THE PEER MONITORING ROLE OF THE INTERBANK MARKET IN KENYA AND IMPLICATIONS FOR BANK REGULATION

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Abstract

We investigate whether the interbank market in Kenya is effective as a peer monitoring and market discipline device and thus complements official bank regulation. We use a unique set of quarterly data on 43 banks which participated in interbank transactions during 2003Q1 - 2011Q1. We uncover a stable inverse relationship between interbank activity and bank risk levels, even after controlling for differences in bank characteristics. Our results suggest that regulators can use the dynamic interbank borrowing activities among large and small banks as market signals to identify banks that are perceived as risky. However, we also find that if a bank continues to increase its net interbank position up a certain level, the impact on bank risk is reversed from risk-reducing to risk-increasing. Given that Kenya's banks have spawned the Eastern African financial space, our findings on Kenya's interbank market have exemplary implications for bank regulation in the region.

JEL classification: G21; E58

Key words: interbank market; market discipline; bank regulation

1. Introduction

For many developing countries, the operation of the interbank market has been neglected as a research area, notwithstanding the important role of the market in financial regulation and stability (Iori, et al., 2006; Nier, et al., 2007). The literature reviewed in Section 2 illustrates the paucity of work in emerging markets. However, two recent developments seem to have refocused the spotlight. The first is the global financial crisis that broke out in 2008 unleashing exogenous systemic risk that still hangs over various economies (see Affinito, 2012; Klomp and De Haan, 2012). There was market failure, but there was also regulatory failure. The second is the transition from Basel I to Basel II, and now Basel III, during which concerns about 'one size fits all' type of official bank regulation for emerging economies have been side-stepped, leaving open the option of exploiting 'market discipline' as a complementary regulatory tool (Murinde, 2010). Nevertheless, the absence of data on interbank market operations is a serious impediment to empirical work.

In this paper, we use a unique set of quarterly data on 43 banks which participated in interbank transactions in Kenya during 2003Q1 - 2011Q1. With this rich Kenya interbank market dataset, our study not only has exemplary implications for bank regulation in the Eastern African banking market but also for other emerging markets.

We seek to investigate the implications of the bank peer monitoring behavior of banks which participate in the Kenya interbank market. Individual banks transact their trading activities in order to meet their demand for and supply of short term funds. The transactions are conducted on the basis of clearly defined rules and procedures, which have been set and agreed among the participating members. As such, the behavior of

participating banks influence the volume of funds traded as well as prices in the market: that is, the liquidity and interest rates in the market.

Participating banks are expected to have specialist knowledge of the credit market and keep up-to-date with key developments in the financial sector as well as the domestic economy and global trends. Importantly, each bank monitors the activities of co-participants in the market and hence the whole system amounts to conducting a peer monitoring mechanism among the participating banks, in a way that is different from the usual regulatory oversight of the central bank.

In addition, there is a link between the Central Bank of Kenya (CBK) and the interbank market. While the principal objective of the CBK is to formulate and implement monetary policy directed to achieving and maintaining stability in the general level of prices, the peer monitoring mechanism in the interbank market may serve as vehicle for market discipline. The Monetary Policy Committee (MPC) of the CBK is responsible for formulating monetary policy, which is implemented by the Monetary Policy Operations Committee (MPOC) through various Open Market Operation (OMO) tools. OMO tools, such as Repurchase Agreements and tap sales of Treasury Bills, are mostly conducted through, and are dependent on, a well functioning interbank market.

One example may serve to highlight the importance of the link between the CBK and interbank market in Kenya. Prior to 2011, the low interest rate environment prevailed in Kenya relative to other economies, which attracted offshore banks to engage in reverse carry trades, an action that created a shortage of dollars in the money market causing the local currency to depreciate. A survey conducted by the CBK Monetary Policy Committee on a few banks in August 2011 to understand persistent exchange rate volatility indicated that the weakening and volatility of the Kenya shilling against other major currencies was attributable to reverse carry transactions and the shortening of the

tenure of currency swaps from 60-90 days to short tenors. Reverse carry transactions involve an offshore bank borrowing a local currency either directly or through swaps. Thereafter, the bank sells the local currency and buys dollars from the market to invest in high markets with high yields. As the local currency weakens, the offshore banks repay this borrowing using fewer dollars. The survey findings showed that from April 2011 the level of activity in the foreign exchange market had increased threefold from around USD 5 billion per month to USD 15 billion in August 2011. During this period, commercial banks increasingly resorted to the CBK's discount window borrowing on average Ksh 18 billion daily between 18th October and 4th November, 2011 (Chart 1). In order to restore and enhance the capacity of the discount window to attain its objective, the CBK issued guidelines for the use of discount window facilities (Banking Circular No. 8 of 2011). The new guidelines stipulated that any bank lending in the interbank market would not be allowed access to funds through the discount window. In determining eligibility for access to the discount window, CBK would consider an individual bank's foreign exchange trading behavior in the past four trading days.

[Chart 1 about here]

Hence, we test whether the interbank market in Kenya is effective as a market discipline device and thus complements official bank regulation; i.e. whether through the interbank market, banks are effective monitors of their peers, reflected in lower borrowing costs and lower risk levels. Specifically, we investigate the relationship between interbank borrowing and bank risk taking using a regression model that captures bank characteristics and some control variables. The data set includes competing measures of bank risk, the net interbank position of banks, a vector of control variables at the individual bank level, a vector of macroeconomic fundamentals which serve as

control variables, and time dummies i.e. bank level data for Kenya; each bank, per year (panel data), for the key variables. The public policy element of this research idea is that interbank market behaviour supplements bank regulation, i.e. regulators can use the time-varying degree of interbank borrowing among large and small banks as market signals to identify banks that are perceived as risky. Also the results bring out two critical factors in this relationship: size matters; and bank ownership matters. Hence, by emphasizing the market discipline role of the interbank market, we challenge two main tenets of Basel II and Basel III: (a) over-reliance of Capital Adequacy Ratio (CAR) as a regulatory device; (b) the view of market discipline in terms of uncertainty in financial markets.

In what follows, the remainder of this paper is structured into five parts. Section 2 presents a review of the relevant literature and highlights the link between the interbank market monitoring and discipline role and regulation. Section 3 presents the methodology and data. Section 4 reports and discusses the empirical results, while Section 6 offers some concluding remarks and policy implications.

2. Literature Review

2.1. The bright side of the story - Interbank market discipline and monitoring role

This paper is motivated by three main developments in policy and research circles. First, the study is motivated by the argument that a robust interbank market is important for the well functioning of a modern financial system. Banks have traditionally been under supervision and regulation in order to prevent them from failure and to maintain the safety and variability of the financial system. However, in the last two decade or so, the financial systems globally have experienced rapid developments in technology innovation and financial innovation. As a result, the traditional regulation and supervision

face the challenge in adapting to the increasingly more sophisticated banking systems. Policy makers and academic researchers (e.g. Berger, Davies and Flannery, 2000; De Young et al., 1998; Peek, Rosengren and Tootell, 1999) have begun to look at the marketplace as a potential additional monitor of the risks taken by banks. A survey by Flannery (1996) summarises the relevant literature. Depositors play a monitoring role. However, deposit insurance has the consequence of diminishing the incentive for such costly action (White, 1989). Another obvious choice is the holders of banks' subordinated debt. Since other lenders have higher priority in the case of insolvency, they have the similar motivation as the banking regulators. However, Flannery and Sorescu (1996) find no evidence of such desired discipline role during the periods when holders of subordinated debt were not implicitly insured. Flannery and Nikolova (2004) provide a detailed overview of the market discipline literature.

Although there are various ways to incorporate the marketplace into the monitoring network, the more popular proposal envisages using banks themselves as monitors to other banks. Rochet and Tirole (1996) provide theoretical argument for the use of interbank relationships as incentives for banks to monitor each other on the condition that lenders believe that an interbank transaction exposes them to potential losses, which is not always the case, for example if "too big to fail" is implied. As summarized by Wells (2004), a well functioning interbank market is essential for efficient financial intermediation. It is argued that the lending banks perform some type of monitoring role on the borrowing banks (banks are particularly good at identifying the risk of other banks), such that the market discipline by the banks supplements existing bank regulation and supervision. This strand of literature (e.g. Furfine, 2001; King, 2008; Dinger and Von Hagen, 2009; Huang and Ratnovski, 2011) relates to market discipline versus government discipline in bank regulation, or on balance the interaction of market

discipline and public policy. The interbank market represents market discipline in terms of strong built-in incentives that encourage banks to operate soundly and efficiently. The idea is that banks accept the moral obligation to conduct financial services business in such a way as to take into account the risks that may affect the non-bank public and other stakeholders. For example, by participating in the interbank market, banks are obliged to improve transparency and disclosure, including the release of timely information on the bank's assets, liabilities and general financial information. The information reduces uncertainty and promotes the function of the interbank market as an exchange between lending and borrowing banks.

Moreover, it has been shown that through the interbank market, banks are effective monitors of their peers (Furfine, 2001). In addition, market discipline may encourage banks to keep a higher amount of reserves than what is required by the official capital adequacy requirements, in order to reduce liquidity risks and increase the confidence of bank depositors. Hence, market discipline through the interbank market potentially plays an important role in bank regulation and supplements regulatory systems in order to increase the safety and soundness of the banking system. The seminal empirical work by Furfine (2001) examines the pricing of interbank lending agreements as an indicator of the ability of banks to monitor their interbank borrowers. Since interbank loans in the federal funds market are large and uncollateralized, they expose lending institutions to significant credit risk. Therefore, this creates incentives for the lending banks to monitor their counterparties in the interbank transactions and price these loans as a function of the credit risk of the borrowing bank. Furfine (2001) finds that banks with higher profitability, fewer problem loans and high capital ratios pay lower interest rates when they borrow overnight. A more recent study by King (2008) finds evidence to support Furfine (2001). He shows that more risky banks will borrow less in

the federal funds market. Ashcraft and Bleakley (2006) argue that by focusing on the correlation of prices with risk may confound supply and demand effects. To solve this issue, they use exogenous shocks to a bank's liquidity position to trace out the credit supply curve. However, only weak evidence of market discipline is documented.

Dinger and Von Hagen (2009) argue that studies like Furfine (2001) in a strict sense only screen the borrowing banks' risk (prior to the lending) rather than monitor by the lending banks. They also argue that the reason for weak evidence of market discipline may due to their focus on the highly developed banking markets, where interbank exposures are mostly caused by short-term liquidity needs. As argued by Rochet and Tirole (1996), short-term interbanks exposure may not work effectively as monitoring tools since they can be quickly abandoned by both interbank transaction counterparties. The previous literature including Furfine (2001) model the determinates of interbank borrower's borrowing quantities and/or interest rates by focusing on different credit risk measurements and other bank specific control variables. Unlike the previous literature, Dinger and Von Hagen (2009) model from a different angle by focusing directly on the risk taking of the banks participating in interbank transactions. By employing data from 296 banks of 10 Central and Eastern European countries from 1995 to 2004, they investigate whether banks that borrow from other banks have lower risk levels. They explore the interbank transaction impact when exposures are long term and borrowers are restricted to small banks so to avoid the "too big to fail" concern. Overall, it is found that long-term interbank exposures lead to lower risk of the borrowing bank.

The market discipline imposed by the interbank market is particularly interesting today in view of the banking problems and bank bailouts that have characterized the global financial crisis. An important lesson learnt from the global financial crisis so far is that government discipline, in terms of formal bank regulation and supervision, is

necessary but not sufficient for dealing with systemic risk; it appears that government discipline is growing less effective as the banking industry and financial markets grow more complex. Hence, overall, it appears the role of market discipline to complement government discipline is becoming increasingly important. In addition, the potential of the interbank market as a market discipline device for regulating the financial industry is particularly important as African countries seek to accomplish the transition from Basel I to Basel II. De Ceuster and Masschelein (2003) review the potential role market discipline can play in financial regulation, in view of the recent history of the current regulatory mechanisms and the disciplining power various market participants have. It is argued that more external risk management disclosure is a key condition to enable market discipline as a regulatory mechanism, which is consistent with Basel II. Moreover, while the government (or the central bank) imposes capital adequacy requirements on banks, market forces may also contribute to the stability of banking systems. For example, market forces may motivate banks to select high capital adequacy ratios as a means of lowering their borrowing costs, i.e. better capitalized banks experience lower borrowing costs. In this context, the reforms within Basel II should focus on increasing transparency and strengthening competition among banks, in addition to emphasizing risk-based capital adequacy.

2.2. The dark side of the story – Contagious interbank market exposure

The second development that motivates this paper relates to the new literature and policy concerns about the undesirable side of the interbank market. It is argued that the structure of the interbank market is a potential important driving factor in the risk and impact of interbank contagion. There are two main building blocks for this argument: the first is that the interbank market has no collateral; the second is that central bank

regulators are inadequate. For example, a network of interbank exposures may lead to domino effects following the event of an initial bank failure. But interbank exposures imply the possibility of direct contagion: the insolvency of a single institution may trigger multiple bank failures due to direct credit exposures. The complete network of interbank exposures that gives rise to this channel of contagion is not observable, making it difficult to assess the systemic risk it poses. Wells (2004) uses data on loans and deposits between UK-resident banks to estimate the distribution of bilateral exposures. The potential for contagion is examined by assuming the sudden failure of each individual bank and estimating the losses incurred to other banks as a result of the initial shock. It is found that, while a single bank failure is rarely sufficient to trigger the outright failure of other banks, it does have the potential to weaken substantially the capital holdings of the banking system. Further, the results suggest that when the failure of a single bank does result in knock-on effects, their severity depends greatly on the maintained assumptions about the distribution of interbank loans and the level of loss given default. An additional transmission channel of contagion on the interbank market is the liquidity channel. It is argued that the liquidity channel contributes significantly to understanding and predicting interbank market crises. The results corroborate the prediction that prudential regulation by individual banks is insufficient to prevent systemic crises.

Also, it is argued that liquidity injections of a classical lender of last resort can effectively mitigate coordination failures on the interbank market both in theory and practice. Apparently, liquidity does matter. Lelyveld and Liedorp (2006) investigate interlinkages and contagion risks in the Dutch interbank market. The study involves two steps. The first step estimates the exposures in the interbank market at bank level using secondary and primary data. The second step performs a scenario analysis to measure contagion risks. It is found that the bankruptcy of one of the large banks puts a

considerable burden on the other banks, but does not lead to a complete collapse of the interbank market. The contagion effects of the failure of a smaller bank are limited, while the exposures to foreign counterparties are not investigated. Moreover, the study finds that, using survey data, that the entropy estimation using large exposures data, as applied in many previous papers, gives an adequate approximation of the actual linkages between banks. The contagion effects are further explored by Iori et al. (2006), who simulate interbank lending. Each bank faces fluctuations in liquid assets and stochastic investment opportunities that mature with delay, creating the risk of liquidity shortages. An interbank market lets participants pool this risk but also creates the potential for one bank's crisis to propagate through the system. The study distinguished between homogeneous banks as well as systems in which banks are heterogeneous. With homogeneous banks, an interbank market unambiguously stabilizes the system. With heterogeneity, knock-on effects become possible, but the stabilizing role of interbank lending remains so that the interbank market can play an ambiguous role. The regional arrangements of the interbank market in each of the 5 countries are also important. As argued by Allen and Gale (2000), financial contagion is an equilibrium phenomenon. If liquidity preference shocks are imperfectly correlated, each bank holds claims on other banks to provide insurance against liquidity preference shocks. When there is no aggregate uncertainty, the first-best allocation of risk sharing can be achieved. However, this arrangement is financially fragile. A small liquidity preference shock can spread by contagion throughout the entire sector. However, in this case, the possibility of contagion depends strongly on the completeness of the structure of claims. Complete claims structures are shown to be more robust than incomplete structures. The dynamics and scope of the interbank market, including access to the market, seem to be driven by a number of factors, prime of which is the relationships among the participating banks. Cocco et al. (2009) use a unique

dataset to show that relationships are an important determinant of banks' ability to access interbank market liquidity. The results suggest that relationships allow banks to insure liquidity risk in the presence of market frictions such as transaction and information costs. Moreover, the interbank market allows banks to cope with specific liquidity shocks. At the same time, the market may be a channel allowing a bank default to spread to other banks. Mistrulli (2007) analyzes how contagion propagates within the Italian interbank market using a unique data set including actual bilateral exposures. In order to cope with non-availability of information on bilateral exposures, the study assumes that banks spread their lending as evenly as possible among all the other banks by maximizing the entropy of interbank linkages. Based on the data available on actual bilateral exposures for all Italian banks, the study compares the results obtained by assuming the maximum entropy are compared with those reflecting the observed structure of interbank claims. The comparison indicates that, in line with the thesis prevailing in the literature, the maximum entropy method tends to underestimate the extent of contagion. However, under certain circumstances, depending on the structure of the interbank linkages, the recovery rates of interbank exposures and banks' capitalization, the maximum entropy approach overestimates the scope for contagion.

2.3. Systematic risk

In the aftermath of the crisis, systemic risk in banking has gained renewed prominence in the literature. Whatever the origin of the financial crisis, it is the responsibility of the regulatory body to provide adequate fire walls for the crisis not to spill over other institutions (Freixas, Parigi and Rochet, 2000). To date, empirical studies aimed at assessing the quantitative importance of systemic risk have analyzed the outcomes of historical banking crises. Sheldon and Maurer (2004) take a new tack by attempting to

assess the level of systemic risk currently in a banking system on the basis of interbank loan structures. A matrix of interbank loans is constructed for Switzerland based on known marginal loan distributions and the principle of entropy maximization. It is found that the latent systemic risk associated with the interbank loan structure existing among Swiss banks in 1987-95 posed little threat to the stability of the Swiss banking system. Indeed, it has been argued that interbank exposure can be a serious source of contagion in a financial crisis, which may enhance systemic risk. Upper and Worms (2005) argue that credit risk associated with interbank lending may lead to domino effects, where the failure of one bank results in the failure of other banks not directly affected by the initial shock. Recent work in economic theory shows that this risk of contagion depends on the precise pattern of interbank linkages. Balance sheet information is used to estimate a matrix of bilateral credit relationships for the German banking system and test whether the breakdown of a single bank can lead to contagion. It is found that in the absence of a safety net, there is considerable scope for contagion that could affect a large proportion of the banking system. The financial safety net (e.g. institutional guarantees for saving banks and cooperative banks) considerably reduces (but does not eliminate) the danger of contagion. Even so, the failure of a single bank could lead to the breakdown of up to 15% of the banking system in terms of assets.

The above review of the literature shows that interbank markets are not only pivotal for liquidity management purpose of financial institutions but also at the same time, interbank markets represent complex networks connecting all interlinked financial institutions in the financial system (Iori et al, 2006). This provides potential monitoring and supervisory tools to complement the traditional financial regulations. On the other hand, this has the danger of potential contagion effect through interbank linkages, which has important implications to the stability of the whole financial system (Nier, et al.,

2007). Both sides of the interbank markets have important implications to the policy makers.

3. Model, Data and Measurement

3.1. The empirical model: The determinants of bank risk

To examine the effect of interbank activities on bank risk, we employ an empirical test of the relation between interbank borrowing and lending and bank risk, which is:

$$BANKRISK_{it} = \alpha_0 + \alpha_1 NIBP_{it} + \alpha_2 (NIBP)^2_{it} + \alpha_3 BANK_{it} + \alpha_4 MACRO_t + \mu_{it} \qquad (1)$$

Where, $BANKRISK_{it}$ is a measure of the risk incurred by bank i at time t; $NIBP_{it}$ denotes the net interbank position of bank i at time t; $(NIBP)^2_{it}$ denotes the square of $NIBP_{it;}$ $BANK_{it}$ is a vector of control variables at the individual bank level, hence for bank i at time t; $MACRO_{jt}$ is a vector of macroeconomic fundamentals which serve as control variables at time t; μ_{it} is the error term.

To measure the riskiness of a bank's business, following Dinger and Von Hagen (2009), three variables that are widely used in the literature are considered: the ratio of loan loss reserves to gross loans; the ratio of loan loss provisions to gross loans and the ratio of net charge-offs to equity, in logarithmic form (LOGNCO). However, the first two variables are only available at annual frequency. Therefore our investigation focuses on the last measurement LOGNCO.

Following Liedorp, Medema, Koetter, Koning and van Lelyveld (2010), we differentiate our investigation from the previous literature by distinguish interbank lending and interbank borrowing. Huang and Ratnovski (2009) show that funding risk can be of equal importance. If banks rely on clustered wholesale funding by a few large counterparties in the interbank market, a sudden (confidence) shock due to noisy public

signal can induce failure to extend credit lines, especially such interbank exposures are short-term. This can lead to fire sales of assets at steep discount, which could put the stability of the banking system in danger. The current financial crisis provides anecdotal evidence in this regard. Therefore it is important to consider both interbank borrowing and lending when considering bank risk. To measure the impact of interbank transaction on bank risk, four variables are included. In the first form of eq.(1) (model 1), the direct effect of interbank borrowing of a bank is measured by the ratio of bank's aggregate interbank liabilities to total assets (IBL_TA). In the second form of eq.(1) (model 2), the direct effect of interbank lending of a bank is measured by the ratio of bank's aggregate interbank assets to total assets (NIA_TA). In the third form of eq.(1) (model 3), the direct effect of interbank exposure of a bank is measured by both bank's aggregate interbank liabilities and assets. The positive coefficients would provide support to the 'contagion' hypothesis to the extent that larger exposures imply an increased sensitivity of the banks' risk to relatively larger reliance on interbank activities. The negative coefficients would support the 'peer monitoring' hypothesis to the extent that more active involvement in the interbank market provide the facilities for banks to monitor their peers hence such improvement of transparency and peer pressure reduce the risks taken by the banks.

We follow Van Lelyveld and Liedorp (2006), who identify foreign counterparties as the most important source of risk for the Dutch interbank market because problems with foreign banks affect all types of bank on the Dutch interbank market. According to the summary statistics in Table 2, at all three size categories, the exposure of foreign banks in Kenya interbank market are significant smaller than the overall data. To capture the potential impact of ownership in Kenya interbank market, we have two variables which are the interaction between the foreign_owner dummy and NIA_TA (foreign_NIA) and the interaction between the foreign_owner dummy and IBL_TA

(foreign_IBL). According to Lelyveld and Liedorp (2006), negative coefficients for both variables mean that more exposure to foreign counterparties is more risky. And also to capture the potential impact of ownership in Kenya interbank market, we have four dummy variables which identify the local and foreign ownership of the banks and whether they are publicly listed or private banks.

In line with studies of the interbank exposure and bank risk literature, a group of variables that capture bank specific characteristics are included. The variable 'size' is the bank size represented by the logarithm of bank total assets. The quadratic form of 'size' is 'squ_size', which allows for a nonlinear from of the dependence between bank size and risk undertaking. In order to further clarify the impact of bank size on bank risks, we have three size categories: large, medium and small. A dummy variable (large_size) equals to one when the bank is categorized as a large bank and zero otherwise. The other dummy variable equals to 1 if the bank is categorized as a medium bank and zero otherwise. Both dummies are normalized by the small bank dummy. Capitalisation (CAPITAL) is measured by the ratio of equity to total assets. Liquid liability ratio (LLR: (deposit and interbank liability) to total assets) measures the liquidity risk. The lower the ratio, the lower the direct funding risk as the bank can more easily fulfill withdrawal requests, so the positive coefficients are expected. The ratio of total loans to total assets (LOANS) measures to what extend the bank relies on traditional intermediation activities as oppose to, for example, more fee- and capital income generating trading activities in securities. Higher LOANS indicates more credit risk but lower market risk therefore the sign is not certain.

In addition to the bank specific variables, a set of macroeconomic control variables are also included. INFLATION is defined as the percentage change in the Consumer Price Index. Real GDP per capita (GDPY) is used as a general measurement of

economic development. Growth rate of real GDP per capita (GROWTH) measures cyclical effects on bank risk.

As argued in Dinger and Von Hagen (2009), interbank borrowing may be endogenous with respect of bank risk, for example, if lending banks price risk or ration more risky banks. Therefore, a Durbin-Wu-Hausman test is conducted in order to test empirically whether endogeneity does exist. The last set of variables included in Table 1 is the instrumental variables, which are closely correlated with a bank's incentive to borrow in the interbank market but not simultaneously correlated with the bank's risk. In Kenya, banks go to the interbank market because they lack a widespread network for deposit mobilization at lower cost and thus go to the interbank market to raise funds at a slightly higher cost. We also argue that the net interbank position can be explained by the asymmetry between the cost of borrowing and profits from lending in the interbank market, which may be measured using the spread in the interbank market. In addition, the net interbank position can be largely affected by the current liquidity position of the bank, as may be measured by bank reserves – which has important implications for the implementation of central bank monetary policy. Hence, we take the bank's ratio of retail deposits to loans as a suitable instrument. In line with previous literature including Dinger and Von Hagen (2009), the difference between interbank lending rate and interbank borrowing rate (ibspread); one lag of NIA _TA (Lag_ NIA _TA); one lag of IBL_TA (Lag_IBL_TA) and the ratio of total deposit to total loan (rdl) are used in testing the endogeneity in models 1 to 2. And an extra instrument variable, the logarithm of loan loss reserves (reserves) is included when we test model 3.

3.2. Data

In this paper we use official documents and CBK data in our empirical investigations. The quarterly data include 43 banks participating in interbank transactions in Kenya during the period of 2003Q1 to 2011Q1.

Table 1 presents the definitions and compositions of the variables included in the empirical model. Table 2 presents the summary statistics of these variables, which are summarized according to the three-size groups of the banks: big, medium and small. Since some of the variables are not available for the whole sample period, the data set is an unbalanced panel data.

[Tables 1 and 2 about here]

3.3. Diagnostic tests and methodology

Table 3 panel A and B presents the results of Durbin-Wu-Hausman test (see Davidson and McKinnon, 1993) conducted for all three forms of (1). A two-stage-least-square (2SLS) estimation are employed as follows: 2SLS First-stage regressions:

$$NIBP_{it} = \lambda_0 + \lambda_1 BANKRISK_{it} + \lambda_2 BANK_{it} + \lambda_3 MACRO_t + \lambda_4 NIBP_{it-1}$$

$$+ \lambda_5 \text{ibspread}_{it} + \lambda_6 \text{rdl}_{it} + \lambda_7 \text{reserves}_{it} + \mu 1_{it} \quad (2)$$

2SLS Instrumental variables regression:

$$BANKRISK_{it} = \beta_0 + \beta_1 NIBP_{it} + \beta_2 (NIBP)^2_{it} + \beta_3 BANK_{it} + \beta_4 MACRO_t + \mu 2_{it} \quad (3)$$

Where the variables are as defined in (1), and $\mu 1_{it}$ and $\mu 2_{it}$ are error terms for equations (2) and (3), respectively.

The weak instrument test results in Table 3 panel A confirm that the instruments are valid and the tests of over-identifying restrictions in Table 3 panel B accept the null hypothesis, which overall confirm the validity of our 2SLS model.

Furthermore, as an unbalance panel, we also conduct different panel diagnostic tests on model 3 to check whether panel regression can be conducted as a robustness test of the results. According results in Table 5 the highly significant Breusch_pagan/Cook-Weisberg test for heteroskedasticity indicates that we need to correct for heteroskedasticity in the panel regress. The highly significant time effects test indicates that we need to account for time effects in the model. Finally the highly significant firm effects F-tests, Breusch-Pagan LM Test and insignificant Hausman tests show that the appropriate model for our dataset is the random effect model controlled for heteroskedasticity and time effects panel regression. Since we know interbank borrowing may be endogenous with respect of bank risk, we also run a Hausman-Taylor panel regression model to take the endogeneity issue into account for the panel data. Hausman-Taylor fits panel-data random-effects models in which some of the covariates are correlated with the unobserved individual-level random effect. The estimators, originally proposed by Hausman and Taylor (1981) and Amemiya and MaCurdy (1986), are based on instrumental variables. Although the estimators implemented in Hausman-Taylor use the method of instrumental variables, it is designed for different problems. The estimators implemented in instrumental estimation assume that a subset of the explanatory variables in the model are correlated with the idiosyncratic error *e[i,t]*. In contrast, the Hausman-Taylor assumes that some of the explanatory variables are correlated with the individual-level random effects, *u[i]*, but that none of the explanatory variables are correlated with the idiosyncratic error *e[i,t]*.

[Table 4 about here]

4. Empirical Results

Table 5 base model column presents the results of an OLS regression without including any interbank exposure measures. The results show that SIZE is significantly negatively related to bank risk (lognco). The larger the bank, the smaller the risk that banks expose to. This supports to some extent the 'too big to fail' idea. The other two size dummies: 'large_size' and 'medium_size' have also significant negative relationship with the bank risk. While the squared size variable 'squ_size' has positive significant link with bank risk. It shows that size matters: larger banks playing in the interbank market have lower risk levels. However, as the size of the bank increases beyond a certain threshold, the size advantage may become a disadvantage. This may be because beyond a certain size the top largest banks tend to lie outside the peer monitoring device and thus size may be a disadvantage for them. In terms of the ownership structure, we find significant impact from both local ownership dummy variables (whether it is publicly listed or private) on bank risk. Unlike the Dutch interbank market, according to the summary statistics in Table 2, at all three size categories, the exposure of foreign banks in Kenya interbank market are significant smaller than the overall data. The regression results also fail to find significant impact from foreign (publicly listed or private) ownership on bank risk. CAPITAL has the expected negative sign and it is highly significant. This is in line with the theoretical notion that banks with higher proportion of owner capital invested in tend to be more cautiously and taking less risk. Another bank specific variable, LLR is found be significantly positive which is what we expect: the lower the ratio, the lower the direct funding risk as the bank can more easily fulfill withdrawal requests. We also find that LOANS is highly significant and positively related to bank risk. It means that Kenya banks expose to high credit risk. The macroeconomic control variables also have the

expected significant impact on bank risks in general. Higher inflation indicates higher risk to banks. Faster growth of the economy leads to higher bank risk level in Kenya. Higher GDP per capita leads to lower risk to Kenya banks.

Model 1 column in Table 5 includes the interbank exposure from the liability side. The results show that IBL_TA has significant negative relation with bank risk. It means that an increase in the aggregate interbank borrowing tends to lower bank risk. it supports the 'peer-monitoring' hypothesis we discussed in section 3.2. And also the squared IBL_TA has a significant positively relation with bank risk. It means that if the bank continues to increase its aggregate interbank borrowing position, it reaches a level where the impact on bank risk is rather reversed from risk reducing to risk increasing impact. This may be related to the explanation of 'contagion' hypothesis to the extent that larger exposures imply an increased sensitivity of the banks' risk to relatively larger reliance on interbank activities. Then Model 2 column in Table 5 includes the interbank exposure from the asset side. The results show that NIA_TA has significant negative relation with bank risk as well. And the squared NIA _TA has a highly significant positively relation with bank risk. The results and explanations are consistent with what we discussed on the interbank liability exposure. Then we turn to the full model, Model 3 column in Table 5, we have consistent results except that the squared IBL_TA is insignificant now. The other controlled variables have consistent results as the other models. The other interbank exposure variable we find significant here is the interbank borrowing rate, which has positive relation with risk. It means that the higher the borrowing rate, the larger the risk banks face, which is in line with what we expected.

Table 6 model 4 column presents the results of the random effect model controlled for heteroskedasticity and time effects panel regression in the third form of eq.(1). Table 6 model 5 column presents the results of Huasman-Taylor panel regression

results. These results are largely consistent with what we find in the GMM regression results in Table 5. What worth mentioning is that there are some significant time effects found in model 4 especially the fourth quarter of 2007, the first and the second quarters of 2008 dummies are significant. This is not surprising given these are the time when the financial markets were in the mid of the 2007/08 financial crisis. Table 7 also presents a series of important events in Kenya interbank market which could have had impact on bank risk from 2007 to 2011. The first quarter of 2006 dummy is also significant. There was a large IPO event by KenGen from 20/03/2006 to 12/04/2006, which might have impact on the liquidity demand in the market. We also find some significant impact of the second quarter of 2009. Among other reforms to open market operations, the tenure of CBK Repos was adjusted twice: to 5 days in May 2009 and to 7 days in July 2009. They may be part of reasons affecting the bank risk here.

Overall, the results reported in Tables 5 and 6 uncover a number of interesting findings. First, banks aggregate lending and borrowing in Kenya interbank market does have the expected peer monitoring effect however, once the volume of lending and borrowing goes beyond a certain threshold the peer monitoring impact is diminished and replaced by contagion effect. As the exposure becomes larger, increased sensitivity of the banks' risk to relatively larger reliance on interbank activities. Second, size matters. Larger banks are exposed to smaller risks however such advantage reverses when its size reaches certain threshold. We argue that this may because some overly large banks are beyond the peer monitoring and according to the "too-big-to-fail" theory, such banks are not under pressure of bank run. Such large banks may take excessive risk in their profit maximizing business activities knowing that no effective peer monitoring is in place and there is implicit insurance from government and financial authority. The financial regulator will step in to prevent potential bank run. In particular Kenyan banks of large

and medium size which are active in the interbank market have lower risk levels. Third, the results also show that Kenya banks also share the common characteristics with banks in the literature in terms of capital, credit risk, liquid liability and so on.

[Tables 5, 6 and 7about here]

5. Conclusion and Policy Implications

The main finding of this study is that Kenyan banks of all sizes which are active in the interbank market have lower risk levels, and that the liquidity in the interbank market is an important part of this process. Specifically, our evidence shows that there is a stable inverse relationship between interbank activity and bank risk levels, even when one controls for differences in bank characteristics. These findings are consistent with the earlier argument in the literature review that the interbank market is potentially an effective market discipline device, as reflected in lower risk levels for participant banks.

The public policy element of this research idea is that interbank market behaviour supplements bank regulation, i.e. regulators can use the time-varying degree of interbank borrowing among large and small banks as market signals to identify banks that are perceived as risky. Hence, potentially, this study is critical for informing bank regulation and supervision in Kenya. Given that Kenya's banks have spawned the Eastern African banking market, our findings on the interbank market in Kenya have exemplary implications for bank regulation in the region.

In addition, it is useful to summarize here some other important policy elements of this work. For example, one policy implication of the results is that the riskiness of the bank can be mitigated by the volume of interbank trading activity. But is also found that

if the bank continues to increase its net interbank position, it reaches a level where the impact on bank risk is rather reversed from risk reducing to risk increasing impact.

Also, the empirical results show that size matters: large banks playing in the interbank market have lower risk levels. However, as the size of the bank increases beyond a given threshold, the size advantage may become a disadvantage. This may be because beyond a certain size the top largest banks tend to lie outside the peer monitoring device and thus size may be a disadvantage for them. The variable for capital has the expected negative sign, which has implications for the role of capital adequacy and the Basel III regulatory codes.

The dummies play an important role in this study and bring into perspective the role of foreign ownership of banks in the economy. These banks appear to have relatively small and insignificant influence on interbank market behaviour compared with their local counterparties and thus reverse the potential for market discipline in Kenya.

The policy implications are important because at the outbreak of the global financial crisis, Kenya was in the course of transition from Basel I to Basel II, and during the recent economic developments in Kenya there were discussions to explore further transition to Basel III. Given the above evidence and findings from this paper, which point to the fact that the interbank market in Kenya provides a mechanism for peer monitoring and discipline among banks participating in the interbank market, Kenya should side-step the 'one size fits all' element of Basel III regulation, and leave open the option of exploiting interbank market discipline as a complementary regulatory tool. Hence, by emphasizing the market discipline role of the interbank market in this study, we recommend that policy makers in Kenya should not take for granted two main tenets of Basel II and Basel III: over-reliance of capital adequacy ratio (CAR) as a regulatory device; the view of market discipline in terms of uncertainty in financial markets.

Overall, it is important to bear in mind that in this paper we study the bank peer monitoring role of Kenya's interbank market as an example, which not only has exemplary implications for the East African regional block but also for the other emerging markets.

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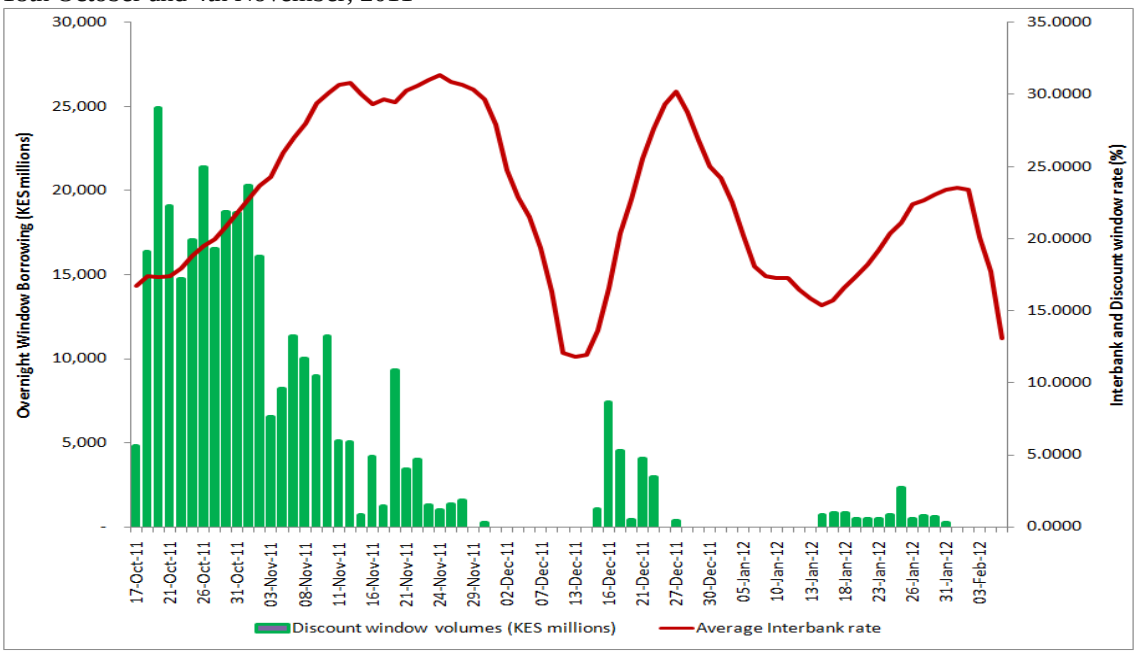
Chart 1: Commercial Banks' Borrowing from CBK and Average Interbank Rate

From April 2011 the level of activity in the foreign exchange market had increased threefold from around USD 5 billion per month to USD 15 billion in August 2011. During this period, commercial banks increasingly resorted to the CBK's discount window borrowing on average Ksh 18 billion daily between 18th October and 4th November, 2011



Source: Central Bank of Kenya

Table 1: Definition and measurement of variables

Variables		Measurement of variables	Observed counterparts or notes
BANKRISK= a measure of the risk incurred by the bank	LOGNCO	the ratio of net charge-offs to equity, in logarithmic form	(a) net charge offs (b) equity
NIBP = the net interbank position of the bank (the linear term)	NIA_TA	The ratio of net interbank assets (NIA) to total assets (TA)	(a) total interbank lending volume (b) total assets
	IBL_TA	The ratio of a bank's interbank liabilities (IBL) to total assets (TA)	(a) total interbank borrowing volume (b) total assets
	foreign_NIA	The interaction between foreign_owner dummy and NIA_TA	(a)NIA_TA (b)foreign_owner dummy
	foreign_IBL	The interaction between foreign_owner dummy and IBL_TA	(a)IBL_TA (b)Foreign_owner dummy
$NIBP^2$ = the net interbank position of the bank (the quadratic term)	squ_NIA_TA	The square of the ratio of net interbank assets (NIA) to total assets (TA)	(a) total interbank lending volume (b) total assets
	squ_IBL_TA	The square of a bank's interbank liabilities (IBL) to total assets (TA)	(a) total interbank borrowing volume (b) total assets
BANK = a vector of control variables at the individual bank level	size = Bank size	The logarithm of total assets	Total assets
	squ_size = $(\text{Bank size})^2$	The logarithm of the square of total assets	Total assets
	CAPITAL = Bank capitalisation level	The ratio of equity to total assets	(a) total equity (b) total assets
	LLR	Liquid liability ratio	Liquid liability ratio
	LOANS	The ratio of total loans to total assets	(a) total loans (b) total assets
	localpub_owner	Dummy variable = 1 for local publicly listed bank and zero otherwise	
	localpriv_owner	Dummy variable = 1 for local private bank and	

		zero otherwise	
	foripub_owner	Dummy variable = 1 for foreign publicly listed bank and zero otherwise	A bank is foreign owned if at least 51% of capital is owned by foreign shareholders
	foripriv_owner	Dummy variable = 1 for foreign private bank and zero otherwise	A bank is foreign owned if at least 51% of capital is owned by foreign shareholders
	large_size	Dummy variable = 1 for category by size = large and zero otherwise, normalized by small_size dummy	
	medium_size	Dummy variable = 1 for category by size = medium and zero otherwise, normalized by small_size dummy	
MACRO = a vector of macroeconomic fundamentals which serve as control variables at the country level	INFLATION	Percentage change in the Consumer Price Index (CPI)	Consumer price index (CPI)
	GDPY = Real GDP per capita	The ratio of real GDP to population	(a) Nominal GDP (b) GDP deflator (c) Population
	GDP growth = Growth rate of real GDP per capita	Percentage change in real GDP per capita	(a) Nominal GDP (b) GDP deflator (c) Population
INSTRUMENT VARIABLES	Lag_IBL_TA	One lag of IBL_TA	(a) net charge offs (b) equity
	Lag_NIA_TA	One lag of NIA_TA	(a) net interbank assets (b) total assets
	Ibspread	The difference between interbank lending rate and interbank borrowing rate	(a) Interbank Lending Rate (b) Interbank Borrowing Rate
	Reserves	The logarithm of loan loss reserves	loan loss reserves
	Rdl	The ratio of total deposit to total loan	(a) total deposit (b) total loan

Table 2 Panel data summary statistics

	Obs	Mean	Std. Dev.	Min	Max		Obs	Mean	Std. Dev.	Min	Max
LOGNCO						**foreign_NIA**					
L	190	-1.47	0.46	-3.37	-0.63		177	0.06	0.13	0.00	0.81
M	414	-1.71	0.61	-5.40	-0.30		386	0.35	0.82	0.00	10.45
S	586	-0.62	0.66	-4.50	0.50		527	0.23	0.70	0.00	7.99
NIA_TA						**foreign_IBL**					
L	177	0.33	0.42	0.00	2.28		176	0.17	0.37	0.00	2.36
M	386	0.67	0.87	0.00	10.45		372	0.22	0.48	0.00	3.87
S	527	2.04	2.88	0.01	33.14		459	0.13	0.48	0.00	4.21
IBL_TA						**LLR**					
L	176	0.50	0.52	0.00	2.37		198	0.42	0.12	0.17	0.78
M	372	0.68	0.85	0.00	4.48		456	0.40	0.17	-0.44	0.89
S	459	0.61	1.05	0.00	9.12		606	0.51	0.37	0.05	5.54
squ_NIA_TA						**ibspread**					
L	177	0.29	0.76	0.00	5.20		176	0.08	0.85	-5.48	3.87
M	386	1.20	5.82	0.00	109.22		372	0.02	0.69	-2.64	5.13
S	527	12.42	60.86	0.00	1098.07		475	-0.03	0.64	-5.26	4.18
squ_IBL_TA						**reserves**					
L	176	0.52	0.99	0.00	5.63		45	5.74	0.91	3.93	7.55
M	372	1.19	2.66	0.00	20.11		95	3.95	1.15	-0.16	6.18
S	459	1.46	5.71	0.00	83.09		151	2.65	1.18	-3.51	7.82
size						**rdl**					
L	198	11.06	0.94	7.95	12.39		198	1.60	0.36	1.10	3.25
M	484	9.61	0.88	6.95	11.15		484	4.21	10.95	0.71	96.61
S	606	8.26	0.55	6.06	9.59		602	12.60	253.04	0.01	6201.00
squ_size						**CAPITAL**					
L	198	123.10	19.61	63.13	153.42		198	0.12	0.04	0.06	0.27
M	484	93.08	16.57	48.36	124.25		484	0.14	0.06	0.01	0.46
S	606	68.47	8.99	36.70	92.05		606	0.20	0.12	0.08	0.77
LOANS											
L	198	0.51	0.08	0.26	0.67	**GDPY**		8732.03	555.27	7537.19	9688.49
M	484	0.48	0.18	0.01	0.80	**growth**		0.01	0.05	-0.08	0.11
S	606	0.57	0.22	0.00	1.24	**inflation**		0.01	0.09	-0.50	0.08

Note: L: large size banks; M: medium size banks and S: small size banks

Table 3 Panel A Weak instrument test

Model 1	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
NIA_TA	0.001	-0.015
squ_NIA_TA	0.000	-0.016
Model 2		
IBL_TA	0.000	-0.017
squ_IBL_TA	0.000	-0.017
Model 3		
NIA_TA	0.056	-0.044
squ_NIA_TA	0.052	-0.048
IBL_TA	0.047	-0.054
squ_IBL_TA	0.042	-0.059

Table 3 Panel B Tests of overidentifying restrictions:

Model 1	Sargan (score) chi2(1)	0.026	(p =0.8715)
	Basmann chi2(1)	0.026	(p= 0.8727)
Model 2	Sargan (score) chi2(1)	0.529	(p = 0.4668)
	Basmann chi2(1)	0.520	(p = 0.4710)
Model 3	Sargan (score) chi2(1)	0.073	(p = 0.7865)
	Basmann chi2(1)	0.066	(p = 0.7978)

Note: The weak instrument test in Table 3 panel A confirms that the instruments are valid and the test results of over-identifying restrictions in Table 3 panel B confirm that there is no over-identifying problem.

Table 4 Panel diagnostic tests

Diagnostic tests		
Firm effects (F-test)	F(39, 854) = 40.86	***
Breusch-Pagan LM Test	chibar2(01) = 844.12	***
Hausman Test	chi2(10) = 12.12	
Time effects	F(29, 39) = 3.52	***
Breusch_pagan/Cook-Weisberg test for heteroskedasticity	chi2(1) = 41.60	***

Table 4 presents the panel data diagnostic tests. According to these results, the appropriate model is the random effect panel regression control for heteroskedasticity and time effects.

Table 5 GMM regression results

	base model			model 1			model 2			model 3		
lognco	Coef.	z-statistics		Coef.	z-statistics		Coef.	z-statistics		Coef.	z-statistics	
NIA_TA							-0.211	[-5.88]	***	-0.254	[-8.22]	***
IBL_TA				-2.906	[-3.25]	***				-0.141	[-3.17]	***
squ_NIA_TA							0.005	[4.05]	***	0.007	[5.53]	***
squ_IBL_TA				0.491	[2.14]	**				0.009	[1.03]	
size	-1.839	[-7.63]	***	-1.981	[-2.55]	**	-2.206	[-6.55]	***	-2.050	[-5.75]	***
squ_size	0.089	[7.09]	***	0.088	[2.21]	**	0.104	[6.23]	***	0.096	[5.43]	***
localpub_owner	0.547	[10.23]	***	0.852	[4.2]	***	0.438	[7.07]	***	0.454	[7.37]	***
localpriv_owner	0.210	[4.94]	***	0.436	[3.06]	***	0.281	[5.58]	***	0.308	[6.01]	***
foripub_owner	0.096	[0.84]		-0.055	[-0.15]		-0.110	[-0.92]		-0.089	[-0.74]	
foripriv_owner	-0.022	[-0.23]		0.127	[0.48]		0.087	[0.71]		0.124	[1.06]	
interbankborrowingrate				0.004	[0.19]		0.011	[1.56]		0.012	[1.88]	*
large_size	-0.753	[-8.44]	**	-0.288	[-0.82]		-0.690	[-6.18]	***	-0.728	[-6.34]	***
medium_size	-0.782	[-14.51]	**	-0.342	[-1.3]		-0.867	[-11.24]	***	-0.915	[-11.74]	***
CAPITAL	-2.237	[-9.41]	***	-2.733	[-3.23]	***	-2.216	[-4.63]	***	-2.465	[-4.65]	***
LLR	0.275	[3.17]	**	-0.253	[-0.72]		0.508	[2.52]	**	0.359	[1.83]	*
LOANS	1.126	[11.9]	***	-0.239	[-0.97]		1.205	[6.26]	***	0.990	[4.76]	***
inflation	1.116	[1.78]	*	3.419	[1.47]		1.884	[2.87]	***	2.638	[3.81]	***
GDPY	-0.000	[-2.13]	**	0.000	[0.87]		0.000	[0.81]		0.000	[1.17]	
GDP growth	1.823	[5.61]	***	-0.092	[-0.08]		1.613	[4.77]	***	1.633	[4.7]	***
constant	8.536	[7.33]	***	10.154	[2.63]	***	9.678	[5.98]	***	9.120	[5.28]	***

Note: 1. Base model does not contain any interbank exposure; model 1 adds only interbank liability to the base model; model 2 adds only interbank asset to the base model and in model 3 both interbank liability and assets exposure are included and instrumented.

2. Base model is OLS regression. Models 1 to 3 are GMM regressions.

3. We present z-statistics controlled for robust standard error.

Table 6 Random effect panel regression and Hausman-Taylor panel regression results

	Model 4			Model 5		
lognco	Coef.	z-statistics		Coef.	z-statistics	
NIA_TA	-0.141	[-2.2]	**	-0.042	[-2.55]	**
IBL_TA	-0.099	[-1.67]	*	-0.003	[-0.1]	
squ_IBL_TA	0.010	[1.5]		0.007	[1.09]	
squ_NIA_TA	0.003	[1.25]		0.001	[0.93]	
size	-2.127	[-2.63]	***	-2.268	[-7.39]	***
squ_size	0.102	[2.59]	***	0.108	[7.01]	***
CAPITAL	-2.305	[-1.95]	*	-4.394	[-12.72]	***
inflation	18.454	[3.29]	***	1.074	[2.15]	**
GDPY	-0.000	[-0.35]		-0.000	[-0.72]	
growth	1.586	[1.45]		1.625	[6.13]	***
localpub_owner	0.469	[3.62]	***	0.747	[2.84]	***
localpriv_owner	0.285	[2.78]	***	0.438	[2.3]	**
foripub_owner	0.023	[0.17]		0.137	[0.26]	
foripriv_owner	0.106	[0.36]		0.288	[0.72]	
large_size	-0.786	[-3.76]	***	-0.729	[-2.68]	***
medium_size	-0.901	[-5.75]	***	-0.873	[-4.41]	***
interbankborrowingrate	0.045	[1.56]		-0.007	[-1.52]	
liquidityliabilityratio	0.304	[0.94]		0.301	[3.26]	***
LOANS	1.032	[2.92]	***	0.612	[4.36]	***
2003Q2	-1.072	[-1.89]	*			
2003Q3	1.193	[3.89]	***			
2003Q4	0.090	[0.38]				
2004Q1	-0.330	[-1.2]				
2004Q2	-0.765	[-1.74]	*			
2004Q3	-1.125	[-2.04]	**			
2004Q4	-0.109	[-0.44]				
2005Q1	-0.109	[-0.55]				
2005Q2	-0.731	[-1.93]	*			
2005Q3	0.137	[0.63]				
2005Q4	-0.142	[-0.65]				
2006Q1	-0.768	[-2.41]	**			
2006Q2	0.198	[1.22]				
2006Q3	-0.238	[-1.16]				
2006Q4	-0.401	[-1.97]	**			
2007Q1	0.072	[0.49]				
2007Q2	-0.168	[-0.95]				
2007Q3	-0.345	[-1.49]				
2007Q4	-0.365	[-1.75]	*			
2008Q1	-0.860	[-3.52]	***			
2008Q2	-1.239	[-2.67]	***			
2008Q3	-0.413	[-1.46]				
2008Q4	-0.248	[-1.17]				
2009Q1	-0.464	[-2.43]	**			
2009Q2	-0.205	[-1.88]	*			
2009Q3	-0.133	[-1.22]				
2009Q4	0.073	[0.72]				
2010Q1	-					
2010Q2	-					
2010Q3	-					
2010Q4	-					
2011Q1	-					
_cons	9.772	[2.16]	**	10.918	[7.29]	***

Table 6 presents random effect regression (model 4) results and Hausman-Taylor panel regression (model 5) results. They are largely consistent with the GMM results in Table 4.

Table 7 Important events in Kenya interbank market from 2007-2011

Date	Reform	Purpose
June 07	MPAC adjusted repo maturity to range between 3 days and 90 days compared with previous maturities of 7 and 40 days	Lengthening maximum maturity to signal to banks that repos could be considered as an alternative investment; shortening the minimum maturity reduced the period during which banks hold excess balances to meet clearing obligations
Aug. 07	Repo amount threshold reviewed downwards from Ksh 50 million to Ksh 20 million	Increase flexibility in liquidity management
Sept. 07	Late repo facility window to run from 2.00 p.m. to 2.30 p.m. introduced at 150 basis points below the day's weighted average repo rate derived from the competitive morning auction.	Capture excess cash reserves received by banks late in the day not drained in the early repo window to help CBK meet its reserve money targets
Dec. 07	Late repo threshold amount lowered again to Ksh 10 million and the margin on the late repo yield narrowed to 100 basis points	Increase participation in late repo window
May 08	Term Auction Deposit Facility (TAD). Introduced: competitive auction bidding, maturity from 3 to 90 days, minimum threshold of Ksh20 million for the morning auction and Ksh10 million for the late auction, late deposit bid prices at 100 basis points below the weighted average TAD rate.	Increase scope for liquidity management after the stock of existing repo securities exhausted.
Sept. 08	Introduction of the Horizontal Repurchase Agreements between commercial banks.	Deepen money markets and enhance distribution of liquidity in the interbank market
May 09	Repo and TAD tenure fixed to 5 days	Improve liquidity management
July 09	Repo and TAD tenure fixed to 7 days. Recourse by banks to reverse repo only after interbank and horizontal repo opportunities exhausted	Improve liquidity management
May 11	Late repo tenure fixed at 4 days	Improve liquidity management

Source: Kenya Central Bank (2011)

Appendix
Table A1 Correlation matrix of the variables

	LLR	LOGNCO	NIA_TA	IBL_TA	squ_NIA_TA	squ_IBL_TA	size	squ_size
LLR	1.00							
LOGNCO	0.04	1.00						
NIA_TA	0.03	0.01	1.00					
IBL_TA	0.02	-0.06	-0.11	1.00				
squ_NIA_TA	0.01	-0.03	0.87	0.17	1.00			
squ_IBL_TA	-0.03	-0.08	0.10	0.91	0.37	1.00		
size	-0.16	-0.37	-0.35	-0.11	-0.20	-0.18	1.00	
squ_size	-0.16	-0.36	-0.33	-0.12	-0.19	-0.18	1.00	1.00
CAPITAL	0.19	0.21	0.21	0.02	0.10	0.07	-0.53	-0.50
inflation	-0.04	0.10	-0.05	-0.14	0.01	-0.12	0.04	0.05
GDPY	-0.05	0.00	0.11	0.05	0.03	0.00	0.03	0.02
growth	0.13	0.05	-0.03	-0.04	-0.05	-0.05	-0.04	-0.04
ibspread	-0.20	-0.12	-0.03	0.09	-0.01	0.08	0.05	0.04
reserves	-0.11	-0.17	-0.30	-0.05	-0.15	-0.09	0.80	0.80
rdl	-0.13	-0.35	0.10	0.05	0.05	0.08	-0.12	-0.11
LOANS	-0.34	0.41	0.12	-0.30	0.07	-0.29	-0.07	-0.06
foreign_NIA	0.06	-0.24	0.17	-0.20	0.02	-0.13	-0.09	-0.09
foreign_IBL	0.29	-0.17	-0.15	0.27	-0.08	0.13	0.04	0.04

	CAPITAL	inflation	GDPY	growth	ibspread	reserves	rdl	LOANS	foreign_NIA	foreign_IBL
CAPITAL	1.00									
inflation	0.04	1.00								
GDPY	0.01	-0.27	1.00							
growth	-0.03	-0.31	0.26	1.00						
ibspread	-0.12	0.03	-0.13	-0.03	1.00					
reserves	-0.42	0.04	-0.03	0.08	0.07	1.00				
rdl	0.23	-0.05	0.00	-0.06	0.06	-0.31	1.00			
LOANS	0.18	0.09	-0.02	0.00	-0.03	0.03	-0.33	1.00		
foreign_NIA	0.02	-0.02	0.04	-0.05	-0.01	-0.20	0.45	-0.23	1.00	
foreign_IBL	-0.13	-0.06	0.08	-0.05	0.00	-0.02	-0.02	-0.32	0.07	1.00