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Segmentation and Efficiency of the Interbank Market in Kenya¹

Moses Muse Sichei², Samuel Kiplang'at Tiriongo³
and Chris Shimba⁴

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Abstract

This paper studies segmentation and efficiency of the interbank market in Kenya. The study utilizes network framework and case studies of countries with developed interbank markets, namely the UK, EU and the US. Using daily data for the period June 2003 to September 5 2012, the study finds that Kenya's interbank market is incomplete and highly segmented by size: small, medium and large banks. Specifically, large banks tend to discriminate against small banks in terms of credit extended and the interest rate charged, which is usually higher than those charged on their peers. The segmented nature of the market has limited its ability to facilitate banks' liquidity management strategy. The case studies show that the efficiency of the interbank market in Kenya can be enhanced through a number of developments such as adding lending products with maturities of more than one day so as to have a term structure; increasing the number of currencies traded; developing a benchmark interbank interest rate; and increasing linkages with other money market segments and monetary policy.

Key Words: Segmentation, interbank, efficiency, Kenya

JEL Classification: E44, D47 and G21

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Introduction

The interbank market plays at least three critical roles in any modern financial system. First, a well functioning interbank market effectively channels liquidity from institutions with surplus funds to those in need, thus allowing for more efficient financial intermediation.

Over-supply or shortfalls in commercial banks' reserves arise from stochastic deposits and withdrawals by customers that create inter-temporal liquidity shocks, which create surplus and deficit banks (Bruche and Suarez, 2010). In such a case, the interbank market serves to clear this imbalance, thus playing a critical role in helping to satisfy temporary, localized excess demand for funding liquidity that is needed for the smooth functioning of the financial system.

Second, central banks intervene in interbank market for liquidity management and monetary policy purposes. The interbank market is the first stage of the interest rate and credit channels of monetary policy transmission. In Kenya the interbank rate should be sensitive to changes in the Central Bank Rate (CBR) and reflect underlying conditions in the market. Effective monetary policy implementation implies that the central bank should manage liquidity in such a manner that the interbank rate stays near (or generally slightly below) the level of the CBR. Like in other countries worldwide, the CBR as the monetary policy instrument, is supported by other facilities such as the level of deposit and lending rates, maintenance regime of the cash reserve requirement, clearing transactions, horizontal repos (secured short-term lending among commercial banks), and open market operations (vertical repos and reverse repos between commercial banks and the central bank).

Finally, the interbank market rate should provide an effective price-discovery in the money market as a whole. This requires a credible benchmark rate, which is computed from trades of majority of the participants in the market. Temporary imbalances may arise from time to time, but the market should restore equilibrium and close undesirable gap, without intervention of the central bank rate. Consequently, interbank rates can be used as effective guide for loans, savings, mortgages, futures, options and swaps.

With an efficient interbank market, banks hit by liquidity shocks would have an incentive to borrow from those with surplus liquidity in order to meet liquidity obligations that fall due. This will enable them not to prematurely liquidate interest-earning assets. Moreover, with an interbank market in place banks will ex ante put aside less liquidity to cushion themselves from shocks and thus invest more in profitable lending transactions. The redistribution of funds between banks is necessary to cope with the expected and unexpected liquidity needs, risk sharing/safety net purposes since banks are heterogeneous and specialized in different activities.

The efficiency of the interbank market in supporting commercial banks' liquidity management process depends largely on the exact patterns of financial linkages among the participating banks. Theoretically, there are four possible segmentation structures of the interbank market: complete market structure (each bank lends to all others), incomplete market structure (some banks lend to selected banks), disconnected

structure (no lending to each other) and multi-money centre (one or some banks lend to each other and connect to small banks, which are not connected among themselves). Kenya's interbank market reflects some of these segmentation characteristics. The type of market structure affects the speed at which the market resolves liquidity distribution issues and achieves stability-the faster this happens the highly efficient the market is.

Literature on segmentation of interbank markets suggests that the ability of banks to borrow in the interbank market is principally affected by their reputation. Market reputation in turn depends on such factors as bank size and ownership. 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 (Allen and Gale, 1990, Allen and Saunders, 1992). A small bank wishing to borrow in the interbank market faces the problem of conveying to potential lenders that it has a good credit record. 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).

Anecdotal evidence shows that the ability of the interbank market in Kenya to withstand liquidity shocks has been hampered by segmentation of the market. For instance the Safaricom IPO which closed in June 2008 led to acute liquidity crunch after an over



subscription of close to Kshs.200 billion was received by four commercial banks. This led to asymmetry in the reserves held by commercial banks and the situation stabilized after Central Bank of Kenya (CBK) stepped in with a number of policy initiatives. Similarly, following discovery of errors in supplementary budget of 2008/2009, Parliament temporarily froze withdrawal of funds from the Consolidated Fund for spending by line ministries in May 2009, which created a liquidity crunch especially for the small banks.

Despite the importance of the interbank market, there is limited research on it in Kenya. Green et al. (2012) studied the interbank market in Kenya and found no segmentation. However, this is inconsistent with what has been observed in Kenya and there is need to explore varied measures of segmentation on the

Kenyan interbank market. The aim of this paper is to augment the stylized facts about segmentation in Kenya's interbank market and analyze its impact on the efficiency. 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 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 literature review while section 4 presents the analytical framework. Section 5 presents the results and discussions. Section 6 concludes and provides some policy recommendations.

Background Information

2.1 Operational framework and stylized facts about 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 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 market⁵. The is evidence of market segmentation as lending and borrowing agreements are not open to all banks but rather there are limited established lines of credit. 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

⁵ The remaining 2 banks offer Islamic banking (Sharia compliant) products and hence do not participate in the trading.



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, banks resort to borrowing

funds from the CBK discount window for funds at the rate of the 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, 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. KEPSS⁶ 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 where 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

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.

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 levied⁷. 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. But with the introduction of RTGS, this system did not have a provision for overdrawing 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.

2.2 Asset-Liability Management in Banking

2.2.1 Fundamentals of liquidity management in a bank

The management of any commercial bank is permanently concerned with the good management of the whole risk profile the organization is exposed to (Sinkey, 2002). If the risks (liquidity risk, interest rate risk, foreign exchange risk, credit risk etc.) had been uncorrelated, then they could have been handled separately, by taking appropriate decisions for specific situations. However, there are strong connections between all categories of risks. Thus, the choice of the Assets and Liability Management (ALM) strategy is central in the practice of liquidity management in banking.

The main goal of ALM in banking is the control of the net interest margin. A bank can adopt a defensive or aggressive ALM strategy. The aggressive ALM strategy focuses on maximizing the net interest margin by changing the balance sheet structure of the bank. On the contrary, the defensive ALM strategy entails isolation of net interest margin from the interest rate

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).

fluctuations, no matter the course of these variances (positive or negative) for the bank. Both of these strategies analyze the position of the bank's balance sheet items that are sensitive to changes in the interest rate.

Banks may use a series of available financial instruments to adjust their assets and liabilities. The most frequent method is the use of money market especially the interbank market. Unlike in well-developed money markets with a deep market and a wide array of financial instruments, in Kenya, there is only one financial instrument in the interbank market (i.e. the overnight lending). They can, however, utilize other money market instruments such as government securities, reverse repo transactions with treasury bills or as a last resort –CBK discount window. The use of the capital market in raising additional funds by banks in Kenya has yet to become popular perhaps due to the fact that the market is still shallow to accommodate products that provide quick short term financing. The slow uptake of capital market instruments such as corporate bonds has been attributed to long procedures for approval of issuance of a corporate bond at the capital markets. Consequently, banks have relied heavily on the interbank market and the existing monetary policy instruments. Unlike the situation in Kenya, developed markets provide an extended variety of instruments in the interbank market, which can be directly transacted or used in different transactions.

The structure of liabilities can also be modified on short-term and long-term basis. This implies adapting ALM strategy according to a series of elements: anticipated structure of assets; interest rates evolution; necessity of ensuring an adequate financing, both from the interest rate risk point of view as well as liquidity risk.

Most banks use the “funds gap” management framework. Under this framework, all items in each side of the bank's balance sheet are classified into those whose cash flows are sensitive and those whose cash flows are insensitive to changes in short-term interest rates (Simonson and Hempel, 1982). Thus, an asset or liability is identified as sensitive if cash flows from the asset or liability change in the same direction and general magnitude as the change in short-term rates. The cash flows of insensitive assets or liabilities do not change within the relevant time period.

“Funds gap” or “gap” is computed as the difference between interest sensitive assets and interest sensitive liabilities. The funds gap (is positive when the shilling amount of sensitive assets exceeds that of sensitive liabilities.

$FG(i) = A(i) - L(i) > 0$ i.e. generated interest income > paid interest expenses. The gap is negative if sensitive liabilities exceed sensitive assets.

$FG(i) = A(i) - L(i) > 0$ i.e. generated interest income < paid interest expenses

Table 1: Impact of changing interest rate over the structure of bank portfolio

Forecasted change of interest rates	Nature of forecasted funds gap	Bank Action: Change of portfolio
Increase	Positive	Increase rate-sensitive Assets, decrease rate-sensitive liabilities
Decrease	Positive	Decrease rate-sensitive Assets, increase rate-sensitive liabilities
Increase	Negative	Increase rate-sensitive Assets, decrease rate-sensitive liabilities
Decrease	Negative	Decrease rate-sensitive Assets, increase rate-sensitive liabilities

When sensitive assets are equal to sensitive liabilities, the bank has a zero fund gap

$FG(i) = A(i) - L(i) > 0$ i.e. generated interest income=paid interest expenses

With a positive gap, the interest margin would increase if short-term rates rose and decrease if short-term rates fell. With a negative gap, the interest margin would decline if short-term rates rose and increase if short-term rates fell. If there is zero gap, interest margin will be stable or will not change regardless of the movement of short-term rates.

The implications for bank management are straightforward and shown in Table 1 above. If an increase of interest rates is anticipated, the bank that has a positive gap will register an increase of its revenues. The action is to increase rate-sensitive assets and reduce rate-sensitive liabilities. Contrariwise, if the anticipated interest rate decline, the bank should

do the converse: reduce rate-sensitive assets and increase the rate-sensitive liabilities.

Depending on the type of strategy that a bank has adopted, changes in assets and liabilities as banks adjust their portfolios have a strong bearing on the bank's participation in the interbank market. If many banks adopt a strategy to reduce their assets in the interbank market, a liquidity crunch can occur leading to volatilities in the interbank market interest rates. This complicates liquidity management by the Central Bank since there will be mixed signals on liquidity conditions in the market and behavior of interest rates. Under such conditions, the monetary authority would be forced to intervene with liquidity injections to ensure stability of interest rates.

2.2.2 Efficiency and Solvency in Banking

As pointed out by Reboredo (2004), there is an interplay between the efficiency and solvency of a bank production plan, which corresponds to the

Figure 1: Solvency-Profitability Trade Off

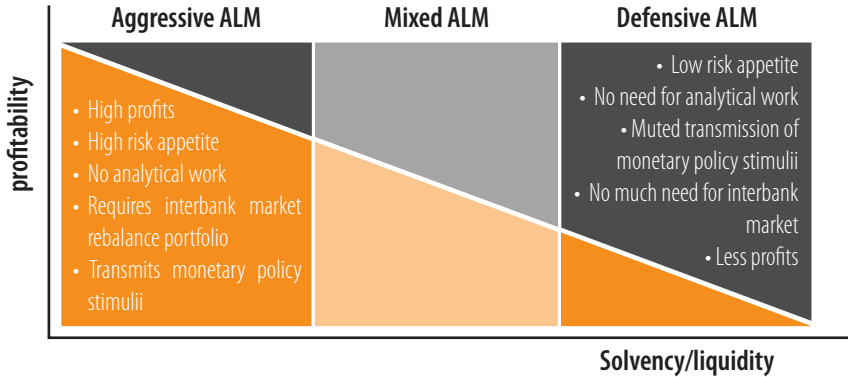
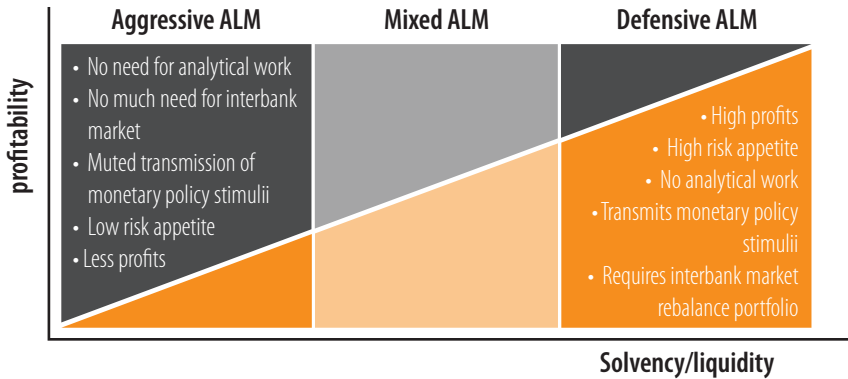


Figure 2: Risk-Profitability trade off



expected profit of the bank. This relationship can be shown in figures 1 and 2. Figure 1 shows that there is a trade-off between solvency and profitability. If a bank follows a policy of ensuring solvency, it will tie up a lot of liquidity and thus unable to make profits through lending. The converse applies to banks which keep less liquidity. Figure 2 presents the flipside of it.

High solvency implies less liquidity/interest rate risk and that implies less profits.

2.2.2 Aggressive ALM Strategy

An aggressive ALM strategy entails utilizing the strategies identified in column 3 of table 1 and consists of three components. The first is computing the funds

gap. The second is anticipating the evolution of the interest rate. This requires analytical work to provide forecasts of interest rates. Finally, is the adjustment of the structure of assets and liabilities that are sensitive to interest rate, in order to maximize the net interest margin. This requires a robust money market, including the interbank money market. Figures 1 and 2 present some of the salient features of the aggressive ALM strategy. The main disadvantage of aggressive ALM strategy is that in case of a failure, it could lead to major losses for the bank. A variant of this strategy is used by the large banks in Kenya.

2.2.3 Defensive ALM Strategy

A defensive strategy tries to preserve the current level of net interest margin by protecting it from any change in interest rates. This type of management tries to maintain a balance between the sensitive assets and liabilities for a certain period of time (i.e. use a zero funds gap). If this point is reached, an increase of interest rates generates a change of collected and paid

interests in the same way, so the net interest margin remains unchanged. Figure 1 and 2 show the salient features of the defensive ALM strategy.

2.2.4 Mixed ALM Strategy

Both the defensive and the aggressive ALM strategy are bank management extremes and they are not used in practice. A mix of strategies is often used and its application depends on the market characteristics, the nature of the money market, the risk appetite of the bank management and shareholders and the management of other types of inter-correlated but inherent bank activity risks.

As such, the variations in the banks' strategies are more of degree of 'defensiveness' or 'aggressiveness' at a particular time period than a clearly defined strategy. The mix of strategies and the continuous review and / adjustments in portfolios has implications on funds available for trading in the interbank market.

Survey of Previous Work

Past studies have attempted to model an efficient interbank market and have shown that an efficiently functioning interbank market is mainly characterized by a number of features, namely: it should be run by professionals sufficiently equipped with the capacity to assess the risks related to the market participation; there should be high degree of market breadth and 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).

However, 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 fragmentation of the market.

While the interbank market plays an integral role in the transmission of monetary policy, little research has been done on it compared to other markets such as the bond, equity or foreign exchange markets (Furfine 1999, Hartman et al. 2001). Available literature on the interbank market covers a few main issues. For instance, Gaspar et al., (2004) study the linkage between changes in monetary policy and institutional environment and movements in the overnight interbank interest rates, Palombini, (2003) discusses the overnight interest rate volatility and factors that influence it and Ewerhart et al., (2003) looks at how the overnight interest rate is affected by

the liquidity management of the central bank. Most of these studies were conducted in developed and emerging markets such as the Euro zone, the US, and Thailand.

Steinsson (2003) identifies a mismatch between interbank rates and the Central Bank's policy rate as an indicator of inefficiencies in the financial system. According to this study, in Iceland, the mismatch suggests that Icelandic banks finance themselves on different terms. This 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. On the other hand, literature on segmentation of interbank markets suggests that the ability of banks to borrow in the interbank market is principally affected by their reputation, which depends on such factors as bank size and ownership. 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 (Allen et al., 1990, Allen and Saunders, 1992). 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. 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).

Generally, banks have limited information on the risk profiles of other banks, thus the price formation mechanisms in the interbank market may not be

efficient⁸. Moreover, limited information implies that banks individually assess the risk profiles of counterparty banks in the interbank market, thus creating lending relationships and segmentation in the market. More precisely, banks with a larger reserve imbalance are more likely to borrow funds from banks with which they have a relationship, and to pay a lower interest rate than otherwise. On the other hand, smaller banks and banks with more non-performing loans tend to have limited access to money markets, and rely more on relationships. Generally, these relationships are established between banks with less correlated liquidity shocks and they allow banks to insure liquidity risk in the presence of market distortions (Cocco et al., 2009).

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-fail'. On this basis, some recent studies recognize the bilateral nature of the interbank market (e.g. Allen

⁸ A market is said to be efficient with respect to a given information set if it is impossible to make economic profits by trading on the basis of the information set, i.e. no arbitrage opportunities, after costs, after risk premium using ex-ante information (Jensen, 1978; Levich, 1985; Ross, 1987).



and Gale, 2000; Freixas et al., 2000; and Leitner, 2005) and conclude presence of tiers in the interbank market.

Little work (at least to our knowledge) has been done on the segmentation of the interbank market in developing markets in general, and Kenya in particular. Green et al., (2012) studied the interbank market operations in Kenya. They tested for convergence of interest rates in the interbank market across bank sizes

and ownership structures and found that interbank interest rates generally converge, implying lack of market segmentation. Gatenga et al., 2010 et al., 2010) argue that the market is fragmented, with large banks serving specific lines of credit and market niches, but not contributing to competition in the sector. There is need to explore varied measures of segmentation on the Kenyan interbank market, and whether segmentation affects market efficiency.

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).

4.1 Network Framework

In this section, the paper attempts to check whether there is market segmentation in Kenya's interbank market or not. This study adopts a network framework suggested by Allen and Gale (2000) to study presence of segmentation in the interbank money market.

4.1.1 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 2). This means that each bank in the system 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.

Table 2: Complete Structure

	Borrow	Small Banks			Medium Bank			Large Banks		
Lend		Bank S1	Bank S2	Bank S...	Bank M1	Bank M2	Bank M...	Bank L1	Bank L2	Bank L...
Small Banks	Bank S1	0	√	√	√	√	√	√	√	√
	Bank S2	√	0	√	√	√	√	√	√	√
	Bank S...	√	√	0	√	√	√	√	√	√
Medium Banks	Bank M1	√	√	√	0	√	√	√	√	√
	Bank M2	√	√	√	√	0	√	√	√	√
	Bank M...	√	√	√	√	√	0	√	√	√
Large Banks	Bank L1	√	√	√	√	√	√	0	√	√
	Bank L2	√	√	√	√	√	√	√	0	√
	Bank L...	√	√	√	√	√	√	√	√	0

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

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 3. For instance small banks trade among themselves and the medium banks but do not trade with large banks.

Table 3: Incomplete Structure

	Borrow	Small Banks			Medium Bank			Large Banks		
Lend		Bank S1	Bank S2	Bank S...	Bank M1	Bank M2	Bank M...	Bank L1	Bank L2	Bank L...
Small Banks	Bank S1	0	√	√	√	√	√	0	0	0
	Bank S2	√	0	√	√	√	√	0	0	0
	Bank S...	√	√	0	√	√	√	0	0	0
Medium Banks	Bank M1	√	√	√	0	√	√	√	√	√
	Bank M2	√	√	√	√	0	√	√	√	√
	Bank M...	√	√	√	√	√	0	√	√	√
Large Banks	Bank L1	0	0	0	√	√	√	0	√	√
	Bank L2	0	0	0	√	√	√	√	0	√
	Bank L...	0	0	0	√	√	√	√	√	0

Notes: √ means an active interbank credit line exists,0 means there is no trade between the pair of 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 4 below.

Table 4: Incomplete and Disconnected Structure

	Borrow	Small Banks			Medium Bank			Large Banks		
Lend		Bank S1	Bank S2	Bank S...	Bank M1	Bank M2	Bank M...	Bank L1	Bank L2	Bank L...
Small Banks	Bank S1	0	√	√	0	0	0	0	0	0
	Bank S2	√	0	√	0	0	0	0	0	0
	Bank S...	√	√	0	0	0	0	0	0	0
Medium Banks	Bank M1	0	0	0	0	√	√	0	0	0
	Bank M2	0	0	0	√	0	√	0	0	0
	Bank M...	0	0	0	√	√	0	0	0	0
Large Banks	Bank L1	0	0	0	0	0	0	0	√	√
	Bank L2	0	0	0	0	0	0	√	0	√
	Bank L...	0	0	0	0	0	0	√	√	0

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

Freixas et al. (2000) added in their analysis 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. They show that under this structure 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.

4.1.2 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 $F_{i \rightarrow k}$ denote the amount lent by bank category j to bank category k on loan l ,

Then:

$$LPI_{Large, Medium, t} = \sum_i F_i^{Large \rightarrow Medium} / \sum_i F_i^{Large \rightarrow All} \dots \dots \dots (1)$$

Where t denotes the time period. 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:

4.1.3 Convergence of Interest Rates in Different Market Segments

We use empirical testing 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: Mean test and Lyung-Box (1978) Q test of serial correlation. The mean test checks whether the deviations in interest rates mean are statistically different from zero. The assumption is that if the series mean is statically 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

$$LPI_{Large, Medium, t} = \sum_i F_i^{Large \rightarrow Medium} / \sum_i F_i^{Large \rightarrow any Mediu} \dots \dots \dots (2)$$

Martingale Difference (MD) process⁹. A white noise process is a sequence of serially uncorrelated random variables with zero mean and finite variance. The assumption 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.

4.2 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.

4.3 Data

We use interbank trading data which capture the traded volume, lender, borrower and interest rates spanning the period June 2003 to September 5, 2012¹⁰. The choice of the sample period is motivated by availability of a reliable and comprehensive dataset on interbank transactions. This period is also characterized by increased volatilities in the market, some of which attributed to issues around market segmentation and lack of an efficient market system.

⁹ A Martingale difference is a process, whose expectation with respect to past values of another stochastic series X is zero, i.e. $E(Y_{t+1} | X_t, X_{t-1}, \dots, X_0) = 0$ for all t .

¹⁰ Interbank trading data was obtained from the Central Bank of Kenya, courtesy of the Kenya Bankers Association

Results

5.1 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.

5.1.1 Kenya's Interbank Exposure Matrix

This information is provided in tables 5 and A1 in the appendix. Table 5 presents the extent to which banks have utilized potential relationships while Table A1 presents a matrix of interbank exposures. The two tables show that Kenya's interbank market is incomplete and highly segmented. It is incomplete because 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 A1, where the money centres are in Q9.

The money centres are the heart of the interbank market in Kenya and these banks follow an aggressive ALM strategy compared to small banks which follow a defensive ALM strategy. 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").

Table 5: Utilization of the potential Relationships

	BORROWER			
		Small	Medium	Large
LENDER	Small	48%	64%	64%
	Medium	51%	77%	82%
	Large	25%	80%	100%

Source: Own computations based on interbank trading data from CBK

There is inadequate interaction among the small banks (Q1). This can also be seen in Table 5 where small banks transact on average with 48% of their peers and 64% of the medium and large banks. It can be clearly observed that, on average, the larger the bank (by size), the greater the proportion of its peers that it trades with. This is basically 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 transact with 77% and 100% of their peers, respectively. In terms of inter-segment transactions, small banks tend to lend more than they borrow. Table 5, 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 still attributed to the defensive ALM strategy adopted by most small banks.

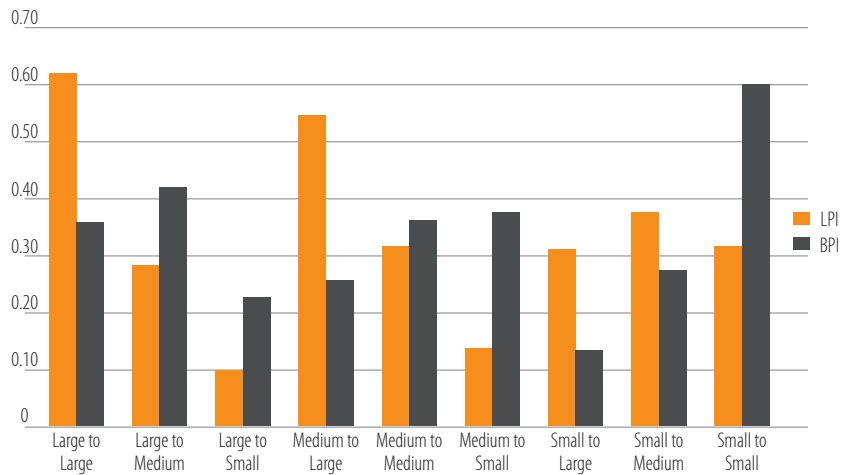
5.1.2 Lending and Borrowing Preferences

Figures 1 shows 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 the endogeneity of lending relationships.

It can be observed from Figure 3 that the most important lender for large banks are their counterpart large banks, which accounts for about 62 percent of total lending, with medium size banks and small-size banks taking up about 28 percent and 10 percent 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 lending on average about 58 percent, 31 percent and 13 percent, respectively over the entire sample period. However, small-size banks lending preference is somewhat balanced in terms of volumes with large banks taking up on average about 31 percent, medium and small-size banks taking up 37 percent and 32 percent of total lending, respectively. 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) or small banks met the balance (22 percent). Medium banks preferred to borrow most of its funds from either small banks (38 percent),

Figure 3: Borrowing and Lending Preference Indices



Source of data: Central Bank of Kenya

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.

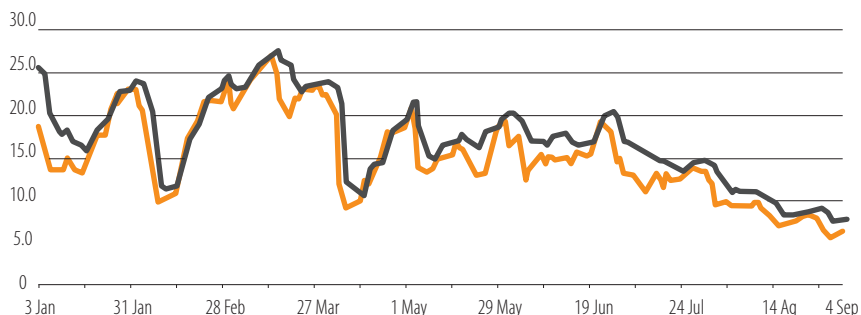
The analyses indicates that there exists lending and borrowing patterns in the interbank market, which are indicative of a market that is fragmented and segmented on the basis of transaction volumes.

Interbank transactions volumes are rationed on the basis of bank size. Generally, a bank would lend and borrow more from a bank that is larger than itself as can be seen from the patterns. This perhaps is 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).

5.1.3 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 4 below.

Figure 4: Interest rate for small to small and small to large banks



The second column of table 6 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 6 presents the Box-Ljung test of serial correlation. The null of no serial correlation is rejected implying that there are three different interbank markets.

5.2 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

Figure 5: Interest rate for Large to Large and Large to small banks

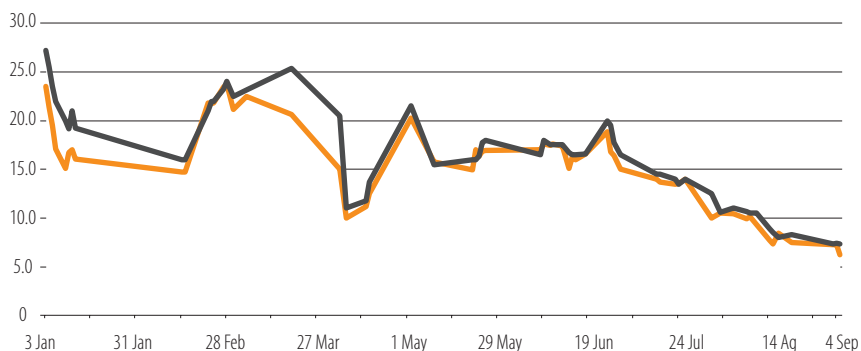


Table 6: Tests of Convergence of Interest Rates in 2012

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

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

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.

5.2.1 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. 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 in line with Table 1.

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.

5.2.2 Role of the Interbank Market in Liquidity Management during Crisis Times

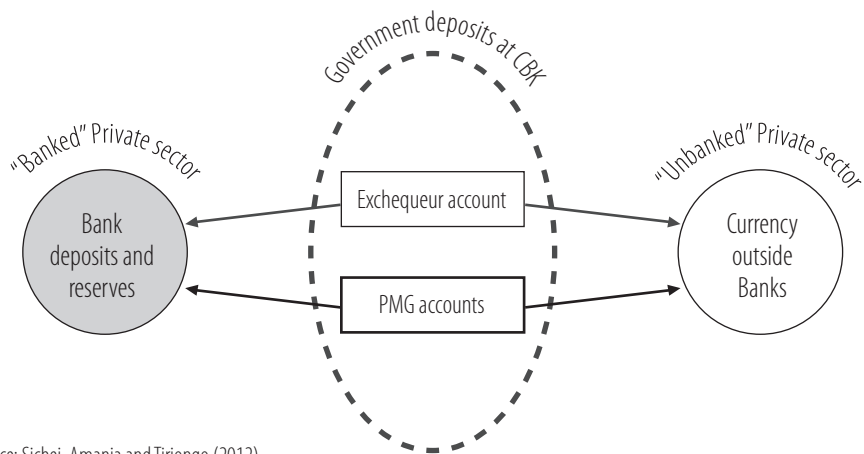
We analyze this using event study in which an assessment is done on how the interbank market reacted to the specific changes. In particular, we focus on some selected major occurrences that are known to have impacted on the interbank market. These include the KenGen IPO in March 2006, Kenya-RE IPO in 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 assisted the CBK in redistributing liquidity from surplus to deficit banks. However, that was not done effectively due to two critical issues. First, not all banks have interbank lines of credit with each other (see Table A1). This is related to the perception of credit risk, ownership and other factors. For the Safaricom IPO for instance, it made the CBK 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 uncollateralised) and were aimed at removing skewness in the distribution of liquidity in the interbank market. However, there have been challenges with the uptake of HRTs because of issues on the realization of the collateral (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. This can be seen in figure 6 on the way bank reserves move in and out of CBK.

In view of these limitations of the interbank market, many small and medium-sized banks in Kenya keep sufficient liquidity to meet maturing liquidity

Figure 6. Shift of Bank Reserves to the CBK and Vice Versa



Source: Sichei, Amanja and Tiriongo (2012)

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.

deposits at or near the London Interbank Offer Rate (LIBOR). The trading procedures used in this market are set and clearly communicated to the participants by the Foreign Exchange & Money Market Committee (FX&MMC) of the Bank of England.

5.3 Case Studies

5.3.1 London Interbank Market

5.3.1.1 Basic Information

The London interbank market is a wholesale money market where deposits are placed and funds are lent between commercial banks in a range of currencies usually for maturities ranging between overnight and 12 months. This implies existence of a clear term structure. The main participants in this market are all banks who deal both as borrowers and lenders, but very large corporations may also be able to place

In this market, short term interbank rates (usually the seven-day interbank rate) are tightly controlled by the Bank of England as part of its day-to-day monetary policy operations but longer term rates are determined in a highly competitive market. The market is closely integrated with other money markets such as those in certificates of deposits, local authorities’ deposits, treasury bills and commercial paper and is thus highly competitive with very narrow spreads between bid and offer rates on different instruments with similar maturities. Because of the high competition and the involvement of the Bank of England in controlling the seven-day interbank rates, the market is said to

be deep and highly competitive with a well behaved yield curve for short term rates. This differs with the interbank market in Kenya.

The market is less segmented since credit lines are open to all banks irrespective of size and the volumes traded. In fact, since the abolition of exchange controls in early 1980s, the London interbank market has developed and attracted foreign investors to take advantage of the developed term structure of interest rates and the clear expectations that the Bank of England has managed to shape overtime through its control on the seven-day interbank rate (Hurn et al.,1995).

5.3.1.2 LIBOR Currencies, Tenors, Computation, Panel of banks

The LIBOR is an interest rate at which banks borrow or place funds from (or with) other banks in the London Interbank market. It is published ex-ante (i.e. before trade) on a daily basis by the British Bankers' Association (BBA) from submissions of a selected panel of banks, made up of the largest, most creditworthy and active banks.

It is quoted in 10 different currencies, namely the US dollar, Euro, British Pound, Japanese yen, Canadian Dollar, Swiss Franc, Australian Dollar, Danish Kroner, New Zealand Dollar, and the Swedish Kroner and in 15 different maturities (overnight, 1 week, 2 weeks, 1,2,3,4,5,6,7,8,9,10,11 and 12 months). This implies that there are 150 rates produced in each business day.

Individual LIBOR rates are calculated as a trimmed mean of the submitted offer rates by the respective

panel of banks based on submissions from a panel of banks. The decision to use the trimmed mean was motivated by the need to ensure that an individual submission by one or few contributing banks cannot manipulate the outcome of the LIBOR rate for the day by quoting outlying or abnormal offer rate. The submissions are done ex-ante (before the event) and are on the basis of the question:

"At what rate do you think interbank term deposits will be offered by one prime bank to another prime bank for a reasonable market size today at 11am?"

Table 7 below shows the number of banks that make offer submissions to Reuters for computation of the different LIBOR rates in all the tenors (Last reviewed in May 2011).

Table 7: Number of Banks in each Contributing Panel

LIBOR Currency	No. of contributing banks
US dollar	18
Euro	15
British Pound	16
Japanese yen	13
Canadian Dollar	9
Swiss Franc	11
Australian Dollar	7
Danish Krone	6
New Zealand Dollar	7
Swedish Krona	6

Source: British Bankers' Association

The contributing banks are selected by the BBA with input from the FX&MMC) based upon three criteria: the scale of market activity, the reputation of the Bank, and perceived expertise in the currency concerned. The association maintains a reference panel of between 6 and 18 contributor banks for each currency calculated. The aim is to produce a reference panel of banks which reflects the balance of the market. Every six months, the FX&MMC undertakes an assessment of each panel, based upon a review of the contributors by the BBA. The review evaluates each bank to assess whether they still meet the above criteria and remain eligible to contribute to the LIBOR rates¹¹. Any Bank can apply to be on any currency panel they choose and the BBA welcomes any potential contributor that trades in the London market.

5.3.1.3 Input from Market/public

The BBA considers appropriate that all participants should be allowed to comment on LIBOR rates. In this regard, the association provides an online secure page that enables interested parties to comment on rates. All queries receive a substantial reply after initial examination and discussion by the FX&MMC Committee, and in most cases an acknowledgment will be provided that the BBA are in the process of investigating the issue. This enhances the credibility of the LIBOR generating process and boosts confidence in the rates, thus enhancing their role as benchmark interest rates.

5.3.1.4 LIBOR as a Benchmark Rate

Based on the credibility of the process of determining the LIBOR, the rate is considered a benchmark rate for unsecured funding in the London market for a given period and currency. It is used by banks, securities houses and investors to gauge the cost of unsecured borrowing in the London interbank market. It is the most widely used benchmark for short term interest rates in the world, primarily because most of the world's largest borrowers borrow money on the London market. Because of its prominence, it is often used in other transactions, such as swaps. It is important because it is the rate at which the world's most preferred borrowers are able to borrow money. It is also the rate on which rates for less preferred borrowers are based. For example, a multinational corporation with a very good credit rating may be able to borrow money for one year at LIBOR plus a certain margin. Developed countries that mainly rely on the LIBOR for a reference rate include the United States, Canada, Switzerland, and the United Kingdom.

5.3.1.5 The LIBOR and Monetary Policy

The Bank of England sets its official bank rate (i.e. the interest rate at which it lends to financial institutions). This interest rate then affects the whole range of interest rates set by commercial banks, including the LIBOR. The aim of the bank of England is to stabilise and steer interest rates (including LIBOR) in line with the policy rate (the bank rate). This is done by influencing the reserves held at the central bank and by controlling the seven day LIBOR rate. While the quantity of reserves is affected by reserve requirements and the standing facilities provided by the central

¹¹ In 2012, Barclays Bank was fined for having manipulated its submissions of interest rates that enter to the computation of the LIBOR

Bank, the control on the seven day interbank rate becomes the anchor for other short term rates. Since the market is deep and competition is high, the yield curve for short term rates is well behaved.

A change in the policy rate is immediately transmitted to short term sterling money market rates, both to money-market instruments of different maturity (such as rates on repo contracts of maturities other than two weeks) and to other short term rates, such as interbank deposits. But these rates may not always move by the exact amount of the official rate change. Soon after the official rate (typically the same day), banks adjust their standard lending rates (base rates) usually by the exact amount of the policy change. This quickly affects the interest rates that banks charge their customers for variable-rate loans, including overdrafts. Rates on standard variable-rate mortgages may also be changed, though this is not automatic and may be delayed. Rates offered to savers also change, in order to preserve the margin between deposit and loan rates. The margin can vary over time according to, for example, changing competitive conditions in the markets involved, but it does not normally change in response to policy changes alone.

5.3.2 Euro Interbank Interbank Market

5.3.2.1 Basic Information

EU member States share a unified money market where the implementation of monetary policy is decentralized and carried out by national central banks. This is the market in which banks exchange deposits they hold on their accounts with the Euro system. This market thus reallocates the reserves

originally provided by the central bank. One reason for this reallocation is that usually, the shortest frequency by which the Eurosystem provides reserves to the banking sector is one week, namely through its main refinancing operations (MROs). There are two interest rates- Euro Interbank Offered Rate (EURIBOR) and the Euro Overnight Index Average (EONIA)

5.3.2.2 EURIBOR Currencies, Tenors, Computation and Panel of Banks

The EURIBOR is a daily reference rate based on the averaged interest rates at which Euro zone banks offer to lend unsecured funds to other banks in the Euro interbank market. Unlike the LIBOR that uses US dollar deposits in lending and borrowing between banks, the EURIBOR uses Euros and Euro deposits instead. For this case, the EURIBOR is the rate at which Euro interbank term deposits are offered by one prime bank to another prime bank. It is also used as a reference rate for Euro-denominated forward rate agreements, short term interest rate futures contracts and interest rate swaps.

A representative panel of banks provides daily quotes of the rate, rounded to three decimal places, that each panel bank believes one prime bank is quoting to another prime bank for interbank term deposits within the Euro zone, for 15 maturities of 1 week, 2 weeks, 3 weeks, 1 month, 2 months . . . to 12 months.

Every panel bank is required to directly input its data no later than 10:45 am on each day that the Trans-European Automated Real-Time Gross-Settlement Express Transfer system is open. Each panel bank is allocated a private page on which to make its

submissions of data. The page can only be viewed by the contributing panel bank and by Thomson Reuters's staff involved in the computation process. From 10.45 am to 11.00 am (at the latest) the panel banks can correct, if necessary, their quotations, after which Thomson Reuters shall, for each maturity, eliminate the highest and lowest 15% of all the quotes collected. The remaining rates are averaged and rounded to three decimal places. When this is done, the EURIBOR rates are instantaneously published on Reuters, which will be made available to all its subscribers and to other data vendors. At the same time, the underlying panel bank rates are published on a series of composite pages which will display all the rates by maturity.

It is compiled in Frankfurt and published by the European Central Bank. EURIBOR is the benchmark rate of the large Euro money market and is sponsored by the European Banking Federation (FBE), which represents the interests of 4,500 banks in 24 Member States of the European Union and in Iceland, Norway and Switzerland and those of the Financial Markets Association.

The contributors to the EURIBOR are the banks with the highest volume of business in the Euro zone money markets. As of 20 September 2012, the panel of banks contributing to the EURIBOR stood at 44 banks. They are largely banks from EU countries (either adopted the Euro as currency or not), or large international banks from non-EU countries but with important euro zone operations. This ensures that the diversity of the euro money market is adequately reflected, thereby making the EURIBOR an efficient and representative benchmark rate.

5.3.2.3 Euro Overnight Index Average (EONIA)

The other widely used reference rate in the euro-zone interbank money markets is the EONIA. It is also published by the European Banking Federation, and is the daily average of overnight rates for unsecured interbank lending in the euro-zone.

The banks contributing to EONIA are the same as the panel banks contributing to the EURIBOR. It is an effective overnight interest rate computed ex-post as a weighted average of all overnight unsecured lending transactions in the interbank market of contributing panel of banks.

EONIA reference rates are calculated by the European Central Bank, based on all overnight interbank assets created before the close of the RTGS system at 6 pm on each business day and published through Thompson Reuters every day at 7pm, EONIA differs from EURIBOR in that the former is an overnight rate and is computed after the trade whereas the latter covers more maturities and is computed based on banks before event submissions (i.e. ex-ante).

5.3.3 US Federal Funds (Interbank) Market

The federal funds market is the market for immediately available reserve balances at the Federal Reserve Bank. All depository institutions that maintain accounts at the Federal Reserve can participate in this market by either borrowing or lending reserve balances. The loans are unsecured and are traded at the federal funds rate. The vast majority of trades are spot and the duration is typically overnight. As such the federal funds market is the marginal source of funding for many banks and the rate at which funds

trade the so-called federal funds rate plays a key role in the extension of credit in the economy.

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. In the direct trading segment, transactions commonly consist of sales by small-to-medium sized banks to larger banks and often take place on a recurring basis. The rate is set in reference to the prevailing rate in the brokered market. In the brokered segment, participation is mostly confined to larger banks acting on their own or a customer's behalf. Trade sizes are generally larger than in the direct trading segment (Stigum, 1990).

There are two ways to settle federal funds trades. Participants can use the Fedwire Funds service to transfer reserves from one depository institution's account to another. The other method is correspondent re-bookings, where mostly smaller banks that do not have accounts at the Federal Reserve Bank may have their deposits at larger correspondents re-booked as overnight loans to those correspondents. The re-booking segment does not involve wire transfers between accounts at the Federal Reserve. The individual loans are typically smaller and the interest rates tend to be $\frac{1}{4}$ percentage points below the rates in the brokered market (Demirlap et al., 2004). By facilitating transfers of most liquid funds among depository institutions, the federal funds market plays a major role in the execution of monetary policy. In fact, the directive for implementation of the US monetary policy from the Federal Open Market Committee to the Federal Reserve Bank states that

the trading desk should 'create conditions in reserve markets' that will encourage federal funds to trade at a particular target range set by the committee. Using open market operations the desk can change the supply of reserve balances and thus create upward or downward pressure on the federal funds rate.

US monetary policy implementation involves intervening in the unsecured interbank lending market. The majority of lending in the fed funds market is overnight, but some transactions have longer maturities. The market is an over-the-counter (OTC) market where parties negotiate loan terms either directly with each other or through a fed funds brokers. Most of these overnight loans are booked without a contract and consist of a verbal agreement between parties. Participants in the fed funds market include: commercial banks, savings and loan associations, branches of foreign banks in the US, federal agencies, and primary dealers.

Interest rates in the unsecured interbank lending market serve as reference rates in the pricing of numerous financial instruments such as floating rate notes (FRNs), adjustable-rate mortgages (ARMs), and syndicated loans. These benchmark rates are also commonly used in corporate cash-flow analysis as discount rates. Thus, conditions in the unsecured interbank market can have wide-reaching effects in the financial system and the real economy by influencing the investment decisions of firms and households.

5.3.4 Some Lessons from the Case Studies

Table A2 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 countries, there is an element of segmentation. Third, an efficient interbank market is 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 England. This is equivalent to the Central Bank Rate (CBR) in Kenya. It may therefore be prudent to develop the Kenyan interbank market borrowing mainly from the UK system.

5.4 Solutions

In order to enable the interbank market to be efficient in distribution of liquidity, price discovery and transmission of monetary policy, 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.

5.4.1 Market Development Issues

The efficiency of the interbank market in 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 in Kenya. 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.

5.4.2 Counterparty Risks

Counterparty risks are the main cause of segmentation in Kenya and can be addressed using the CAMPARI lending principle 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 **C**haracter of the borrowing bank, the **A**bility to repay, the **M**eans/ Margins in terms of assets/profits of the borrowing bank, **P**urpose for the Loan, **A**mount of the loan being extended (is it enough or too much?), and **R**epayment terms (ability to repay), and the **I**nsurance /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. HRTs attempted to deal with the security but uptake is slow due to difficulties of realizing 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 CBK on this 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 to convince some banks to change their modes of operation with regard to risk. Banking is all about risk-taking. Finally, the stakeholders should take proactive steps to develop the interbank market in terms of liquidity and product range.

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. 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 and case studies, the study finds that the market is incomplete and highly segmented by size: small, medium and large banks. 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 segmented nature of the interbank market 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, which they could not borrow from the large banks. Third, it is partly because of this exclusion that small banks adopt a defensive ALM strategy and find themselves keeping too much liquid assets to hedge against liquidity risks.

Review of interbank markets in the UK, EU and the US shows that the Kenyan market is still deficient in many respects including lending of



limited maturities and lack of a yield curve, need for more currencies, need for clear rules of engagement and information sharing, and the need for a reliable and transparent benchmark interest rate, which can be used to price other financial instruments.

The finding in this paper raises interesting policy issues. First, there is need to develop a deep and competitive interbank market, which banks can use in their ALM functions. Second, there is need to have both unsecured lending for short-term loans and secured lending for longer maturities. This calls for that collateral in the interbank market. The horizontal repos provide an alternative but the uptake has been slow due to on the realization of the collateral (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, there is need to broaden the product range beyond overnight lending. This will allow for a well-behaved yield curve for the he 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 in Kenya. Finally, the interbank market should be linked with other money market segment and monetary policy.

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	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22
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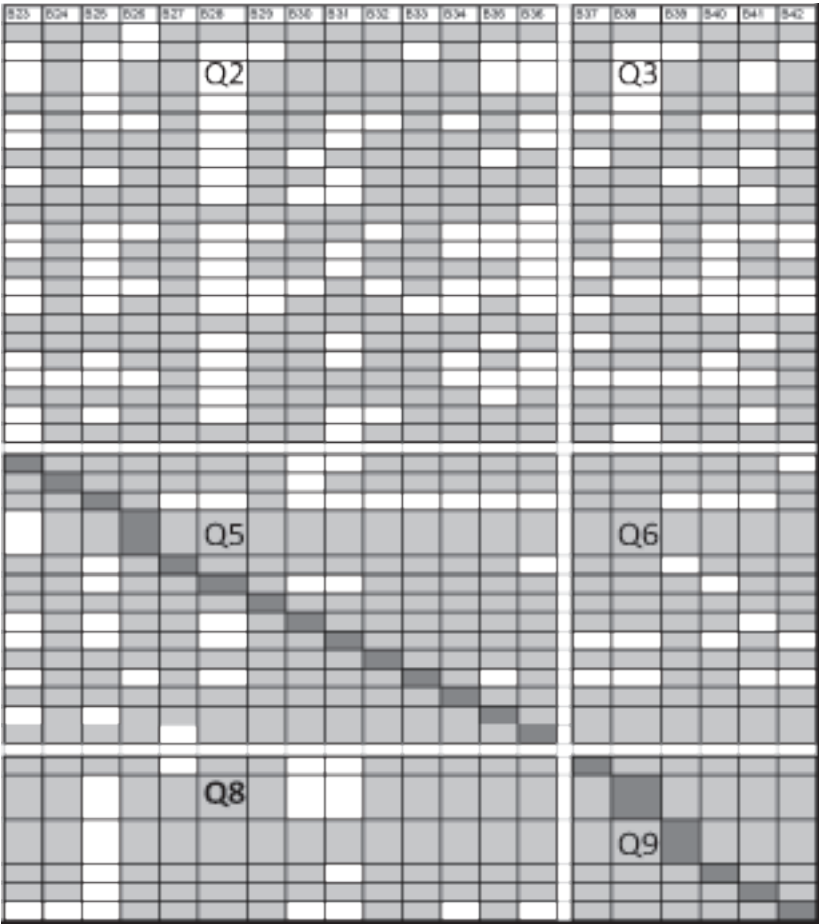




Table A2: Comparison of Kenyan, UK, EU and US Interbank Market

Feature/Dimension	Kenyan Interbank Market	London Interbank Market	EU Interbank Market	USA Interbank Market
1. Level of development	Shallow and uncompetitive	Deep and highly competitive	Deep and highly competitive	Deep and highly competitive
2. Segmentation of the Market	The market is highly segmented in terms of volumes traded and the interest rate charged.	There is limited segmentation credit lines are open to all banks irrespective of bank size or volumes traded	The market is segmented	Usually, the markets are characterized by one directional lending; from smaller banks to larger banks.
3. Role of the central bank		<ul style="list-style-type: none"> CBK indirectly influences the interbank through provision of reserves 		
<ul style="list-style-type: none"> No audit of the credibility of the bilateral fixing / setting the lending rates. 		<ul style="list-style-type: none"> 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. 		
<ul style="list-style-type: none"> Bank treasurers are regularly audited to ensure they make consistent and credible offers for money. Failure to provide consistent offers that can be backed by market conditions can lead to the bank being excluded from the panel of banks. 	<ul style="list-style-type: none"> 	Limited role of the ECB	<ul style="list-style-type: none"> 	The Federal Reserve is not involved in controlling the interbank rate, but only indirectly through provision of reserves.
<ul style="list-style-type: none"> There is no regulator audit of the bank of the credibility of the bilateral fixing / setting the lending rates, 				
<ul style="list-style-type: none"> The Fed reserve bank ensures the target range of rates is pre-announced by the FOMC 				

Feature/Dimension	Kenyan Interbank Market	London Interbank Market	EU Interbank Market	USA interbank Market
4. Rules of engagement	No clearly established rules of engagement in this market. But bilateral lines of credit agreements	There is a structured market which is well developed and is regulated by the FX&MMC of the Bank of England that generates the rules of engagement.	There is a structured market which is well developed	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
5. Participants	Only banks are involved in this market	Both banks and large corporations participate in this market	Only banks participate	All depository institutions that maintain accounts with the federal reserve bank i.e. banks and thrift institutions
6. Linkage with other money market segments	The market is not directly linked with any other money market such as the treasury bills market in terms of pricing.	The market is well integrated with other markets such as the certificates of deposits, local authorities' deposits, treasury bills and commercial paper.	The market is linked to other markets	There are two types of trading, the direct trading (bilateral arrangements) and the brokered trading. The interest rates (federal funds rates) between these markets are linked.
7. Number of Currencies traded	Trades in a single currency—the Kenya shilling	Trades in 10 different currencies (US dollar, Euro, British Pound, Japanese yen, Canadian Dollar, Swiss Franc, Australian Dollar, Danish Kroner, New Zealand Dollar, and the Swedish Kroner)	The EURIBOR uses Euros and Euro deposits instead	Trades in single currency—the US dollar.
8. Tenor and existence of well behaved yield curve	Single tenor (overnight only) hence no existence of a yield curve	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	EURIBOR covers 15 different maturities. EONIA covers the overnight	Typically overnight trades.



Feature/Dimension	Kenyan Interbank Market	London Interbank Market	EU Interbank Market	USA interbank Market
7. Number of Currencies traded	Trades in a single currency-the Kenya shilling	Trades in 10 different currencies (US dollar, Euro, British Pound, Japanese yen, Canadian Dollar, Swiss Franc, Australian Dollar, Danish Kroner, New Zealand Dollar, and the Swedish Kroner)	The EURIBOR uses Euros and Euro deposits instead	Trades in single currency- the US dollar.
8. Tenor and existence of well behaved yield curve	Single tenor (overnight only) hence no existence of a yield curve	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	EURIBOR covers 15 different maturities. EONIA covers the overnight	Typically overnight trades.
9. Ex-ante or ex-post computation of interest rate	The interbank rate is computed ex-post (after trade). This means that if there is no trade, no data			
	The LIBOR is computed ex-ante (before trade), which ensures that data exist for every tenor and currency.			

	Feature/Dimension	Kenyan Interbank Market	London Interbank Market	EU Interbank Market	USA interbank Market
10.	Trades included in computation of the interest rate	All trades for the day are used to compute the interbank rate. This allows a few trades to manipulate the market rate	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.	Computed based on trimmed mean (excluding the top and bottom 15% extreme quartiles) of the submission of panels of banks. This minimizes market manipulation by a few offers	Ex-post trades
11.	Input from the public	The market does not gain input from the public on the rates charged.	The public makes input on any concerns about the LIBOR rate which are taken seriously by the FX&MMMC. This enhances the role of the LIBOR rate as a benchmark rate for other funds.	No input from the public	No public participation in the price setting process.
12.	Collateral	Unsecured	Unsecured	Both secured and unsecured	Unsecured

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