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Abstract

This paper assesses the role that bank segmentation plays in the efficiency of the interbank market and the extent to which segmentation and inefficiency of the interbank market impedes the effectiveness of monetary policy. Using a unique (not public) Kenyan daily dataset for the period June 2003 to September 5 2012 obtained from the Central Bank of Kenya (CBK), and utilizing network framework and event studies, the findings show that the Kenyan interbank market is incomplete, segmented and inefficient and this impedes monetary policy effectiveness in the short run particularly during periods of liquidity volatility. Evidence however shows that monetary policy is still effective in the long run, notwithstanding inefficiencies at the interbank market. However, this should not be any consolation for monetary policy makers since monetary policy is intended to work in the short to medium term. To improve the efficiency of the interbank and its role as a channel of transmitting monetary policy in such underdeveloped interbank markets like Kenya, monetary authorities must broaden the product tenors, increase the number of currencies traded, link the interbank with other money market segments and address counterparty risks.

Key Words: Segmentation, interbank, efficiency, Kenya

JEL Classification: E44, E52, G14, G21
1. Introduction

Efficiency of the interbank market is very vital for the effective conduct of monetary policy. The interbank market plays at least three critical roles in any modern financial system that have important implications for the effectiveness of monetary policy.

First, a well-functioning interbank market acts as an effectively channel for liquidity management in the banking system. It channels liquidity from institutions with surplus funds to those in need, thus allowing for more efficient financial intermediation and more effective monetary policy implementation. Over-supply or shortfalls in commercial banks’ reserves arise from stochastic deposits and withdrawals by customers that create inter-temporal liquidity shocks in banks (Bruche and Suarez, 2010). Moreover, with an interbank market in place banks *ex ante* will put aside less liquidity to cushion themselves from shocks.

Second, the interbank market acts as the conduit for the transmission of monetary policy through the interest rate and credit channels. The interbank rates should therefore be sensitive to changes in the policy rate and should reflect underlying conditions in the market if the interbank market is efficient. An effective monetary policy transmission would be reflected at the interbank market when the interbank rate stays near (or generally slightly below) the level of the policy rate. Steinsson (2003) conducting a study on Iceland finds a mismatch between interbank rates and the Central Bank’s policy rate and concludes that the mismatch is an indicator of inefficiencies at the interbank market. The mismatch suggests that Icelandic banks finance themselves on different terms. This, the authors argue, is a sign of flaws in the interbank market as an intermediary between the banks that have excess liquidity and those that can make the best use of it. Wide variations between the interbank rate and the policy rates are therefore signs of inefficiencies in at the interbank market.

Finally, an efficient interbank market provides an effective price-discovery mechanism in the money market as a whole. Temporary imbalances may arise from time to time, but the market should restore equilibrium and close undesirable gap, without intervention of
the central bank. Consequently, interbank rates can be used as effective guide for loans, savings, mortgages, futures, options and swaps. Wide deviations between interbank rates and retail market rates are therefore a sign of inefficiencies at the interbank market which may compromise the role of the interbank market as a mechanism to restore equilibrium in the markets.

Past studies have shown that an efficiently functioning interbank market is characterized by a number of features including; high degree of market depth with varied instruments spanning different tenors; narrow bid-ask spreads; presence of symmetric information, open credit lines and proper coordination among participants i.e. there is a clear structure of the operations in the interbank market with clear rules of engagement (Vento and Ganga, 2009 and Porter et al., 2009). They argued that the interbank market may fail to allocate liquidity efficiently because of some externalities, especially adverse selection problem and asymmetric information about the counterparty risks defined by the quality of assets that the participating banks hold. This creates counterparty risks and segmentation of the market.

Efficiency of the interbank market can however be seriously eroded if the banking sector is segmented. While the interbank market is assumed a priori and often modeled in the literature as a centralized exchange in which banks smooth liquidity shocks (e.g. Ho and Saunders, 1985; Bhattacharya and Gale, 1987; or Freixas and Holthausen, 2005), in reality, the market is decentralized: deals are struck bilaterally between pairs of banks (Stigum and Crescenzi, 2007). This defining market feature may give rise to market inefficiencies (Duffie et al., 2005) and segmentation where small banks may be considered more risky than the large banks, with the latter being regarded as ‘too-big-to-fail’. This may erode the importance of the interbank market in its role of liquidity management thereby compromising the effectiveness of monetary policy.

Literature suggests that segmentation of the interbank market and the ability of banks to borrow in the interbank are principally caused by bank reputation, which depends on such factors as bank size and ownership (Allen et al., 1990). Large banks usually tend
to be net borrowers while smaller banks tend to be net lenders in the market with the interbank market utilized as one source of funds for banks wishing to engage in “window dressing” of their balance sheets. A small bank wishing to borrow in the interbank market faces the problem of conveying to potential lenders that it has a good credit risk record (Allen and Saunders, 1992). This information asymmetry between a small borrowing financial institution and a prospective counterparty is part of the theoretical justification for the “large bank-small bank dichotomy” (Ho and Saunders, 1985).

While the interbank market plays an integral role in the transmission of monetary policy, little research has been done on it when compared to other markets such as the bond, equity or foreign exchange markets (Furfine 1999, Hartman et al. 2001). More specifically there has been very little research and policy attention on whether the interbank market can effectively play its role as a conduit for monetary policy transmission if the market is segmented. It is no surprise therefore that most monetary authorities put very little policy efforts in place to improve the interbank market to ensure that monetary policy works better. In some instances, the working of the interbank market is completely ignored by the monetary authorities. The question however is why one would expect a segmented interbank market to be efficient and the answer is ‘it depends on the level of structure of the segmentation’. This paper in our knowledge gives the first critical analysis of this question. Using a unique (not public) dataset obtained from the central bank of Kenya (CBK) and a mix of methods including network analysis, event study and case studies, this paper assesses the level of segmentation in the interbank market in Kenya and analyses the extent to which the segmentation affects the efficiency of the interbank market and the effectiveness of monetary policy actions. The study adopts a network framework suggested by Allen and Gale (2000) and case studies of three developed interbank markets. Daily data on volumes and interest rates are used covering the period June 2003 to August 2012.

The results show that while the strongest borrowing relationship existed among the small banks (59 percent), the weakest relationship was between large and small banks where small banks can borrow on average about 13 percent of their funding needs from
large indicative of a market that is fragmented and segmented on the basis of size. Event studies show that different shocks led to a gridlock in the banking sector liquidity during shock periods leading to inefficient re-distribution of liquidity and compromising the effectiveness of monetary policy in the short run. However, monetary policy transmission is not affected by the segmentation and inefficiency of the interbank market in the long run as deviations of the interbank rates from the monetary policy stance in the short run tend to be corrected in the long run. Monetary policy actions are normally however, intended to have effects in the short to medium term. In order to enable the interbank market to be efficient in distribution of liquidity, price discovery and transmission of monetary policy in such underdeveloped interbank markets like Kenya, a number of microstructure issues need to be addressed. These include, among others, broadening the product tenors, increasing the number of currencies, linkage with other money market segments, and addressing counterparty risks.

The rest of the paper is organized as follows. Section 2 presents the background information, including the operational framework of Kenya’s interbank market. Section 3 presents the analytical framework. Section 4 presents the results and discussions. Section 5 concludes and provides some policy recommendations.

2. The Operation of the interbank market in Kenya

This section outlines the operational framework of Kenya’s interbank market and the asset-liability management strategies employed by banks. The operational framework covers the structure, timing, sources of funds to banks, transactions, traders and the settlement of transactions in the interbank market.

Unlike in other developed money markets where interbank loans have different maturity profiles, the market in Kenya only trades funds on an overnight basis, uncollateralized and all in domestic currency. The market is used by banks to smooth out payments as it allows them to clear maturing cash obligations of both customers and other commercial banks as well as provide a source of funds to meet the statutory requirements on cash reserves. The market is therefore critical in commercial banks liquidity management;
allowing banks with liquidity shortages to access funding or banks with excess liquidity over and above their daily requirements to invest and earn a return. In this regard, the market promotes an efficient use of resources.

Currently 41 out of the 43 banks trade in the interbank market\(^5\). Lending and borrowing agreements are not open to all banks but rather there are limited established lines of credit. This is a strong indicator of existence of market segmentation. These lines of credit are created through a credit profiling process that banks conduct on each other i.e. assessing the creditworthiness of the other banks. It is largely done on the basis of, among other factors, size of bank (considering parent company if it is a subsidiary), asset sizes and also ownership (either foreign, local private or local public). Banks with relationship at ownership levels would have open credit lines even if their asset bases are not strong enough. The credit lines establish lending and borrowing limits for other banks both in terms of volumes it can trade and whether or not the bank can actually trade. The terms of the credit lines are reviewed regularly as creditworthiness of banks change. There is no specific timeliness for the credit lines but the credit profiling of the banks would dictate their exposure limits to their counterparts. In Kenya, each bank has at least one credit line with at least one other bank, but the exposure volumes would vary. In commercial banks’ liquidity management practice, banks engage in developing relations with banks with whom they have unrelated risk exposure to ensure smooth settlement of their payments should there be unanticipated upsurge in their cash requirements. The establishment of credit lines is a reflection of the initial evidence of segmentation and lack of an efficient interbank market in Kenya.

In terms of timing and settlement of transactions, the interbank market opens between 8.30am and 4.30pm but with two somewhat distinct sessions. The first session (8.30am-3.30pm) allows banks to trade funds to settle interbank customers’ payments / demands. The second session (3.30pm to 4.30pm) is dependent on the outcome of the first session and allows banks to square their positions by trading the excess funds with other banks that find themselves with cash requirements. In this second session, banks also settle bank to bank obligations. Whenever, there are shortages in this session,

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\(^5\) The remaining 2 banks offer Islamic banking (Sharia compliant) products and hence do not participate in the trading.
banks resort to borrowing funds from the CBK discount window at the prevailing central bank rate (CBR). This is done as a measure of last resort.

In Kenya, all interbank transfers and trading transactions are effected through the Kenya Electronic Payments and Settlement System (KEPSS). Interbank deals are concluded bilaterally between commercial banks which originate payments instructions on SWIFT to be effected through the Real Time Gross Settlement (RTGS); a system that was introduced effective August 15, 2006. Payment instructions are standardized. Prior to the introduction of RTGS, instructions were sent to CBK by banks manually and later via SWIFT for manual posting at CBK. In such a case, the clearing account of the lending bank is debited as the borrowing bank is credited with the amount agreed on bilaterally. Since interbank loans are overnight loans, repayments are done by reversing the entries on the clearing accounts, but with the amounts plus interest on the following working day before 4.30pm. Interest rates charged are on an annual basis and hence pro-rated to daily rates. KEPSS\(^6\) through RTGS and the Reuters screen are critical in the execution of interbank trading. Transactions in the interbank market are either initiated by borrowers seeking funds or lenders with excess funds. The need for funds or excess funds available is posted on the Reuters screen which all banks have access to.

Before 2003, each bank held funds at the Central Bank in one main single account, but the funds were dedicated for two main purposes: the statutory cash reserve requirements (CRR) and funds to facilitate clearing of the interbank transactions. The account was split into two distinct accounts based on the functions of the funds. The CRR account was dedicated to meeting the statutory cash reserves requirement where banks were required to meet this requirement on a daily basis, without which penalties would be levied\(^7\). On the other hand, the clearing account was mainly dedicated to clearing payments for the interbank market. The separation of CRR ratio accounts from clearing accounts left banks with very little funds in the clearing accounts. Consequently, banks would overdraw their clearing accounts whenever their maturing cash obligations in the interbank market would surpass their clearing account balances.

\(^6\) KEPSS is efficient in high value and time-critical transactions, such as the ones for the interbank trading and, monetary policy implementation transactions, receipt and payment of government securities, and taxes.

\(^7\) However, since August 2011, CRR requirements were observed by banks based on a monthly average. The change was intended to enhance commercial banks' liquidity management (MPC press release , August 2011)
But with the introduction of RTGS, this system did not have a provision for overdrawals in the clearing accounts.

Consequently, CBK introduced an Intra-day Liquidity Facility (ILF) to ensure that all interbank transactions were facilitated to settle and enhance stability of the market. The ILF provides collateralized lending of funds to commercial bank to facilitate their daily intra-day payment obligations in the KEPSS. Under this facility, commercial banks identify and set aside pre-determined amounts of Government securities from their portfolio holdings for securing intra-day borrowings based on their anticipated average daily liquidity requirements. The credit limit for drawdown against any Treasury Bills is 90% of the face value of the security while that of Treasury Bonds is 80% of the face value of the security pledged. The ILF is created once and is availed to the commercial bank on a daily basis until the securities mature or the commercial bank cancels the facility. Even though the ILF is collateralized, the funds are provided to banks interest-free. In case of default; CBK grants a forced collateralized overnight loan to a commercial bank that has failed to settle ILF as per the ILF Agreement. Funds are advanced to the affected bank at the prevailing CBR.

3. Analytical Framework

The study utilizes two approaches to analyse interbank market segmentation and efficiency, namely network framework suggested by Allen and Gale (2000) and case studies in which we tease out lessons from three developed interbank markets, namely the United Kingdom (UK), United States of America (USA) and the European Union (EU).
3.1. Network Framework
In this section, the paper attempts to determine whether there is market segmentation in Kenya’s interbank market. This study adopts a network framework suggested by Allen and Gale (2000) to study presence of segmentation in the interbank money market.

3.1.1. Exposure Matrices
According to the network framework, there exist three potential types of interbank structures. First is complete structure in which each bank is symmetrically connected to other banks in the system (Table A1 in Appendix 1). This means that each bank borrows and lends to all other banks in the system. Allen and Gale (2000) argue that when an interbank market has a complete structure, the effect caused by unexpected shock in one bank can be absorbed by a large number of banks, which reduces the intensity of the shock. Second, is the incomplete structure where banks are only connected to their neighbours (i.e. those in the same or neighbouring segment) as shown in Table A2 in the Appendix 1. For instance small banks trade among themselves and with the medium banks but do not trade with large banks. When the interbank market is incomplete the initial shock in one bank is transmitted to its neighbours but in a large magnitude, which would have ripple effects. Third, there is incomplete and disconnected structure which means existence of unconnected interbank market segments as shown in Table A3 in the Appendix 1. Freixas et al. (2000) discusses a fourth market structure which is called a money centre. A money centre is symmetrically connected with other banks that are not connected among themselves. The authors show that when a shock hits a bank that is connected to the money centre, there is no effect on the money centre. However, if the shock hits the money centre it affects all the banks that are connected to it.

3.1.2. Intensity of Lending and Borrowing Activity
In order to determine the intensity of the lending and borrowing activity between banks, an approach suggested by Coco et al. (2009) is used. Banks are categorized into three groups: large, medium-size or small banks. In this case, for every lender category and every borrower category, a Lender preference index (LPI) is computed, which is equal
to the ratio of total funds that each category of banks, say large banks, has lent to the
other category of banks during the given day, over the total amount of funds that the
large banks have lent in the interbank market during the same day. Thus each time
period, $t$, in our analysis is a day. In this case, let $F_{i}^{j \rightarrow k}$ denote the amount lent by bank
category $j$ to bank category $k$ on loan $i$.

Then:

$$LPI_{\text{Large, Medium, } t} = \frac{\sum_{i \in t} F_{i}^{\text{Large} \rightarrow \text{Medium}}}{\sum_{i \in t} F_{i}^{\text{all}}} \quad (1)$$

Where $t$ denotes the time period in this case a day. This ratio is more likely to be high if
large banks rely on medium banks more than on small banks to lend funds in the
market.

Similarly, we compute a Borrower Preference Index (BPI) as the ratio of total funds that
each bank category has borrowed from the other category in a given period, as a
fraction of the total amount of funds that the category has borrowed from the market in
the same period:

$$BPI_{\text{Large, Medium, } t} = \frac{\sum_{i \in t} F_{i}^{\text{Large} \rightarrow \text{Medium}}}{\sum_{i \in t} F_{i}^{\text{any} \rightarrow \text{Medium}}} \quad (2)$$

3.1.3. Convergence of Interest Rates in Different Market Segments
We empirically test for convergence of interest rates in the different segments of the
market in the same way as done by Green et al. (2012). In literature, interbank market
segments are formed on the basis of bank ownership and size (see Green et al., 2012),
and interbank volumes. As a first step to indicate existence of market segments, we
observe convergence of interbank rates over a fairly longer period than the period used
by Green et al. (2012), and then test for statistical differences in interbank rates across
the segments over specific periods. In essence, we test the null hypothesis that the
interbank rate charged for banks within the same bank size classification (as defined)
are not statistically different from the rates across the different bank segments.
Two tests are used to check whether the deviations of the interest rates for the different market segments are statistically equal to zero or not these are the Mean test and Lyung-Box Q test of serial correlation. The mean test checks whether the deviations in interest rates mean are statistically different from zero. The hypothesis is that if the series mean is statistically different from zero, then there is segmentation in the interbank market. The Lyung-Box Q test checks whether the differences in interest rates are white noise or Martingale Difference (MD) process\(^8\). A white noise process is a sequence of serially uncorrelated random variables with zero mean and finite variance. The hypothesis is that if the differences in the interest rates charged for the different segments are white noise or MD, then there is no segmentation in the interbank market.

3.2. Case Studies of the UK, USA and the EU

In this approach, a detailed study is done on the interbank markets of the United Kingdom (UK), the United States of America (USA) and the European Union (EU). The selection of the interbank markets in these countries is informed by the developed nature of the market, historical/colonial relationship with Kenya and availability of information.

As a qualitative method of analysis, the case studies focused on aspects relating to market segmentation and market efficiency. With regard to efficiency, an attempt is made to tease out key lessons regarding, among others, efficiency in allocating funds; extent of price discovery and in particular existence of benchmark interest rate; term structure (tenors of funds traded); number of currencies traded; link between interbank market and monetary policy and collateralization.

3.3. Data

We use interbank trading data which capture the traded volume, lender, borrower and interest rates spanning the period June 2003 to September 5, 2012. Interbank trading data was obtained from the Central Bank of Kenya and is not public\(^9\). The choice of the sample period is motivated by availability of a reliable and comprehensive dataset on

\(^8\) A Martingale difference is a process, \(Y\) whose expectation with respect to past values of another stochastic series \(X\) is zero, i.e. 
\[
E(Y_t | X_t, X_{t-1}, ..., X_0) = 0 \text{ for all } t.
\]

\(^9\) We thank the Central Bank of Kenya Governor, Prof. Njuguna Ndungu for his kind permission to use the data.
interbank transactions. This period is also characterized by increased volatilities in the market some of which have been attributed to issues around market segmentation and lack of an efficient market system.

4. Results

4.1. Is the Interbank Market Segmented?

The critical issue we first attempt to establish is whether there is market segmentation in the interbank market. This is done by analyzing interbank exposures, lending and borrowing preferences of the small, medium and large banks and empirically establishing where there are statistically significant differences in the interest rates charged across the different categories.

4.1.1. Kenya’s Interbank Exposure Matrix

Table A4 in the Appendix 1 presents the extent to which banks have utilized potential relationships while Table A5 in the Appendix 1 presents a matrix of interbank exposures. The two tables show that Kenya’s interbank market is incomplete and highly segmented since not every bank trades with all other banks. The market is segmented by size into small, medium and large banks. The interactions in the interbank market exhibit a multiple money centre structure. The role of the money centres are played by 6 large banks, which are linked to other banks that are not fully linked among themselves. This can visually be seen from Table A5, where the money centres are in Q9.

The money centres are the heart of the interbank market in Kenya. If a shock hits a money centre or there is liquidity gridlock, there will be ripple effects in the entire market. The medium banks are the next tier of money centres ("quasi-money centres").

The results also show that there is inadequate interaction among the small banks (Q1). This can also be seen in Table A4 where small banks transact on average with 48% of their peers and 64% of the medium and large banks. It can be clearly observed, on average, that the larger the bank (by size), the greater the proportion of its peers that it
trades with. This occurs because of the perceived high credit risk for smaller banks that is augmented by the fact that the interbank market is non-collateralized. Medium (Q5) and large (Q9) banks (in Table A5) transact with 77% and 100% of their peers, respectively. In terms of inter-segment transactions, small banks tend to lend more to the medium and large banks than they are able to borrow from the same banks. Table A4, shows that while small banks lend to 64% of medium and large banks, they borrow from 51% of the medium and 25% of the large banks. This is a clear sign of interbank market segmentation where the large banks do not trust the smaller banks and therefore do not lend to them.

4.1.2. Lending and Borrowing Preferences

Figure B1 in the Appendix B show the evolution of the Lending Preference Index (LPI) and the Borrower Preference Index (BPI) across the different bank categories and over the period June 2003 to August 2012 computed using equations (1) and (2). The time series dimension of the analysis allows us to deal with the issue of endogeneity of lending relationships.

It can be observed from Figure B1 that large banks prefer to get funds from their counterpart large banks, which account for about 62 percent of total lending to the large banks, with medium size banks and small-size banks taking up about 28 percent and 10 percent of the total lending to the large banks respectively on average. For medium-size banks their lending preference similarly starts with large banks, followed by their peers then lastly the small-size, proportionally with large, medium and small banks contributing on average about 58 percent, 31 percent and 13 percent of the total lending to the medium banks, respectively. However, small-size banks lending preference is somewhat balanced in terms of volumes with large banks contributing about 31 percent of the total lending to the small banks, medium banks lend about 37 percent of the total lending to the small banks and 32 percent of total lending to the small banks coming from their peer small banks. This illustrates that there are asymmetries in financing, with some borrowers being much more important than others.

In terms of the BPI, it is clear that large banks over the period preferred to borrow most of their funds from either medium banks (41 percent) or other large banks (36 percent)
and the small banks met the balance (22 percent). Medium banks preferred to borrow most of its funds from either small banks (38 percent), their peers (36 percent) with large banks providing the remainder (25 percent). Small banks obtained more than half of its funding (59 percent) from its counterpart peers while the medium and large banks provided 38 percent and 13 percent, respectively over the same period. It is noteworthy to indicate that while the strongest borrowing relationship existed among the small banks (59 percent), the weakest relationship was between large and small banks where small banks can borrow on average about 13 percent of their funding needs from large. The analyses indicates that there exists lending and borrowing patterns in the interbank market, which are indicative of a market that is fragmented and segmented on the basis of transaction volumes. Interbank transactions volumes are rationed on the basis of bank size. Generally, a bank would lend and borrow more from bank that is larger than itself as can be seen from the patterns. This perhaps because banks would want to create and build lending relationships with banks with less correlated liquidity shocks and they allow banks to insure liquidity risk in the event of market distortions (Cocco et al. 2009).

4.1.3. Testing for Equality of the Interbank Interest Rates
We obtain a balanced series of matching transactions dates between the different categories of banks and compute the deviations in the interest rates charged. These are plotted in Figure B2 and B3 in the Appendix B. The second column of Table A6 in the Appendix A shows that the null of equality of interest rates in all sets of transactions across the different bank sizes is rejected. This implies that interest rates across the different sizes of banks do not converge meaning there exists market segmentation especially between large and medium banks, large and small banks. The third column of Table A6 presents the Box-Lyung test of serial correlation. The null of no serial correlation is rejected implying that there are three different interbank markets.

4.2. Is the Interbank Market in Kenya Efficient?
The efficiency of the interbank market is assessed on the basis of its ability to perform three critical functions. First, it should effectively channel liquidity from institutions with
surplus funds to those in need, thus allowing for more efficient financial intermediation. In effect when there is an effective interbank market banks should not hold substantial liquidity to cushion themselves against liquidity shocks. Second, the interbank market should be a good conduit for the interest rate channel of the monetary policy transmission. In effect when the CBR is changed, the interbank market rates should respond in tandem. Finally, the interbank market should provide an effective yield curve which can be used as a basis for pricing of the loans. We mainly focus on the first function.

4.2.1. Role of the Interbank Market in Liquidity Management during Normal Times

In normal times, banks with excess liquidity provide short-term loans without collateral as interbank loans to banks with a liquidity deficit. This interconnection between banks can lead to an enhanced liquidity allocation and increased risk sharing amongst the banks as argued by Allen and Gale (2000). Banks perceived to have higher counterparty risks from the continuous profiling process are charged more for their loans compared to those with less risk.

However, there are still challenges that still exist in the interbank market in Kenya even during normal times. First, the interbank market in Kenya is less developed in terms of its depth and width when compared to other markets. There is only one product (overnight lending), which limits the extent to which banks can utilize it for their liquidity management strategy to that spans more than one day. Additionally, the liquidity available is limited and dependent so much on government deposits. Second, there is limited interconnectedness between banks as has been evidenced in the earlier sections. This is especially the case between the small and large banks. Large banks hold most of the liquidity and thus control activity in the interbank market. The large banks tend to discriminate against relatively smaller banks in terms of credit they can extend to them and the interest rate they charge (usually higher rate than that charged on their peers). With this situation, banks are limited in the extent to which they can
utilize the interbank market to rebalance portfolio following changes in short-term interest rates.

Third, there is no full information available to all market participants as there is no clear mechanism for flow of relevant information and hence, there are asymmetries in the market. This tends to affect the credit profiling process and thus the interest rates structure. Fourth, Bank treasurers play a critical role in the interbank market. In line with this, banks make independent policies and therefore decisions on their asset-liability mix. In this regard, there is no harmonized / structured way for banks to engage in the interbank market. The differences in the asset-liability policies create inefficiencies in the way different banks respond to market conditions and thus the market.

Combined, all these show characteristics of an inefficient market.

4.2.2. Role of the Interbank Market in Liquidity Management during Crisis Times

We analyze this using event study in which an assessment is done on how the interbank market reacted to the specific changes. In particular, we focus on some selected major occurrences that are known to have impacted on the interbank market. These include the Kenya Electricity Generating Company Limited (KenGen) Initial Public Offer (IPO) in March 2006, Kenya Re-Insurance Co. Ltd (Kenya-RE) IPO in July-August 2007, Safaricom IPO in March-May 2008, Infrastructure Bonds of February 2009, Supplementary Budget Crisis of April/May 2009 and the developments in 2011 and 2012.

In all these events the shock led to a gridlock in the banking sector liquidity. If the interbank market was functioning well, it should have effectively redistributed liquidity from surplus to deficit banks. However, that did not happen effectively due to two critical reasons. First, not all banks have interbank lines of credit with each other as was discussed earlier (see Table A5). This is related to the perception of credit risk, ownership and other factors. For the Safaricom IPO for instance, the CBK had to step in
and withdraw liquidity from the receiving banks and at the same time inject the same to those with liquidity shortages. It also led CBK on 12th September 2008 in collaboration with banks to roll out the Horizontal Repos (HRTs). The HRTs are collateralized (using treasury bills as opposed to the interbank market which is uncollateralized) and were aimed at removing skewness in the distribution of liquidity in the interbank market. However, the uptake of HRTs faced challenges because of difficulties in the realization of the collateral in case of default. In the current framework, the security does not change hands during the collateralization process and thus there is lack of confidence on the realization of the collateral in the event of default.

Second, the liquidity in the interbank market is very limited and relies so much on the government deposits. Whenever there is a shock especially in terms of movement of government deposits, it hits the interbank market heavily.

In view of these limitations of the interbank market, many small and medium-sized banks in Kenya keep sufficient liquidity to meet maturing obligations i.e. adopt a defensive ALM strategy. For the large banks, which are perceived to be “too big-to-fail”, they have access to the interbank market and usually adopted an aggressive ALM strategy and consequently do not keep too much liquidity.

4.3. Impact of segmentation and (in)efficiency on the effectiveness of monetary policy

As mentioned earlier, the interbank market acts as the conduit for the transmission of monetary policy through the interest rate and credit channels. An effective monetary policy transmission would be reflected at the interbank market when the interbank rate stays near (or generally slightly below) the level of the policy rate. A look at the trends in policy rate (proxied by the 91-day treasury bill rates) and the interbank rates in Kenya given in the Figure B4 in the appendix B, shows that there is a disconnect between the two rates. The figure plots the trends in the two rates between the liquidity crisis period of July-December 2012 when Safaricom had their IPO. From the figure, the interbank rates do not follow the changes in the policy rate particularly during that period of increased liquidity in the market. Interbank market therefore does not act as a conduit
for the transmission of monetary policy stance during periods of volatile liquidity flows. This therefore makes the monetary policy ineffective as policy direction is not transmitted or reflected in the market during these shock periods. However, as shown in Figure B5 in the appendix B, interbank rates still trend policy rates quite well in the long run even with inefficient interbank markets. This implies that monetary policy transmission is not affected by the segmentation and inefficiency of the interbank market in the long run as deviations of the interbank rates from the monetary policy stance in the short run tend to be corrected in the long run. However, this may not be a reason to celebrate since monetary policy actions are intended to have effects in the short to medium term.

4.4. Case Studies and lessons for segmented markets like Kenya’s

Table A7 in the appendix presents a comparison of the Kenyan, UK, EU and US Interbank market in terms of some characteristics/dimensions. Several lessons can be drawn from these case studies in terms of characteristics of an efficient interbank market. First, an efficient market should be “deep and highly competitive”. This would distribute liquidity and price counterparty risks appropriately. Second, segmentation of the interbank market is a matter of degree. Even in developed interbank markets, there is an element of segmentation. Third, an efficient interbank market must be integrated with other money market segments in the same country such as treasury bills, commercial paper etc. Fourth, an efficient interbank market should trade in more than one currency to enable banks perform their ALM strategy across currencies. Fifth, an interbank market should have more than one tenor and a well-behaved yield curve. Sixth, a reliable interbank rate is transparent, covers a credible panel of banks and is not amenable to manipulation. Finally, in terms of the link between the interbank market and monetary policy, the Kenyan system is quite close to the UK. Specifically, the LIBOR is linked to the official bank rate, which is manipulated by the Bank of England which is the equivalent of the Central Bank Rate (CBR) in Kenya.
4.5. **Improving Efficiency of the interbank in underdeveloped markets like Kenya**

In order to enable the interbank market to be efficient in distribution of liquidity, price discovery and transmission of monetary policy in underdeveloped interbank markets like Kenya, a number of microstructure issues need to be addressed. These include, among others, broadening the product tenors, number of currencies, linkage with other money market segments, and addressing counterparty risks.

4.5.1. **Market Development Issues**

The efficiency of the interbank market in in most underdeveloped interbank markets like Kenya can be improved in a number of ways. First, longer maturity loans should be included and a well-behaved yield curve developed to provide a benchmark to price other financial securities. This, however, needs to be secured; otherwise segmentation may increase beyond the current level due to counterparty risks. Second, loans denominated in other currencies should be introduced after developing a mechanism to deal with the foreign exchange risk in addition to credit risk. Third, the interbank rate should be developed into a credible and reliable benchmark interest rate. This would entail looking at its computation in terms of panel of banks and actual method of calculation. Finally, the interbank market should be integrated with other money markets within and responsive to monetary policy.

4.5.2. **Counterparty Risks**

Counterparty risks are the main cause of segmentation in most underdeveloped interbank markets like Kenya and can be addressed using the CAMPARI lending principle\(^\text{10}\) that defines the critical considerations for lending/borrowing. The CAMPARI principle argues that for a lending transaction to occur, a bank must consider a number of factors, namely the **Character** of the borrowing bank, the **Ability** to repay, the **Means/Margins** in terms of assets/profits of the borrowing bank, **Purpose** for the Loan, **Amount** of the loan being extended (is it enough or too much?), and **Repayment terms** (ability to repay), and the **Insurance/collateral**.

\(^{10}\) CAMPARI is an acronym that stands for: C-Character of the borrowing bank, A-Ability to repay, M-Margin of finance, P-Purpose for the loan, A-Amount of the loan, R-Repayment terms, and I-Insurance/collateral.
In terms of asymmetric information regarding the character of the bank there is need to work on three critical issues. First, there is need to work on insurance/security of the loan. Specifically, the interbank market should have both secured and unsecured lending. Introduction of horizontal repos attempted to deal with the security issue in Kenya but uptake is slow due to difficulties of realizing the security (lending bank does not hold lien on the collateral). Second, there is need to address the problem of the purpose of the loan. Overnight lending is not only limiting in terms of the use of the funds, but also makes it difficult to introduce collateral. It takes time for security to be perfected. Finally, prudential regulations are important to ensure that banks are strong (thus influence the character of the bank) so as to induce confidence on the part of their potential lenders. The supervisory role of the central banks in instilling market discipline and adherence to financial management and reporting standards by banks is critical.

Some of the bank ALM strategies especially the defensive approaches lead to wastage of liquidity or inefficient allocation of liquidity, and therefore adversely impacting on the transmission of monetary policy signals. In this regard, there is need for moral persuasion by the central banks to convince banks that engage in aggressive strategy to change their modes of operation with regard to risk when the market is too liquid.

5. **Conclusions and Policy Recommendations**

The paper set out to analyze the extent to which market segmentation impacts on the efficiency of the interbank market in Kenya and how segmentation impacts on (impedes) the effectiveness of monetary policy in underdeveloped interbank markets. Efficiency is defined to mean the extent to which the interbank market performs liquidity distribution, mutual insurance against risks, price discovery and transmission of monetary policy.

Using network framework, even studies and and case studies, the study finds that the market is incomplete and highly segmented by size. First, large banks hold most of the liquidity and thus control liquidity in the interbank market. Small banks are net lenders
while large banks are net borrowers. Second, large banks tend to discriminate against relatively small banks in terms of opening credit lines and the interest rate they charge (usually higher interest rate than that charged on their peers).

The findings show that segmentation in such markets reduces the efficiency of the interbank market. The segmented nature of the interbank market in Kenya has affected its efficiency. First, some banks have not been able to effectively use the market to rebalance their portfolios while performing the asset-liability management function. Second, the segmented nature of the interbank market has limited its ability to perform the key function of mutual insurance against liquidity shocks. This was evident during the Safaricom IPO in 2008 and the supplementary budget crisis of May 2009, in which small banks found themselves with liquidity shortages and yet they could not borrow from the large banks. Segmentation and inefficiency in the interbank market is found to impede the transmission of monetary policy during periods of liquidity volatility and in the short run but not in the long run as short run deviations of the interbank rates tend to be corrected in the long run. Policy makers however need to take care that the ineffectiveness of monetary policy in the short run is corrected since monetary policy actions are intended to have effects in the short to medium term.

Review of interbank markets in the UK, EU and the US shows that improving the efficiency of such markets will require introduction of both unsecured short-term loans and secured lending for longer maturities. Second, there is need to broaden the product range beyond overnight lending in such markets. This will allow for a well-behaved yield curve in the interbank market which can be used to price other financial instruments. Third, foreign currency loans should be introduced in the interbank market to enable banks do ALM function across currencies. Fourth, the interbank rate should be developed into a credible and reliable benchmark for the money market. Finally, the interbank market should be linked with other money market segment and monetary policy.
References


### Appendix 1: Tables

#### Table A1: Interbank market with complete structure

<table>
<thead>
<tr>
<th>Lend</th>
<th>Borrow</th>
<th>Small Banks</th>
<th>Medium Banks</th>
<th>Large Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bank S1</td>
<td>Bank S2</td>
<td>Bank S…</td>
<td>Bank M1</td>
</tr>
<tr>
<td>Small Banks</td>
<td>BankS1</td>
<td>0</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>BankS2</td>
<td>√</td>
<td>0</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>BankS…</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>Medium Banks</td>
<td>BankM1</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankM2</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankM…</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>Large Banks</td>
<td>BankL1</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankL2</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankL…</td>
<td>√</td>
<td>√</td>
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</tbody>
</table>

Notes: √ means an active interbank credit line exists, 0 means there is no trade between the pair of banks.

#### Table A2: Interbank Market with incomplete structure

<table>
<thead>
<tr>
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<th>Borrow</th>
<th>Small Banks</th>
<th>Medium Banks</th>
<th>Large Banks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>BankS 1</td>
<td>BankS 2</td>
<td>BankS…</td>
<td>Bank M1</td>
</tr>
<tr>
<td>Small Banks</td>
<td>BankS1</td>
<td>0</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>BankS2</td>
<td>√</td>
<td>0</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td>BankS…</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>Medium Banks</td>
<td>BankM1</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankM2</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankM…</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>Large Banks</td>
<td>BankL1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankL2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>BankL…</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>

Notes: √ means an active interbank credit line exists, 0 means there is no trade between the pair of banks.
### Table A3: Interbank Market with incomplete and disconnected structure

<table>
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<th>Small Banks</th>
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<th>Large Banks</th>
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<tbody>
<tr>
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<td>BankS1</td>
<td>BankS2</td>
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</tr>
<tr>
<td>Small Banks</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>BankS1</td>
<td>0</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>BankS2</td>
<td>√</td>
<td>0</td>
<td>√</td>
</tr>
<tr>
<td>BankS…</td>
<td>√</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>Medium Banks</td>
<td>BankM1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BankM1</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BankM2</td>
<td>0</td>
<td>√</td>
<td>0</td>
</tr>
<tr>
<td>BankM…</td>
<td>0</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Large Banks</td>
<td>BankL1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BankL1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BankL2</td>
<td>0</td>
<td>0</td>
<td>√</td>
</tr>
<tr>
<td>BankL…</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes: √ means an active interbank credit line exists, 0 means there is no trade between the pair of banks.

### Table A4: Utilization of the potential Relationships

<table>
<thead>
<tr>
<th>LENDER</th>
<th>BORROWER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>Small</td>
<td>48%</td>
</tr>
<tr>
<td>Medium</td>
<td>51%</td>
</tr>
<tr>
<td>Large</td>
<td>25%</td>
</tr>
</tbody>
</table>

Source: Own computations based on interbank trading data from CBK
Table A5: Matrix of Interbank Exposures

Source of data: Central Bank of Kenya
Notes: The shaded cells (yellow) in the matrix reflect presence of a trading relationship between the lending bank (row) and the borrowing bank (column). Please note that the cells in the matrix should not be attributed to any specific bank in Kenya.
Table A6: Tests of Convergence of Interest Rates in 2012

<table>
<thead>
<tr>
<th>Null hypothesis</th>
<th>Mean test</th>
<th>Box-Lyung Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large banks segment is same as the medium banks segment</td>
<td>t= -7.215136 (0.000)***</td>
<td>Q_test =115.38 (0.001)*** Lag 70</td>
</tr>
<tr>
<td>Large banks segment is same as the small banks segment</td>
<td>t= 6.036029 (0.000)***</td>
<td>- Q_test=83.718 (0.001)*** Lag 45</td>
</tr>
<tr>
<td>Medium banks segment is same as the small banks segment</td>
<td>t= 7.742232 (0.000)***</td>
<td>- Q_test=190.79 (0.000)*** Lag 84</td>
</tr>
</tbody>
</table>

Note: Numbers in parentheses represent the p-values for the t-statistics and Q-statistics. ***, **, * represent level of significance at 1%, 5%, 10%, respectively.

Table A7: Comparison of Kenyan, UK, EU and US Interbank Market

<table>
<thead>
<tr>
<th>Feature/Dimension</th>
<th>Kenyan Interbank Market</th>
<th>London Interbank Market</th>
<th>EU Interbank Market</th>
<th>USA interbank Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Level of development</td>
<td>Shallow and uncompetitive</td>
<td>Deep and highly competitive</td>
<td>Deep and highly competitive</td>
<td>Deep and highly competitive</td>
</tr>
<tr>
<td>2. Segmentation of the Market</td>
<td>The market is highly segmented in terms of volumes traded and the interest rate charged.</td>
<td>There is limited segmentation credit lines are open to all banks irrespective of bank size or volumes traded</td>
<td>The market is segmented</td>
<td>Usually, the markets are characterized by one directional lending; from smaller banks to larger banks.</td>
</tr>
</tbody>
</table>
| 3. Role of the central bank        | - CBK indirectly influences the interbank through provision of reserves  
- No audit of the credibility of the bilateral fixing /setting the lending rates. | - The FX&MMC of the Bank of England controls the seven-day interbank rate. This enhances the link between the policy rate (repo rate) with short term market rates and hence the efficiency of monetary policy.  
- Bank treasurers are regularly audited to ensure they make consistent and credible offers for money. Failure to provide consistent offers that can be | - Limited role of the ECB | - The Federal Reserve is not involved in controlling the interbank rate, but only indirectly through provision of reserves.  
- There is no regulator audit of the bank of the credibility of the bilateral fixing /setting the lending rates.  
- The Fed reserve bank ensures the target range of rates is pre- |
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>backed by market conditions can lead to the bank being excluded from the panel of banks. announced by the FOMC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. Rules of engagement</strong></td>
<td>No clearly established rules of engagement in this market. But bilateral lines of credit agreements</td>
<td>There is a structured market which is well developed and is regulated by the FX&amp;MMC of the Bank of England that generates the rules of engagement.</td>
<td>Participants in this market can either trade directly with each other or use the services of a broker. The brokers do not take positions themselves but rather bring buyers and sellers together on an anonymous basis</td>
</tr>
<tr>
<td><strong>5. Participants</strong></td>
<td>Only banks are involved in this market</td>
<td>Both banks and large corporations participate in this market</td>
<td>Only banks participate</td>
</tr>
<tr>
<td><strong>6. Linkage with other money market segments</strong></td>
<td>The market is not directly linked with any other money market such as the treasury bills market in terms of pricing.</td>
<td>The market is well integrated with other markets such as the certificates of deposits, local authorities' deposits, treasury bills and commercial paper.</td>
<td>The market is linked to other markets</td>
</tr>
<tr>
<td><strong>8. Tenor and existence of well behaved yield curve</strong></td>
<td>Single tenor (overnight only) hence no existence of a yield curve</td>
<td>15 different maturities from overnight to 12 months. There is a well behaved yield curve. This provides a good basis for pricing other financial instruments</td>
<td>EURIBOR covers 15 different maturities. EONIA covers the overnight</td>
</tr>
<tr>
<td><strong>9. Ex-ante or ex-post computation of interest rate</strong></td>
<td>The interbank rate is computed ex-post (after trade). This ensures that data exist for every tenor</td>
<td>The LIBOR is computed ex-ante (before trade), which ensures that data exist for every tenor</td>
<td>The Eonia is computed ex-post for rates charged by a selected panel of banks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rates are determined bilaterally through verbal agreements between trading banks but with close</td>
</tr>
</tbody>
</table>
means that if there is no trade, no data and currency. The choice of the panel of banks for the Euribor and Eonia is based on a clearly defined criterion that ensures all market conditions are taken into account, including the diversity of the Euro area market.

monitoring by the OMO desk of the Fed Reserve Bank to make sure the rates are within the predetermined target range. The overall market rate is determined ex-post.

<table>
<thead>
<tr>
<th>10.</th>
<th><strong>Trades included in computation of the interest rate</strong></th>
<th>All trades for the day are used to compute the interbank rate. This allows a few trades to manipulate the market rate</th>
<th>Computed based on trimmed mean (excluding the 2 extreme quartiles) of the submissions of panels of banks. This minimizes market manipulation by a few offers.</th>
<th>Ex-post trades</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td><strong>Input from the public</strong></td>
<td>The market does not gain input from the public on the rates charged.</td>
<td>The public makes input on any concerns about the LIBOR rate which are taken seriously by the FX&amp;MMC. This enhances the role of the LIBOR rate as a benchmark rate for other funds.</td>
<td>No public participation in the price setting process.</td>
</tr>
<tr>
<td>12.</td>
<td><strong>Collateral</strong></td>
<td>Unsecured</td>
<td>Unsecured</td>
<td>Both secured and unsecured</td>
</tr>
</tbody>
</table>
Appendix B: Figures

Figure B1: Borrowing and Lending Preference Indices

Source of data: Central Bank of Kenya

Figure B2: Interest rate for small to small and small to large banks

Figure B3: Interest rate for Large to Large and Large to small banks
**Figure B4:** Trends in interbank rates and policy rates during crisis period in Kenya (July – Dec in 2008)

**Figure B5:** Trends in interbank rates and policy rates in the long run
<table>
<thead>
<tr>
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<th>Author(s)</th>
<th>Title</th>
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<td>Uses and Abuses of Per-diems in Africa: A Political Economy of Travel Allowances</td>
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