two kind of policy can be undertaken. First, banks have to reduce the instability of deposits. The establishment of a better risk management framework as well as the introduction of the deposits insurance could contribute to lower the volatility of deposits. Second, banks need to boost the demand for credit. To do so, it is important to soften the access to credit market by being more flexible about the required collateral.

5. Conclusion

In this paper, we explain one of the SSA banking industry paradox. Indeed, banks are hoarding a large amount of reserves, while the private sector struggles to find funding. We hypothesize that the build-up of reserves by banks is driven by two key factors: the weakness of demand and the instability of deposits. Using the credit market disequilibrium framework, we first estimate the disequilibrium between the demand and the supply on the credit market. At this stage the results suggest that the disequilibrium on the market is induce by shocks on the demand. Then, using this disequilibrium indicator in addition to the volatility of deposits, we explain the reserves hoarding by banks in SSA. Our results confirm the prior hypotheses. In fact, the disequilibrium indicator as well as the volatility of deposits is statistically significant within our regressions, confirming that in SSA the build-up of reserves is driven by the lack of demand and the instability of deposits. Therefore, our results suggest that the establishment of a better risk management framework as well as the softening of the conditions to access the credit market could allow banks to reinject the reserves in the economy, and therefore contribute to the emergence of a sustainable private sector.

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Table 1

Variables	N	Mean	SD	Min	Max
Deposit Rate	226	8.583	6.842	2.433	48.691
Return on Assets (RoA)	226	2.173	1.772	-4.678	9.908
Return on Equity (RoE)	226	22.326	20.356	-48.863	160.344
Exports of Goods and Services	226	36.155	20.065	6.320	110.618
GDP	226	22,897,847,685	48,814,724,488	487,038,822	299,415,359,540
Imports of goods and Services	226	44.483	31.452	18.287	246.812
Inflation	226	10.280	25.771	-8.975	324.997
Aggregate Raw Materials Index	226	81.398	12.027	62.881	109.965
Lending Rate	226	20.069	15.733	5.570	103.160
JP Morgan Agricultural Index	226	18.111	5.623	12.620	32.980
Claims on Private Sector	217	8,714,764,490	31,676,971,748	34,414,867	242,528,634,361
Lagged Loans	217	7,305,038,777	26,957,611,070	25,739,276	198,861,967,695
Lending Capacity	226	21,751,368,442	107,204,540,037	22,300,182	922,124,748,106
Estimated Demand	217	10,781,059,471	35,404,844,154	64,170,963	265,870,000,000
Estimated Supply	217	11,273,149,721	36,264,474,471	84,015,460	246,830,000,000
Disequilibrium	217	492,141,645	4,345,761,674	-19,030,000,000	45,991,000,000
Disequilibrium Indicator	217	10.786	21.191	-22.613	67.327
Reserves to Deposits	217	18.423	12.324	34.093	94.893
Volatility of Deposits	217	0.229	0.149	0.041	1.167
Skewness of Deposits	217	-3.105	91.244	-323,562	233
Extended Reserves to Assets	182	42.046	12.666	11.867	78.970
Excess Supply	217	13.677	18.264	0.000	67.327
Excess Demand	217	-2.891	5.6	-22.613	0.000
Equity to Assets	182	10.238	3.038	0.575	20.430

This table reports descriptive statistics on variables used within the estimates

Table 2

Variables	Parameters	Standard Errors
Demand Function		
Intercept	0.209***	0.065
Lending Rate	0.136**	0.063
GDP	0.141***	0.047
Aggregate Raw Materials Index	0.146***	0.046
Imports of goods and Services	0.141**	0.061
Exports of Goods and Services	0.177***	0.057
Lagged Loans	0.136***	0.050
Inflation	0.136**	0.055
Supply Function		
Intercept	0.108***	0.028
Lending Rate	0.135**	0.065
Lending Capacity	0.174***	0.060
Deposit Rate	0.187***	0.066
JP Morgan Agricultural Index	0.186**	0.081
Lagged Loans	0.169***	0.064
Return on Assets (RoA)	0.131**	0.056
Return on Equity (RoE)	0.145***	0.055
Sigma Demand	0.934***	0.093
Sigma Supply	0.991***	0.099
Likelihood	-211.855	
N	226	

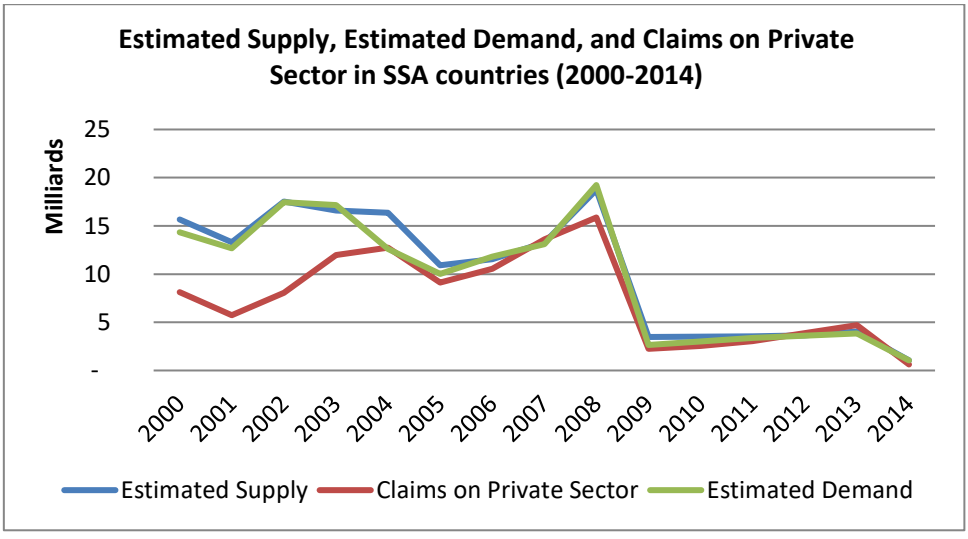
This table reports the estimates of demand and supply function.

Table 3

Variables	Reserves to Deposits				Extended Reserves to Assets			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Disequilibrium Indicator	0.057*		0.096**		0.077		0.128***	
	(0.033)		(0.042)		(0.055)		(0.049)	
Excess Supply		0.092**		0.142***		0.133**		0.222***
		(0.039)		(0.052)		(0.069)		(0.061)
Excess Demand		-0.111		-0.113		-0.190		-0.303*
		(0.125)		(0.150)		(0.171)		(0.176)
Deposits Volatility	49.851***	50.215***	51.905***	52.423***	14.349**	14.93**	16.591***	17.638***
	(10.896)	(10.801)	(4.965)	(4.961)	(7.61)	(7.491)	(5.906)	(5.825)
Skewness	0.011	0.011	0.015*	0.016*	0.015	0.015	0.015*	0.016*
	(0.011)	(0.011)	(0.009)	(0.009)	(0.012)	(0.012)	(0.011)	(0.011)
Equity to Assets	0.074	0.091	-0.103	-0.087	-0.31	-0.283	-0.546*	-0.513*
	(0.231)	(0.228)	(0.254)	(0.253)	(0.307)	(0.303)	(0.302)	(0.297)
Intercept	0.057**	0.046*	0.079**	0.072*	0.414***	0.396***	0.455***	0.439***
	(0.025)	(0.025)	(0.043)	(0.043)	(0.042)	(0.042)	(0.051)	(0.050)
Years Fixed Effects	No	No	Yes	Yes	No	No	Yes	Yes
N	182	182	182	182	182	182	182	182
R^2	0.376	0.380	0.445	0.452	0.062	0.075	0.216	0.246

This table presents the estimates allowing to explain the hoarding of reserves in SSA banking industry. Two dependent variables are considered within the regressions: the reserves to deposits and the extended reserves to assets. The estimates are done using OLS (Model 1, 2, 5 &6) with heteroscedasticity-consistent standard errors between brackets. Then Fixed Effects are introduced in Model 3, 4, 7&8. *, **, *** denotes significance respectively at the 10%, 5% & 1% level.

Appendix A



This graph aims to show the evolution of Estimated Supply, Demand, and granted loans over time. More specifically, it allows showing that these 3 curves have the same shape during our study period. Moreover, except between 2000 and 2003, the correlation between the curves is strong, validating that the model is well calibrated and estimated. However, the collapse at the end of period (2013-2014) can be partly explained by the fact that in this period the number of observations in our sample was low, and therefore has to be taken with caution.