# Do Interbank Interest Rates Reflect The Financial Soundness Of Borrowing Banks?

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**ABSTRACT** *Uganda has a vibrant interbank market in which most commercial banks participate regularly, mostly in the overnight market. This paper investigates the factors driving the prices paid by individual banks to borrow on the interbank market, using panel data regression on quarterly data of commercial bank's balance sheets and income statements over the period 2011Q3 - 2017Q4. Our results indicate that the bank's financial soundness indicators (FSIs) have an influence on the price paid by a bank to borrow; a bank with weaker FSIs pays more to borrow than a bank with stronger FSIs. We also find that the volume of demand for interbank funds, by each individual bank, relative to its size in the banking market, raises the costs of borrowing, and that the spreads for individual banks display a degree of "stickiness", and in general, 'big' and 'internationally-affiliated' banks incur a lower cost of interbank funds while 'Small banks suffer higher rates. These results suggest that interest rate spreads, around the average market rate, in the interbank market contains information about market perceptions of counterparty risk. Therefore, by monitoring the spreads paid by banks in the interbank market, bank supervisors could obtain useful information to guide risk based supervision strategies, in particular, a bank faced with rising spreads might warrant closer inspection by bank supervisors to determine what the cause could be.*

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## I: INTRODUCTION

Pillar III of the Basel II capital Accord allots a role for the market to monitor and discipline risk taking by banks. One of the channels through which this can occur is the price (the interest rate) which banks pay to borrow wholesale funds. In Uganda, as in many developing countries, the most developed segment of the wholesale fund market is that for interbank loans. As banks might be expected to have a good understanding of the financial position of their counterparts in the interbank market they should be well placed to price the risk entailed in interbank lending. If so, the interbank loan market could provide incentives for more prudent management by banks, as this would be reflected in lower costs of interbank borrowing. In addition, the interest rates paid by individual banks in the interbank market might provide bank supervisors with valuable information about potential fragility in these banks.

Although there is a considerable volume of research on the interbank market in the developed world, but mainly on the U.S and the Euro zone (Furfine, 2001; King, 2008; Dinger and von Hagen, 2009 and Summer, 2013), there has been fewer studies on developing and emerging economies (Markose, 2013; Martinez-Jaramillo et al., 2014; and Leon et al,. 2015; Murinde et al., 2016), probably because of the unavailability of detailed data on interbank trades. Indeed, Green *et al*., (2016) notes that overnight interbank trading in many frontiers and emerging markets is relatively thin and not sufficient to support fully a monetary policy based on open market operations. This paper aims to contribute to our understanding of relationships in interbank markets in developing economies, utilising an extensive data set on interbank trades in Uganda generated by the Bank of Uganda, which allows us to identify differences in the interest rates paid by individual commercial banks to borrow on the interbank loan market.

We use time series panel data set of commercial banks' balance sheets and income statements over the period 2011Q3 - 2017Q4 to empirically investigate whether the interbank interest rates paid on overnight loans by individual banks in Uganda are influenced by the financial soundness of the borrowing banks, other characteristics of banks such as size and ownership and the bank specific demand for funds on the interbank market. Our results indicate that different measures of a bank's financial soundness have an influence on the price paid by a bank to borrow; in particular, a bank with weaker financial soundness indicators (FSI) pays more to borrow than a bank with stronger FSIs. We also find that the volume of demand for interbank funds, by each individual bank, relative to its size in the banking market, raises the costs of borrowing and the spreads for individual banks display a degree of "stickiness". Moreover, in general, 'big' and

'internationally-affiliated' banks incur a lower cost of interbank funds while 'Small banks suffer higher rates.

The rest of the paper is structured in five sections. Section II explores the theoretical .background pertaining to the interbank money market and the structure of the interbank market in Uganda, while a review of empirical studies is done in Section III. Section IV details the estimation strategy and the bank level data used in the study. Empirical results are given in Section V and Section VI concludes.

## II: THEORETICAL BACKGROUND & STRCUTURE OF THE INTERBAK MARKET IN UGANDA

### 2.1 Theoretical background

Interbank loan markets exist because banks are subject to unanticipated liquidity shocks, such as the unanticipated withdrawal of a large deposit. The credibility of banks depends upon their being able to honour their labilities as they fall due, hence in the absence of an interbank loan market, banks would have to hold a higher volume of highly liquid assets (precautionary reserves) as an insurance against liquidity shocks, thus foregoing the potentially higher returns available through investment in illiquid assets.

In a perfectly competitive interbank market with no credit risk, every bank should be able to borrow (or lend) an unlimited amount of funds at the prevailing market interest rate. The market rate itself might vary between time periods because of fluctuations in aggregate liquidity conditions, but across the market at any point in time there should be no variation between banks. In practise, however, interbank markets are not perfect. We can identify three reasons why the perfect market paradigm might not characterise the interbank market and would lead to differences in interbank borrowing interest rates, or in access to credit, across banks.

First, the small size of the interbank market or market concentration may not allow all borrowers to face a perfectly elastic supply curve for interbank funds. Instead they would face an upward sloping supply curve and as such, an increase in demand for interbank funds by an individual bank might be sufficiently large to drive up the interbank interest rate. Second, the interbank market may be segmented (Oduor et al, 2014). Segmentation may reflect perceptions of credit risk as discussed below, but it could also arise from other factors which are at least partly independent of any objective measure of credit risk, such as the size of the bank or its reputation

or that of its parent bank or lack of reliable information about the financial condition of banks. Third, unless interbank loans are fully collateralised with readily realisable securities or are insured by a third party (such as a deposit protection fund), interbank lending involves credit risk. The credit risk arises because the borrowing bank may default on the repayment of its interbank liabilities, because of financial distress. As credit risk is partly idiosyncratic to banks – it depends on the individual characteristics of each bank rather than just general market conditions – perceived credit risk will differ across banks.

The interbank market can respond to the presence of credit risk in two ways. Lenders could add a risk premium to the interest rate charged to the borrower, which should reflect the lender's perception of that risk and thus the probability that the interbank loan will not be repaid. Banks might be expected to have a good understanding of the financial condition of their counterparts in the interbank market and to use this knowledge to price risks, provided that they will actually bear the risk of lending (Rochet and Tirole, 1996). Lending banks might also ration credit to banks they regard as especially risky, or to banks whose financial condition is not transparent. Thus there could be both a quantity and a price effect of perceived credit risk, or probably some combination of the two. If markets are segmented, and some borrowing banks are only able to borrow from a sub-set of the market, these banks might face higher interbank interest rates than would be the case if they were not credit rationed, because the banks willing to lend them funds would have a greater degree of market power.

There are factors which might mitigate credit risk, however. A large, systemically important bank might be perceived by the market as being "too big to fail' (TBTF) in that the bank regulator and/or government would provide support to prevent its failure in the event that it suffered financial distress, because the adverse economic consequences of its failure would be too great. A bank which is TBTF would, therefore, be able to borrow funds more cheaply on the interbank market because of the implicit support it enjoys from the government. The credit risk of a bank which is a subsidiary of a large reputable, well established international bank might also be mitigated if it is perceived to enjoy the implicit support of its parent, because the failure of a subsidiary would damage the global reputation of the parent. This support is explicit in the case of subsidiaries of international banks which are deemed to be globally systemically important (G-SIBs). Under proposals by the Financial Stability Board, G-SIBs are being required to hold sufficient resources, termed total loss absorbing capacity (TLAC) at the global level to cover all potential losses in their materially significant subsidiaries without jeopardising financial stability

or causing losses to taxpayers and to ensure the continuity of their critical functions (Financial Stability Board, 2014).

## 2.2 Structure of the interbank Market in Uganda

Since the late 1990s, commercial banks in Uganda have participated in an interbank market. Volumes of transactions traded in Uganda shillings have grown from 0.1 trillion in 2000 to 6 trillion and 26 trillion in 2011 and 2017, respectively. Though commercial banks are the only participants, the market is heterogeneous, with banks differentiated based on ownership and size. Ownership depends on the country of origin of the majority shareholder and as such, banks can be regarded as local or foreign. The latter can be further divided into regional banks, with a parent bank in Africa, and global banks, with a parent bank outside of Africa. Following the closure of one domestic bank in early 2016, there are currently seven globally owned banks, 15 regional banks and two domestic banks.

Banks can further be disaggregated into three groups according to their size. For the purposes of this study, a bank has been designated as small if its total assets account for less than *one* percent of the banking industry's total assets. As at December 2017, 9 banks were considered small with a combined market share of 6 percent. We define medium sized banks as those whose share of total assets in the industry fall between *one and eight* percent. There are 10 medium sized banks with a combined market share of 32 percent. Large banks are those with a market share of above *eight* percent, of which there are 5 with a total market share of 62 percent. **Table 1** indicates activity in the interbank (lending and borrowing) by bank size, over the period 2011 to 2017 for overnight loans.

**Table 1: Volume of Interbank Transactions disaggregated by the Size of the Participant as a Percentage Share of Total Lending and Borrowing**

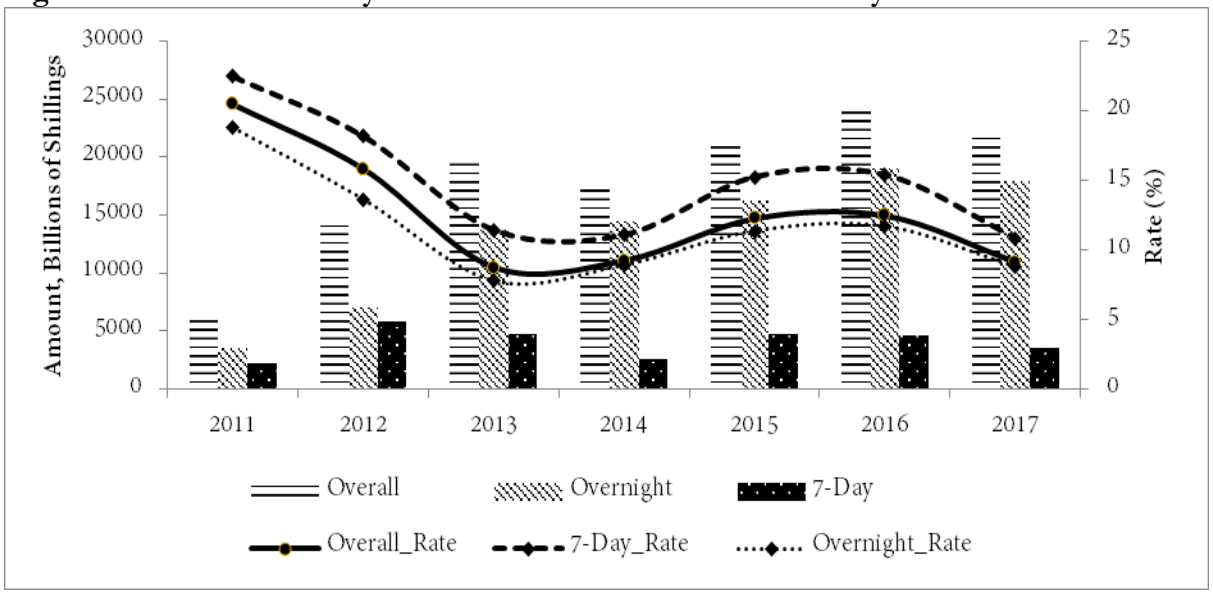
| SIZE CATEGORY→ | **SMALL** | | **MEDIUM** | | **LARGE** | |
|---|---|---|---|---|---|---|
| YEAR↓ | Borrowing | Lending | Borrowing | Lending | Borrowing | Lending |
| 2011 | 7.6 | 2.1 | 92.2 | 33.8 | 0.2 | 64.1 |
| 2012 | 6.9 | 1.5 | 93.1 | 36.0 | 0.0 | 62.5 |
| 2013 | 26.5 | 7.1 | 70.5 | 43.9 | 3.0 | 49.0 |
| 2014 | 26.4 | 8.6 | 68.8 | 38.2 | 4.8 | 53.2 |
| 2015 | 38.6 | 14.8 | 55.8 | 40.3 | 5.6 | 44.9 |
| 2016 | 24.9 | 6.2 | 72.3 | 42.4 | 2.8 | 51.4 |
| 2017 | 30.2 | 9.8 | 66.2 | 38.2 | 3.6 | 51.9 |

Source: Bank of Uganda and Author's compilation

It can be observed that lending by these three categories of banks is consistent with their asset share, i.e., large banks lend the most and small banks the least. However, medium sized banks borrow much more than they lend, accounting for more than 70 percent of borrowing in the overnight market on average, albeit their share has reduced from 92 percent in 2011 to 66 percent in 2017. Large banks on the other hand lend much more than they borrow which reflects that fact that they hold more liquidity than the other categories of banks.

The main instruments on the interbank market are unsecured interbank loans with the majority being overnight or 7-day tenors (**Figure 1**), although occasionally there are loans for longer maturities such as 14 and 30 days. The implementation of an inflation targeting monetary policy framework by the BOU since July 2011 has been supportive of the developments in the interbank market, by reducing volatility in interbank rates. The BOU carries out open market operations, mainly through repos and reverse repos, to align average interbank rates with its prevailing policy rate.

**Figure 1: Volume of activity and interest rates in the Interbank by Tenor of Loans**



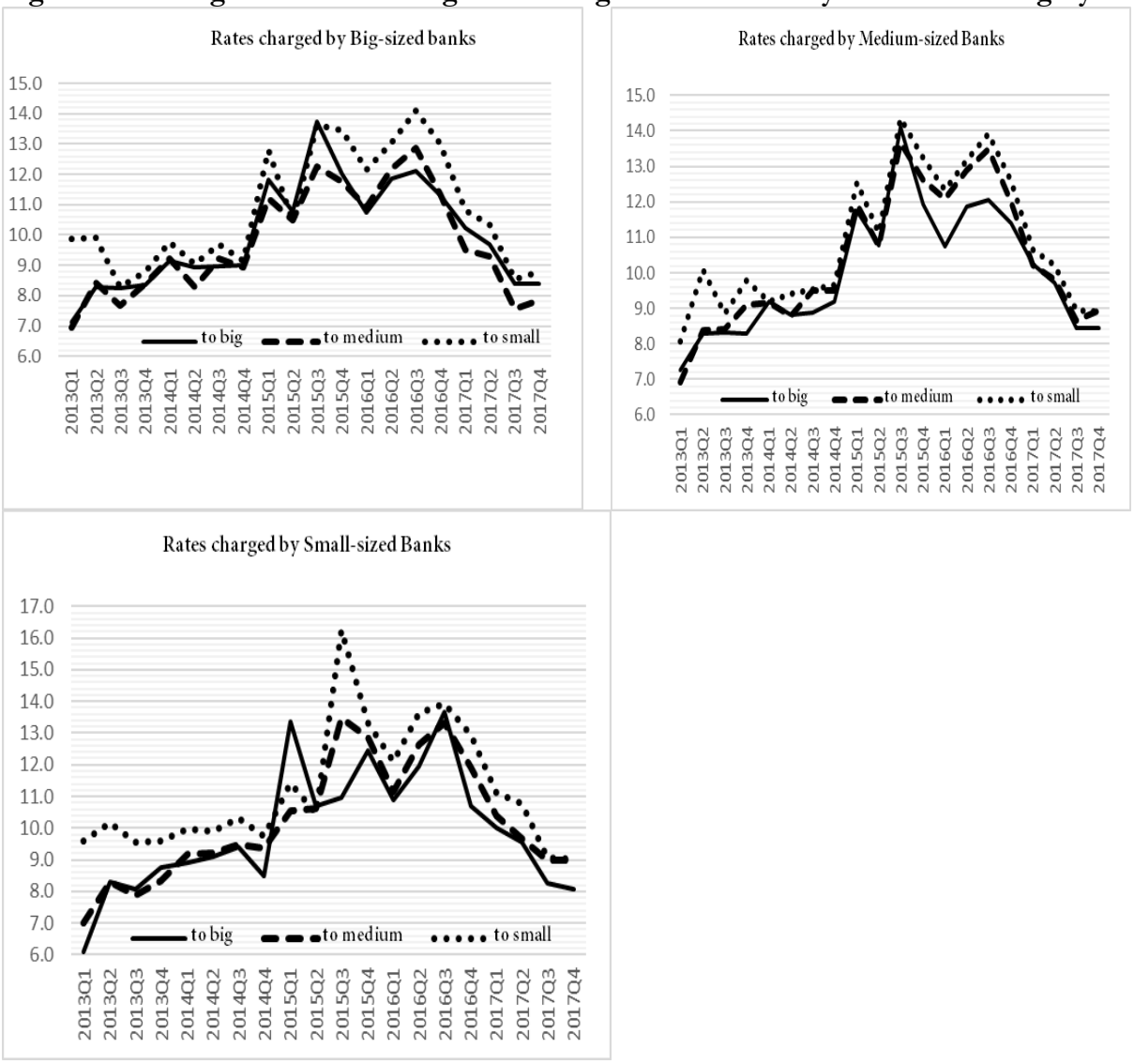

Source: Bank of Uganda and Authors' compilation

Generally, large banks have the lowest borrowing costs in the interbank market except for when borrowing from other large banks (**Figure 2**). Small banks incur the highest costs irrespective of the lender. On average, small banks pay more for interbank loans relative to medium and big banks, by approximately 1 and 2 percentage points, respectively.

These differences indicate imperfections within the interbank market. They suggest, either that large banks can exploit market power over smaller banks, or that lending to smaller banks is

perceived as more risky than lending to larger banks, possibly because the former are less diversified.

**Figure 2: Overnight Interbank Weighted Average Interest Rate by Asset-size Category**




Source: Bank of Uganda and Author's compilation

Interbank market imperfections do also arise because some banks impose limits on the amount which they will lend to certain other banks, or even refuse to lend to some other banks at all, although these credit limits, which are often determined by their parent banks are not transparent. As such, the Ugandan interbank market is segmented and can be classified as having an incomplete market structure.

In conclusion, the analysis on structure of the interbank market highlights key findings which guide our selection of variables, model specification and empirical analysis: First, the Ugandan market is segmented on the basis of volume of transactions according to bank size and

ownership. Generally, small and medium sized banks borrow more relative to large banks. Second, over 90 percent of the transactions in the interbank are overnight trades. Third, big banks are more liquid than small banks and medium banks and hence are the main suppliers of liquidity with themselves having a lower demand for borrowed funds on the interbank market. This has resulted into lower lending and borrowing rates for the large banks compared to the other two size categories of banks. Moreover, as aforementioned, some large banks are constrained in their lending to other banks by credit limits imposed by their parent banks, and these banks sometimes have to offload surplus liquidity at interest rates well below the average interbank market rates to the few banks that both require funds and are not constrained by the credit limits of the lender. And lastly, there is more volatility in both the rates and amounts observed amongst transactions between small banks relative to transactions where bigger banks are involved.

## III: EMPIRICAL STUDIES

Furfine (2001) examines whether the interest rates paid in the overnight Federal Funds market (the US interbank market) reflect measures of the borrower's credit risk. He uses a sample of more than 17,000 Federal Funds transactions to regress the interest rate on proxies for credit risk, such as the non-performing loans, capital ratios and profitability of the borrower, as well as other characteristics such as bank size. He found that proxies for credit risk have a statistically significant impact on lending rates, with the expected signs. The size of the loan relative to the borrower's capital is also positively correlated with the lending rate. However, the size of the borrowing bank is negatively correlated with lending rates; large banks receive more favourable terms in the interbank market. Furfine concludes that "banks can distinguish credit risk among their peers and price loan contracts accordingly" (page 54).

King (2008) confirmed Furfine's (2001) finding of a statistically significant interbank interest rate response to credit risk and also showed that the response of the interbank yields increased in magnitude as a result of regulatory reforms in the mid-1990s that imposed more of the costs of bank failure on uninsured creditors. King employed Heckman's (1976) two-stage model, which entails estimation of Probit and OLS regressions, to examine the risk pricing and rationing as well as the particular types of risk that interbank lenders in the sample responded to. The study was based on a sample of 2,029 banks in the US interbank market and analysed two sub periods, 1986 to 1995 and 1996 to 2005, before and after regulatory reforms. The controls used in the

model were bank real assets, a dummy variable for Home Loan Bank membership, deposit growth, non-pledged securities/assets growth and loan growth. The results also indicated that quantity rationing and its response to the institutional changes were as important as the pricing effects.

Dinger and von Hagen (2009) turn the question round and examine whether banks which borrow in the interbank market are characterised by lower risk. They use a large sample of banks in central and Eastern Europe, in markets which are two tiered with large incumbent banks, enjoying implicit guarantees from government, being able to mobilise deposits cheaply and lend through the interbank market to new entrant smaller banks which face higher costs than the large banks in deposit markets. They regress measures of risk incurred by each bank on its position in the interbank market and control variables. They find that interbank borrowing is associated with substantially lower risk incurred by borrowing banks.

Geng, Grivoyannis, Zhang and He (2016) estimated three panel data regression models to examine the effects of the interbank market rate, central-bank rate and bank-level lending rate on bank risk in China. In each model, the dependent variable, the risk variable (the non-performing loan ratio or insolvency risk) was regressed on interest rates (interbank market rate, the central-bank rate and a bank-level lending rate), bank-level control variables (assets, Capital Adequacy Ratio, Return on Assets) and a macroeconomic control variable, Gross Domestic Product. The analysis was based on annual data from 2001 to 2012 for all 16 Chinese listed banks whose assets accounted for over 65 percent of the assets of the Chinese banking industry in 2012. The sample contained the five large commercial banks, eight joint-stock commercial and three city commercial banks. Their results showed that the interbank market rate and the central bank interest rate were positively correlated with bank risk, while the bank-level lending rate was negatively correlated with bank risk.

The Colombian interbank market examined in Sarmiento (2016) provides evidence of the interbank market participants monitoring of risk of their counterparties. The study .investigates the effect of bank characteristics on interest rates paid by borrowing banks in the interbank market using a sample of daily overnight bilateral unsecured operations among 53 banking institutions from January 2011 to December 2014. Employing Heckman regression model in order to correct for the sample selection bias, the study found a positive correlation between the riskiness of borrowing banks and the price paid in the interbank market and a negative

correlation with the quantity of funds borrowed. A negative correlation was found between the capitalisation and liquidity and the price paid by the borrowing banks, and a positive correlation with access to the interbank market. The study also found that borrowing banks paid higher prices and hoarded liquidity during periods of large disparities in bank liquidity positions and monetary policy tightening; this effect was found to be higher for small banks.

Murinde *et al.* (2016) investigate whether the interbank market in Kenya is effective as a peer monitoring and market discipline device over the period 2003q1-2011q1 for 43 banks which participated in the interbank activity. Using OLS regression, the Generalized Method of Moments (GMM) and Two-Stage Least Squares regression, they uncover a stable inverse relationship between interbank activity and bank risk levels (after controlling for other bank risk determinants and financial crisis). They also find that if a bank continues to increase its interbank position up to a certain level, the impact on bank risk is reversed from risk-reducing to risk-increasing due to possible contagion effect. Furthermore, when banks are grouped by different characteristics, they find that for less risky banks (including larger, listed, foreign and older banks) the risk reduction effect due to peer monitoring is smaller.

The empirical analysis on the interbank market interest rates has employed bank-level cross-section regressions, which takes into account the time-invariant nature of bank characteristics. More recent econometric methods, however, make it possible to model the time-variant variables, as in our analysis.

## IV: THE ESTIMATION STRATEGY AND DATA

The financial sector in Uganda is dominated by commercial banks. Weighted against GDP, bank's assets averaged 83.2 percent of the country's total financial assets and nearly 100 percent of the financial system deposits (Apaa et al. 2019). Commercial banks report, on a monthly basis, detailed balance sheets and income statements to the Bank of Uganda – the regulator. As of December 2017, there were 24 regulated commercial banks in Uganda, of which 19 had been operational throughout the period 2011Q3 - 2017Q4. The selection of the sample period therefore is motivated by data availability.

The study applies panel data regression on quarterly data of commercial bank's balance sheets, income statements and financial soundness indicators, together with daily data on banks' lending

and borrowing in the interbank market and the interest rates applied to these transactions. The daily interbank data are converted into quarterly averages for the purposes of econometric analysis. Panel data models are particularly suiting in the current analysis as they allow for the cross-sectional characteristics of commercial banks to be considered simultaneously. This enables analysis of the dynamic interaction between the overnight rate a borrowing bank pays on the interbank loan market to plug short-term liquidity constraints and individual bank's characteristics, including the bank ownership and size, loan quality, profitability and demand for funds. In addition, by pooling together several time series and cross-sections, the number of observations increases, which in turn increases the degrees of freedom (Baltagi, 2008). To estimate the impact of bank characteristics, structure and demand on the interbank interest rate in Uganda, we estimate a panel data model of the general form in **eqn.1**.

$$1_{day}\, waspread_{it} = \propto_0 + \beta_1 1_{day} waspread_{it}(-1) + \beta_2 \mathbf{x}_{it} + \beta_3 d_{it} + \beta_4 \mathbf{y}_{it} + \varepsilon_{it} \qquad (1)$$

Where $\boldsymbol{x}$ is a vector of bank specific financial soundness indicators; *d* is bank specific demand on a particular trading day, i.e., trade asset share and $\boldsymbol{y}$ is a vector of dummies capturing the structure of banks, including ownership and size, all observed at time *t*. The lagged term of the dependent variable is included to captures the interest rate inertia in the interbank market. $\beta_i \ (i = 1, \dots, 4)$ are the coefficients and $\propto$ is the intercept to be estimated while $\varepsilon_{it}$ is the error term, assumed to be normally distributed with a zero mean and homoskedastic variance, i.e., $\varepsilon_{it} \sim N(0, \delta^2)$. As can be noted in **eqn.1**, the dependent variable is weighted average overnight spread. This is in cognisant of the fact that while average interbank rates at any point in time are determined by monetary policy, individual banks borrow at a spread, above or below the average rate depending on their own idiosyncratic characteristics. We therefore computed overnight *waspread* according to **eqn.2**.

$$waspread_{it} = QAR_{it} - WAIR_{it} \qquad (2)$$

Where

$$WAIR_{it} = \sum_{i=1}^{19} \left( \frac{trade\ share_{it}}{industry\ total\ trade_{it}} \right) QAR_{it}$$

In **eqn. 2**, $QAR_{it}$ = bank level quarterly average interest rate; and WAIR is quarterly weighted average interest rate. The waspread therefore captures the difference between the prevailing

weighted average interbank interest rate on the day the transaction took place and the interbank overnight interest rate paid by each borrowing bank.

Among bank specific characteristics, our analysis includes measures of the riskiness of a borrowing bank. The most common indicator to describe asset quality of a bank is the ratio of nonperforming loans to total outstanding loans (NPL). The riskiness of a bank creates the possibility that it might default on its interbank liabilities because of financial distress which implies that it would be charged a risk premium on the price it pays to borrow on the interbank market. Therefore it would be expected that riskier banks, *ceteris paribus*, pay higher interest rates than less risky banks. We also include, in the financial soundness indicators, measures of profitability, namely the ratio of profits to total capital (return on equity, ROE) and the ratio of profits to total assets (return on assets, ROA). NPL, ROE and ROA are all expressed as percentages. We capture bank specific demand for funds on the interbank market by the interaction between trade share and asset size ($d_{it}$), defined as in **eqn. 3**.

$$1_{day} trade\ asset\ share = \frac{trade\ share_{it}}{asset\ share_{it}} \tag{3}$$

Where

$$trade\ share_{it} = \frac{trade\ share_{it}}{total\ 1day\ trading}; \text{ and } asset\ share_{it} = \frac{asset_{it}}{total\ industry\ assets}$$

Essentially, trade asset share captures bank specific demand relative to its size. All these variables are in percentages, and are sourced from commercial banks' balance sheets and income statements submitted to the Bank of Uganda. If banks face an upward sloping supply curve for funds, we would expect that a larger trade asset share would lead to higher borrowing rates.

Within the vector for the structure of the banking market, our specification considers bank ownership (global, regional and domestic) and size (big, medium and small), which enter the estimation models as dummies to preserve the degrees of freedom which would otherwise diminish with splitting of the already small sample. However, this structural classification comes with practical difficulties. Big banks (defined by asset share) are mainly global banks while medium and small banks are either regional or domestic banks. Given this, we construct four dummies: a dummy for global ownership (*D_global*) which also captures almost all big sized banks; a dummy for 'others' (regional and domestic) ownership (*D_others*) which also captures medium and small sized banks, a dummy for medium sized banks (*D_medium*) and a dummy for

small banks sized banks (*D_small*). Since *D_others*, *D_medium* and *D_small* overlap, the *D_others* dummy is treated as a residual. Therefore, in an effort to implement estimation in a manner careful enough not to fall into a dummy trap, only *D_global*, *D_medium* and *D_small* dummies are included in the regression model. For brevity, the set-up of any of these dummies, considering for example, a dummy for global ownership, takes the form in **eqn.4**:

$$D\_Global = \begin{cases} 1: & if\ global \\ 0: & otherwise \end{cases} \quad (4)$$

The statistical description of the bank level data is given in **Table 2**. A comparison of the minimum, maximum and standard deviation suggests wide dispersion of the data. The mean and median for almost all the series are not numerically different, suggesting either that there are no significant outliers in the data or that if there are, they are symmetric around the mean.

**Table 2**: Summary Statistic for Bank Level Variables

| **Variable description** | Mean | Median | Std. Dev. | Max. | Min. |
|---|---|---|---|---|---|
| Overnight weighted average spread | -0.00 | -0.01 | 1.67 | 6.58 | -13.11 |
| NPL to total gross loans | 5.47 | 4.57 | 4.85 | 48.85 | 0.00 |
| Return on equity | 7.71 | 12.78 | 35.99 | 52.44 | -658.16 |
| Return on asset | 1.45 | 1.89 | 3.29 | 8.08 | -25.01 |
| 1_day trade asset share | 1.19 | 0.76 | 1.25 | 6.63 | 0.00 |
| Banks with Global ownership (also doubles as big banks) | 0.22 | 0.00 | 0.41 | 1.00 | 0.00 |
| Medium sized banks (mainly domestic and regional) | 0.27 | 0.00 | 0.44 | 1.00 | 0.00 |
| Small sized banks (mainly domestic and regional) | 0.46 | 0.00 | 0.50 | 1.00 | 0.00 |
| Other banks (regional and domestic banks) | 0.78 | 1.00 | 0.41 | 1.00 | 0.00 |

Obs. = 475
Source: Author's computations

**Table 3** presents the correlations between the dependent variable and the regressors given in **eqn.1**. There is a positive correlation between 1_day weighted average spread and the bank *i*'s loan quality (*npl*), demand for funds on the interbank market (*1_day trade/asset share*), small sized banks (*small*) and the categorization in the others category (*others*) – regional, domestic; medium and small.

**Table 3**: Correlation coefficients of 1_day Weighted average spread with regressors.

| | 1_day waspread | npl | roe | 1_day trade/asset share | roa | Global | Medium | Small | Others |
|---|---|---|---|---|---|---|---|---|---|
| 1_day waspread | 1.000 | | | | | | | | |
| NPL | 0.148*** | 1.000 | | | | | | | |
| Roe | -0.189*** | -0.595*** | 1.000 | | | | | | |
| 1_day trade asset share | 0.081* | -0.078*5 | -0.051 | 1.000 | | | | | |
| Roa | -0.229*** | -0.607*** | 0.785*** | -0.068 | 1.000 | | | | |
| Global | -0.189*** | -0.166*** | 0.205*** | 0.162*** | 0.350*** | 1.000 | | | |
| Medium | -0.187*** | -0.170*** | 0.053 | -0.079* | 0.188*** | -0.018 | 1.000 | | |
| Small | 0.291*** | 0.304*** | -0.283*** | 0.001 | -0.551*** | -0.490*** | -0.556*** | 1.000 | |
| Others | 0.228*** | 0.077* | -0.237*** | 0.229*** | -0.368*** | -0.680*** | 0.018 | 0.490*** | 1.000 |

Notes: In parentheses are *p*-values, while asterisks ***,**, and * represent 1, 5 and 10 percent significance levels, respectively.

Source: Authors' computations

The correlation is negative for return on equity, return on assets, globally owned (big) banks and medium sized banks. Moreover, there is potential multicollinearity among the financial soundness indicators, i.e., $\rho_{npl,roe} = 0.6$; $\rho_{npl,roa} = 0.6$); and $\rho_{roe,roa} = 0.8$. These correlations necessitate that three variants of eqn. 1 are estimated. Thus eqn.1 is rewritten as in eqns. 5-7:

$$1_{day}\, waspread_{it} = \propto_0 + \beta_1 1_{day} waspread_{it}(-1) + \beta_2 \mathrm{npl}_{it} + \beta_3 d_{it} + \beta_4 D_{global} + \beta_5 D_{medium} + \beta_6 D_{small} + \varepsilon_{it} \quad (5)$$

$$1_{day}\, waspread_{it} = \propto_0 + \beta_1 1_{day} waspread_{it}(-1) + \beta_2 \mathrm{roe}_{it} + \beta_3 d_{it} + \beta_4 D_{global} + \beta_5 D_{medium} + \beta_6 D_{small} + \varepsilon_{it} \quad (6)$$

$$1_{day}\, waspread_{it} = \propto_0 + \beta_1 1_{day} waspread_{it}(-1) + \beta_2 \mathrm{roa}_{it} + \beta_3 d_{it} + \beta_4 D_{global} + \beta_5 D_{medium} + \beta_6 D_{small} + \varepsilon_{it} \quad (7)$$

## V: EMPIRICAL RESULTS

For panel data, where cross-sections, N and time periods, T are small, the analysis usually relies on traditional estimation techniques – fixed/random effects estimators or instrumental variable methods of Arellano and Bond (1991). In these estimators, individual groups are usually pooled together, such that the slope parameter is homogenous across groups and only the intercepts are allowed to vary. Our panel data is of quarterly frequency containing 19 cross sections of commercial banks and 25 points of time series which makes it suitable for fixed/random effects estimation. The Hausman (1978) test [$\chi(3)=23.71$ (0.000)] reveals that the preferred model is the fixed effects. **Table 4** presents the panel OLS estimates in which overnight (1-day) weighted average spread (***1_day waspread***) is regressed on non-performing loans ratio (***npl***), return on equity (***roe***), return on asset (***roa***), bank demand, i.e., trade share interacted with asset size (***1_day trade asset***) and the lagged spread (***1_day waspread (-1)***) and the dummy variables corresponding to the structure of the banking industry. Because the soundness indicators (***npl, roe***, ***roa***) are highly correlated (see **Table 4**), they are used interchangeably in the estimation, birthing **Model 1**, **Model 2** and **Model 3** (in **Table 4**), which corresponds to **eqns. 5, 6** and **7**, respectively. The lagged dependent variable and the dummy variables are maintained in all the variant estimations.

Across all the specifications, the coefficient on the lagged dependent variable is positive and significantly different from zero. This indicates an element of price stickiness, where the previous period price a bank paid on the interbank market has a strong bearing on what it is likely to be paid in the current period. This could suggest that, once a bank acquires a reputation for being more or less risky, this reputation persists and continues to influence the price it pays to borrow even in the presence of short term changes in its financial soundness indicators. The coefficient on the bank specific demand is also positive and statistically significant, indicating that as the share of a bank's borrowing in the market relative to its asset share increases, it has to pay higher rates to borrow funds. This is consistent with expectation that the higher the demand for interbank funds by each individual bank, the higher the price paid by the bank. Banks do not face an infinitely elastic supply curve for funds.

The coefficient on the "big" and "internationally-affiliated" banks shows that this cluster of banks can borrow at lower interest rates. This is either because they have market power or because their size or ownership provides a degree of insurance against default which is independent of their actual financial condition, as proxied by their respective financial soundness indicators. The coefficient on "Small" banks on the other hand carries an opposite sign to that

on 'big and 'internationally-affiliated banks', which indicates that they are charged higher rates to borrow on the interbank market irrespective of their financial soundness indicators, possibly because they are perceived to have access to fewer resources than larger banks to support them in the event that they suffer financial distress; e.g. they are less likely than a larger bank to be recapitalized or provided with liquidity by their owners to prevent a default on the interbank market.

**Table 4:** Results with the 1-day Weighted Average Spread as a Dependent Variable

| **Dep. Var** → / **Regressors** | **1_day waspread** | | |
|---|---|---|---|
| | **MODEL 1** | **MODEL 2** | **MODEL3** |
| C | **-0.420*** | -0.150 | -0.070 |
| | [-1.938] | [-0.723] | [-0.310] |
| 1_day waspread (-1) | **0.149***** | **0.148***** | **0.146***** |
| | [2.963] | [2.962] | [2.896] |
| NPL | **0.029*** | | |
| | [1.781] | | |
| ROE | | **-0.006***** | |
| | | [-2.817] | |
| ROA | | | **-0.058**** |
| | | | [-2.113) |
| 1_day trade asset | **0.156**** | **0.137**** | **0.135**** |
| | [2.590] | [2.282] | [2.239] |
| D_Global | **-0.440*** | **-0.418*** | **-0.413*** |
| | [-1.943] | [-1.853] | [-1.821] |
| D_Medium | -0.194 | -0.268 | 0.268 |
| | [-0.884] | [-1.220] | [-1.212] |
| D_Small | **0.456**** | 0.398* | 0.312 |
| | [-1.967] | [1.723] | [1.244] |
| S.E. of regression | 1.572 | 1.563 | 1.570 |
| | 10.761 | 11.665 | 11.007 |
| F-statistic | (0.000) | (0.000) | (0.000) |
| D-W | 1.813 | 1.824 | 1.815 |
| Cross sections included | | 19 | |
| Total unbal. Panel obs. | | 447 | |
| Periods included | | 25 | |

Notes: In [] parentheses are t-values and () are p-values. Asterisks ***,**, and * represent 1, 5 and 10 percent significance levels, respectively. The coefficient to D_others is about 0.56 on average, positive and significant at the 5% level.

The coefficient on *npl* – the measure of asset quality (in **Model 1**), is both positive and significant. This suggests that the higher the credit risk, the more likely it is for a bank to attract unfavorable rates in the interbank market, as lenders add a premium to the interest rate they charge to compensate for the higher probability of default. The ratio of profits to total capital (ROE) in **Model 2** and the ratio of profits to total assets (ROA) in **Model 3**, respectively are negatively signed and highly significant. In either case, this suggests that more profitable banks are perceived as being less of a credit risk and can therefore borrow at lower interest rates on the interbank market.

## VI: CONCLUSION AND IMPLICATIONS FOR POLICY

Uganda has a vibrant interbank market in which most commercial banks participate regularly, mostly in the overnight market. This paper has investigated the factors driving the prices paid by individual banks to borrow on the interbank market, using panel data regression on quarterly data of commercial bank's balance sheets and income statements over the period 2011Q3 - 2017Q4. Average interbank rates at any point in time are determined by monetary policy, but individual banks borrow at a spread, above or below the average rate depending on their own idiosyncratic characteristics.

We found that different measures of a bank's financial soundness – its loan quality and two measures of profitability – each have an influence on the price paid by a bank to borrow. A bank with weaker financial soundness indicators (FSI) pays more to borrow than a bank with stronger FSIs. The market appears to be able to monitor the financial condition of borrowing banks and the implications for default risk and price this into the interest rates charged to borrowers. We also find that the volume of demand for interbank funds, by each individual bank, relative to its size in the banking market (proxied by its asset share), raises the costs of borrowing, suggesting that each bank faces an upward sloping supply curve for funds. The positive coefficient on the lagged dependent variable suggests that spreads for individual banks display a degree of "stickiness", possibly because a bank's reputation for riskiness persists even when its FSIs change.

Our results also show that the structure of the banking market has a significant influence on the overnight rates, where, in general, 'big' and 'internationally-affiliated' banks incur a lower cost of interbank funds while 'Small banks suffer higher rates. This is consistent with the notion that 'big' and 'internationally-affiliated' banks are price-takers with more power to influence activity in

the interbank market but it may also suggest that these banks are perceived as being less likely to default on their interbank obligations, irrespective of their actual financial condition, because their owners have the financial resources and incentives to support their banks in the event that they incur financial distress.

These results have implications for bank supervisors in that they suggest that interest rate spreads, around the average market rate, in the interbank market contains information about market perceptions of counterparty risk. By monitoring the spreads paid by banks in the interbank market, bank supervisors could obtain useful information to guide risk based supervision strategies; e.g. a bank whose spreads rise might warrant closer inspection by bank supervisors to determine the cause of this. One possible extension of this research would be to examine whether the interbank interest rate spreads provide an "early warning" of future deterioration of the financial condition of a bank. This might be the case if banks were able to detect, through their knowledge of the banking market, risky behaviour by their peers before this translates into a deterioration of FSIs.

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