THE PEER MONITORING ROLE OF THE INTERBANK MARKET IN KENYA AND IMPLICATIONS FOR BANK REGULATION[1]

by

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[1] This research is based partly on work funded by the Kenyan Ministry of Finance and the Central Bank of Kenya under contract Kenya/SPN/FS/CBK/05/2010-11. We thank the Ministry and the Central Bank for their extensive discussions and help in the course of this work. The interpretations and conclusions expressed in this paper are entirely our own and should not be attributed in any manner to The Kenyan Ministry of Finance or the Central Bank of Kenya.

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Abstract

This paper investigates 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, after controlling for other bank risk determinants and financial crisis. However, we also find that if a bank continues to increase its interbank position up a certain level, the impact on bank risk is reversed from risk-reducing to risk-increasing due to possible contagion effect. By grouping banks by different characteristics, our results suggest that for less risky banks including larger, listed, foreign and older banks, the risk reduction effect due to peer monitoring is smaller. The evidence of Kenya's interbank market discipline role has not only exemplary implications for the East African regional block but also for other countries at a relatively early stage of financial development.

JEL classification: G21; E58

Key words: Interbank market; Market discipline; Peer monitor; Bank size

1. Introduction

For many countries especially developing economies, interbank market has been neglected as a research area. This paper focuses on the bank peer monitoring implication of the behavior of participating banks in the Kenya interbank market. Three recent developments have motivated our work: The first is the 2007/08 global financial crisis unleashing exogenous systemic risk. One of the important lessons 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 especially as the banking industry and financial markets grow more complex. On the other hand, the recent wave of financial crises has renewed the interest in market discipline in banking systems. Pillar 3 of the new Basel Capital Accord lays out several disclosure recommendations in order to enhance market discipline. Market discipline in banking is normally defined as a situation in which private sector agents face costs that are positively related to the risks undertaken by banks and react on the basis of these costs (Berger, 1991). The interbank market is the market in which individual banks transact their trading activities in order to meet their demand for and supply of short term funds. 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 this is different from the usual regulatory oversight of the central bank and the usual private monitoring candidates. Hence, overall, it appears that the interbank market role of market discipline to complement government discipline is becoming increasingly important. Second, the

potential market discipline role by the interbank market is particularly important as African countries seek to accomplish 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). Third, the existing studies have provided very limited understanding of interbank market especially in emerging economies. As one of the most important and developed financial markets in Africa, study of Kenya interbank market can provide important insight to fill in the research gap. In comparison with other East African economies, Kenya's banking sector has for many years been credited for its size and diversification. The participations of banks with different ownerships, listed status and sizes in the interbank market provide us rich information to have further insight into how different players behave in the market discipline role.

Motivated by these three recent developments discussed in the last paragraph, we intend to contribute to the literature in those three areas. Furthermore, we intend to make the following contributions: First, from the regulators' point of view, interbank market has two important implications: market discipline role and contagion effect. As far as we are aware of, previous studies never consider them together. Hence the implication of their results is incomplete at the best. In the study, we can model these two effects in one model. Second, by analyzing the unique dataset including the actual interbank exposure of individual banks and bank specific characteristics provided by Central Bank of Kenya (CBK), we are able to study the interbank market discipline role in much more depth than the existing studies. To deal with the non-availability of information on bilateral exposures, most of the existing studies assume that banks spread their lending as evenly

as possible among all the other banks by maximizing the entropy of interbank connections. However, our data summary statistics reveal asymmetric distribution of both interbank asset and liability exposures in Kenya. Similarly the prevailing finding shows that the maximum entropy method is liable to underestimate the extent of contagion (Mistrulli, 2007). With the unique dataset, methods adopted in our study can avoid this problem.

The remainder of this paper is structured into five parts. Section 2 presents a review of the relevant literature explaining further why we focus on Kenya and highlighting the link between the interbank market peer monitoring role and regulation. Section 3 presents the methodology and data. Section 4 reports and discusses the empirical results, while Section 5 offers some concluding remarks and policy implications.

2. Literature Review

2.1 Why do we focus on Kenya?

African financial systems are generally lacking in breadth and depth. In comparison with other East African economies, Kenya's banking sector has for many years been known for its size and diversification, for example, private credit to GDP in Kenya was 23.7% in 2008 compared with a median of 12.3% for Sub-Saharan Africa (Beck, Demirguc-Kunt and Levine, 2009). Kenyan financial sector is still largely bank-based as the capital market is considered narrow and shallow (Ngugi et al, 2006). The process of financial intermediation in the country largely depends on commercial banks (Kamau, 2009). Due

to contagion effect, any failure in the sector could lead to bank runs, even crises and has an immense implication on the economic growth of the country. The Central Bank of Kenya (CBK) is in charge of banking sector regulation and supervision in Kenya. Over the past decades, there have been numerous revisions to the Banking Act, Central Bank of Kenya Act and prudential guidelines in order to strengthen CBK's supervisory role. On the other hand, economic theory provides conflicting predictions about the impact of regulatory and supervisory policies on bank performance (e.g., Barth et al., 2004, 2007, 2010). Regulation may interfere with the efficient operation of banks. Both theories and empirical evidence suggest that environmental regulations impede entry into sectors where the regulatory compliance standards are high (Coen and Heritier, 2005). Regulators are also subject to their own personal incentives and political pressures when exercising their duties. Lastly, "regulatory capture" could arise from the close working relation between the regulators and the regulated, and the remoteness of those in whose interest the regulation is being carried out.

Market discipline can help regulators limit political pressure and tolerance in microprudential regulation. Barth et al. (2006) show that societies that emphasize banking sector market monitoring perform better based on a range of criteria. Following the banking crisis of 1985/86, Kenya established a Deposit Protection Fund Board (DPFB) with a wide mandate (Beck, et al., 2010). Deposit insurance is often seen as an integral part of a financial safety net (refer to Demirguc-Kunt and Kane (2002) for a detailed survey). While deposit insurance could also weaken market discipline as depositors are less motivated to properly monitor and discipline banks, which result in additional pressure on official regulators (Demirguc-Kunt and Detragiache, 2002). Like Kenya,

countries with poorly developed capital markets, accounting standards, and legal systems may not be able to rely effectively on private monitoring. Even in the most developed economies, banking activities become more and more complicated and opaque hence making effective monitoring more difficult. Therefore, excessively reliance on private monitoring may lead to the exploitation of depositors and poor bank performance. Equity holders and bondholders may not monitor managers effectively without referring to more drastic procedures including bankruptcy or takeovers, which may not always be preferred by policy makers. In this context, the interbank market is another possible market discipline candidate to complement government discipline.

Compared with the interbank markets in the rest of the Africa, Kenya interbank market is already entrenched (Green, et al., 2017). Table A1 in the appendix lists key events in Kenya interbank market from 2007 to 2011 period. We can see that Kenya interbank market is an actively managed and actively used market by Kenya central bank and commercial banks. For example, prior to 2011, there has been a shortage of dollars in Kenyan money market causing the local currency to depreciate. A survey conducted by the CBK Monetary Policy Committee on a few banks to understand persistent exchange rate volatility indicates that the weakening and volatility of the Kenya shilling against other major currencies are attributable to reverse carry transactions. The survey shows 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(CBK, 2011). During this period, commercial banks increasingly resorted to the CBK's discount window borrowing on average Ksh18 billion daily between 18th October and 4th November, 2011. In order to restore and enhance the capacity of the discount window to

attain its objective, the CBK issued guidelines which 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.

Kenya has not only the entrenched interbank market, the composition of Kenya banking sector has also exemplary effect in emerging markets. The ownership structure of banks in Kenya has changed over the last few years with many regulatory and financial reforms. According CBK Bank Supervision Annual report, there is now less state involvement in the banking sector but more foreign bank operations in the country. Government had significant ownerships in five banks in Kenya in 2000 but in 2008, the number had dropped to three banks. During the same period, the number of locally incorporated foreign banks increased from four to eight, while the number of branches of foreign-owned banks reduced from seven to five. Some studies suggest that foreign banks perform better with higher profit margins and lower costs compared to their domestic counterparties (Chantapong, 2005; Farazi et al. 2011; Azam and Siddiqui, 2012). While Detragiache (2006) argues an opposite view about the foreign bank performance in relation to financial development and credit creation in developing countries. The increasing presences of foreign banks in emerging markets are not specific to Kenya or Africa. The existing studies provide us no information on foreign bank behavior in the interbank market discipline role.

Despite the impressive developments in Kenya banking sector in the last decades, competitiveness in the banking sector is still restricted by structural rigidities and segmentation (Beck and Fuchs, 2004). Many small banks concentrate on specific niches, without contributing to competition in the sector. Large banks prefer to lend and borrow from each other in the interbank market but not with small banks due to perceived risk or non-existence of credit lines. The current structures may thus have an impact on how they respond to policy directives from the regulator and also how they behave in their market discipline role. Lelyveld and Liedorp (2006) find 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. Overall Kenya's interbank market offers an interesting and important model for other countries at a relatively early stage of financial development. And yet, we are lack of systematic studies on Kenya interbank especially its market discipline role.

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

The study is motivated by the argument that a robust interbank market is important for the well functioning of a modern financial system (Iori, et al., 2006; Nier, et al., 2007). With the rapid developments in technology innovation and financial innovation in financial sector, the traditional regulation and supervision face the challenge in adapting to the increasingly more sophisticated banking systems. Policy makers and academic researchers (e.g. De Young et al., 1998; Peek, Rosengren and Tootell, 1999; Berger, Davies and Flannery, 2000) have begun to look at the marketplace as a potential additional monitor of the risks taken by banks. 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. As argued by Wells (2004), in a well-functioning interbank market, it is 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. 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. The 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.

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 problematic loans and high capital ratios pay lower interest rates when they borrow overnight. Similary, King (2008) 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. It may be argued, however, 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 (see Dinger and Von Hagen, 2009). As argued by Rochet and Tirole (1996), short-term interbank exposure may not work effectively as monitoring tools since they can be quickly abandoned by both interbank transaction counterparties. Unlike the previous literature, Dinger and Von Hagen (2009) focus 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 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, their results show that long-term interbank exposures lead to lower risk of the borrowing bank. 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.

2.3. 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 - contagion. It is argued that the structure of the interbank market is a potentially 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. Unlike borrowing and lending between the CBK and commercial banks which are all secured, transactions in the interbank market are invariably unsecured and based on lines of credit and the network of lending relationships. Daily transactions in the market are influenced by the liquidity position and requirements of individual banks and of the banking system as a whole. Large flows of funds at the clearing, such as during IPOs, can create substantial imbalances in liquidity as among different banks (Green, et al., 2017). Furthermore, a network of interbank exposures 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. The insolvency of a single institution may trigger multiple bank failures due to direct credit exposures via interbank network. As argued by Allen and Gale (2000), financial contagion is an equilibrium phenomenon. 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. 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. At the same time, the market may be a channel allowing a bank default to spread to other banks. Similarly, with the UK data, Wells (2004) 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. The above review of the literature shows that interbank markets are not only pivotal for the liquidity management purpose of financial institutions but also 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 and Data

3.1. The empirical model I: The determinants of bank risk

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

$$BANKRISK_{it} = \alpha_0 + \alpha_1 IBP_{it} + \alpha_2 (IBP)^2_{it} + \alpha_3 BANK_{it} + \alpha_4 MACRO_t + \mu_{it} \quad (1)$$

Where, $BANKRISK_{it}$ is a measure of the risk incurred by bank i at time t; IBP_{it} denotes the interbank position of bank i at time t; $(IBP)^2_{it}$ denotes the square of $IBP_{it;}$ $BANK_{it}$ 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, et al. (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 interbank borrowing and lending separately 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), 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), 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). The positive

coefficients α_1 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 α_1 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. The positive coefficients α_2 would suggest that if the bank continues to increase its aggregate interbank lending/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, and conversely for negative coefficients α_2.

Ownership is one of the variables that affect the performance of banks. Studies suggest that big and successful foreign banks have tested management expertise in other countries over years and yet are able to customize and apply their operation systems effectively cross-border (Azam and Siddiqui, 2012; Chantapong, 2005; Farazi et al. 2011). According to the summary statistics in Table 2 panel B, for both interbank lending and borrowing positions, the exposure of foreign banks in Kenya interbank market are significant larger than their domestic counterparties. To capture the potential impact of foreign ownership in Kenya interbank market, we include a foreign ownership dummy variable (foreign) in $BANK_{it}$ vector. And also to capture the potential impact of shareholder ownership in Kenya interbank market, we include another dummy variable (public) in $BANK_{it,}$ which identifies whether the banks are publicly listed or private banks. Listed banks tend to be larger and better performed banks hence we hypothesize that both foreign and listed banks have smaller risk exposure than their counterparties hence negative coefficients.

The other important bank specific factor is bank size. Larger banks are exposed to smaller risks however such advantage may reverse when its size reaches certain threshold. 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. Hence 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. Bank size is measured by the logarithm of bank total assets (size_logta), which is hypothesized to have negative coefficient. Its quadratic form 'squ_size_logta' is expected to have positive coefficient to allows for a nonlinear 'U'-shape form of the dependence between bank size and risk undertaking behavior. CBK also classifies Kenyan commercial banks into three peer groups using a weighted composite index that comprises assets, deposits, capital, number of deposit accounts and loan accounts. A bank with a weighted composite index of 5 percent and above is classified as a large bank (captured by large_size dummy), a medium bank (captured by medium_size dummy) has a weighted composite index of between 1 percent and 5 percent while a small bank (captured by small_size dummy) has a weighted composite index of less than 1 percent. In the robustness test, we use the alternative size variable 'size_dummy', which equals to 3 for large_size, 2 for medium size and 1 for small size banks.

Age is another important bank characteristics included in $BANK_{it,}$. 'Age' is defined as the difference between sample year and the year in corporation. We also use a dummy variable (age_dummy) as a alternative measure, which equals to one if age is larger than

or equal to 30 years. Some argue that the older the bank the more experience it has in risk management but older banks could also build up more risky assets than the younger ones. Hence the sign of the coefficient is empirical.

In line with studies of the interbank exposure and bank risk literature, a group of bank specific characteristics are also included. Beck and Fuchs (2004) examined the various factors that contribute to high interests spread in Kenyan banks. Overheads were found to be one of the most important components of the high interests rate spreads. An analysis of the overheads showed that they were driven by staff wage costs which were comparatively higher than other banks in the Sub-Saharan African countries. We measure managerial efficiency by the ratio of overheads cost to total asset ('overheads_ta'). We hypothesize that the lower the managerial efficiency (i.e. the higher the overheads_ta), the higher the bank risks. A number of studies (e.g., Rochet, 1992; Gorton and Winton, 1995; Hovakimian and Kane, 2000), prior to the recent crisis, have emphasized the role of capital standards in preventing bank failure and in safeguarding customers and the whole economy from negative externalities. Hence bank capitalization is expected to have negative coefficient. Liquid liability ratio ('LLR') (deposit and interbank liability to total assets,) measures the liquidity risk. 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 extent 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 empirical.

In addition to the bank specific variables, a set of macroeconomic variables including inflation (INFL) and growth rate of real GDP per capita (GROWTH) are included to control for cyclical effects on bank risk. According to Murinde, et al. (2012), the total interbank lending volume was dominated by small banks followed by large banks in 2003-2005 then the pattern largely reversed after this period. We include a 'break' dummy (equals to one after 2005) to capture any structural break in impact on risk.

3.2. The empirical model II: the interbank market monitoring/contagion effect cross different bank groups

$$BANKRISK_{it} = \alpha_0 + \alpha_1 IBP_{it} + \alpha_2 (IBP)^2_{it} + \alpha_3 BANK_{it} + \alpha_4 MACRO_t + \alpha_5 (IBP_{it} * BANK_{it}) + \mu_{it} \quad (2)$$

Where $(IBP_{it} * BANK_{it})$ represents the interaction term between interbank exposure and a group of bank-specific characteristic dummies including age_dummy, 'size', 'public' 'foreign' and 'break' dummies. Each dummy variable interacts in turn with interbank liability or assets to identify whether the peer monitoring/contagion effects vary cross different bank groups. According to the discussion in section 3.1, if large and well performing banks have smaller risks and if there is peer monitoring effect, then we expect that $(IBP_{it} * BANK_{it})$ has positive coefficient. It means that for less risky banks, the risk reduction effect due to peer monitoring is smaller.

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, we run a baseline model with OLS regression which does not include any interbank exposure variables then we apply Generalized Method of Moments

(GMM) using use iterative GMM estimator to all these models mentioned above. As a robustness check we also conduct Two-Stage-Least-Square regressions controlled for heteroskedastic and autocorrelated errors. 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 by 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, in line with previous literature including Dinger and Von Hagen (2009), the difference between interbank lending rate and interbank borrowing rate (ibspread); the logarithm of loan loss reserves (reserves); the ratio of total deposit to total loan (rdl); one lag of nia _ta (lag_nia _ta) and one lag of ibl_ta (lag_ibl_ta) are considered as instruments in the regressions. Table 1 sums up the variable explanations and hypotheses included in the empirical model.

3.3 Data

We use official documents and data from the CBK in our empirical investigations. The quarterly data include 43 banks participating in interbank transactions in Kenya during the period of 2003Q1 to 2011Q1. Table 2 Panel A shows the sample composition by three categories: i) the ownership status: foreign and local; ii) the shareholder ownership:

private and public and iii) the three-size groups of the banks: large, medium and small. The composition shows that 79% of the banks participate in Kenya interbank market during the sample period are local banks. These local banks are mainly small private banks. Table 2 Panel B presents the summary statistics of these variables, which are summarized according to the same three categories. The summary statistics is based on the average value of each bank cross the whole sample period. The summary shows that in terms of the difference between interbank lending rate and interbank borrowing rate (ibspread), local banks, public banks and larger banks seem to have higher spreads than their counterparties on average. Similar to the Dutch interbank market, foreign banks operating in Kenya interbank market have higher and more variable interbank exposures on average than those of their local counterparties. Similar situation we also observe on private banks in the sample. When we compare among three-size groups, interbank lending exposure seems to be related to their size reversely. Small banks have the largest exposure and highest variations among them. As expected, comparing size measured by the logarithm of total assets, foreign banks and public banks operating in Kenya interbank market tend to be larger than their domestic and private counterparties. In terms of bank capitalization level measured by the ratio of equity to total assets, foreign banks and private banks have slightly higher level than their counterparties and again, size seems to have negative link with capitalization ratio. The small banks have the highest average capitalization level than the others. When we turn to Liquid Liability Ratio, the summary shows that foreign banks have much higher direct funding risk than local banks do. Large and medium banks have lower liquid liability ratio than the small ones. In the case of loan level measured by the ratio of total loans to total assets, local, private and small banks seem to have higher level of loans than their counterparties. In the case of the ratio of total deposit to total loan (rdl), foreign banks, private banks and smaller banks have

higher ratios than their counterparties. Table A2 presents the correlation matrix of the variables. There is no evidence of a correlation pattern that suggests highly collinear variables. 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]

4. Empirical Results

4.1 Determinants of bank risks

Table 3 baseline model column presents the results of an OLS regression without including any interbank exposure measures. The third and the fourth columns present the GMM regression results of eq.(1) with interbank liability and asset exposure related variables respectively. Both ibl_ta and nia_ta have significant negative relation with bank risk. The results are consistent with the 'peer-monitoring' hypothesis discussed in sections 2.2 and 3.1. Both Squ_ibl_ta and squ_nia_ta have significant positive relation with bank risk, which suggests if the bank continues to increase its aggregate interbank borrowing and lending position, it reaches a level where the impact on bank risk is rather reversed from risk reducing to risk increasing. 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.

The rest of the results on bank specific variables are consistent and in line with our hypotheses discussed in section 3.1.in general across all the models. It shows that size matters. As expected, size_logta is highly significantly negative and the quadratic form:

squ_size_logta has positive significant link with bank risk. This supports to some extent the 'too big to fail' idea. In the context of interbank market, 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 results are consistent when the alternative size dummy measure is applied (Table A3). Furthermore, as hypothesized, we find 'foreign' dummy is highly significant with negative coefficient. The other bank specific control variables all have expected signs and highly significant. 'LOANS' is highly significant and positively related to bank risk, especially when we include interbank assets. It means that traditional intermediation activities expose Kenya banks to credit risk, which could partly be due to interbank lending activities. The macroeconomic control variable 'GROWTH' has significant positive impact on bank risks especially when we include interbank assets. During economic boom, the increasing interbank lending activity is linked to increasing bank risk.

[Tables 3 about here]

As alternative robustness check, we also adopt two-Stage-Least-Square (2SLS) to all the models. The results of 2SLS are in line with the GMM results presented. At the end of all tables, GMM C statistic (Hayashi, 2000), also known as the difference-in-Sargan statistic (for GMM) and Wooldridge's (1995) score test and a regression-based test of exogeneity, which both can tolerate heteroskedastic and autocorrelated errors (for 2SLS), are significant suggest that the variables (ibl_ta and nia_ta) are endogenous. And the weak instrument test results suggest that the instruments used have strong explanatory power.

4.2 The interbank market monitoring effect cross different bank groups

This section presents and discusses the results of eq.(2). Table 4 second column shows that the interaction term between interbank liability and size measure 'logta_ibl' has significant positive coefficient. 'size_logta' still has significant negative coefficient as Table 3. As expected it suggests that the larger the size the smaller the bank risks. Hence for these banks with smaller risks, the risk reduction effect due to interbank peer monitoring is smaller as well. The rest of the results are consistent with Table 3. Table A4 shows that by using the alternative size measure, a single size dummy, the results still hold. Results in Table 5 show that the interaction terms between interbank liability/asset exposures and 'foreign' dummy have significant positive coefficients. As expected, it suggests that for these foreign banks with relatively smaller risks, the risk reduction effect due to interbank peer monitoring is smaller as well. Similarly, in Table 6, 'public' dummy is highly significantly negative and its interaction term with interbank liability is significantly positive. It also suggests that for these publicly listed banks, which have relatively smaller risks, the risk reduction effect due to interbank peer monitoring is smaller compared with private banks. Finally, Table 7 presents the results of interaction term between age dummy and interbank exposure. It suggests that banks in corporation more than 30 years have relatively lower risks than banks younger than 30 years hence the risk reduction effect due to interbank peer monitoring is smaller for these older banks as well. In general, the above interaction results are significant for interbank liability exposure mainly. Hence the risk reduction effect due to interbank peer monitoring becomes smaller when the less risky larger, foreign, listed and older banks are the borrowers.

[Tables 4, 5, 6 and 7 about here]

Overall, the above results reported are in line with the hypotheses and existing literature on bank risk determinants. They uncover a number of interesting findings. First, banks aggregate lending and borrowing in Kenya interbank market do 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 to the extent that larger exposures imply an 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. According to the "too-big-to-fail" theory, 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 to prevent potential bank run. Third, by grouping banks by different bank characteristics, we have identified that larger, foreign, public and old banks have relatively smaller risks compared to their counterparties, consequently, the risk reduction effect due to interbank peer monitoring is smaller for these less risky banks when they are the borrower in the interbank market. Fourth, the results also show that the usual bank risk determinants in terms of capitalization, credit risk, liquid liability, managerial efficiency and macroeconomic variables identified in the literature can also be applied to Kenya banks.

5. Conclusion and Policy Implications

This study applies GMM method to a set of unique Kenya interbank exposure data during the period of 2003Q1 to 2011Q1. The empirical evidence is consistent with the earlier

literature that the interbank market can be an effective market discipline device, as the riskiness of the bank can be mitigated by the volume of interbank trading activity even when one controls for common bank risk determinants. However, we also find that if the bank continues to increase its interbank position, it reaches a level where the impact on bank risk is rather reversed from risk reducing to risk increasing impact. Such risk reduction effect is smaller if the borrowing banks are less risky because they are larger, foreign, listed or older banks. The empirical results also show that bank size matters. Although larger banks have relatively lower risk levels, as the size of the bank increases beyond a certain threshold, the size advantage may become a disadvantage.

These empirical findings have important public policy implications. The interbank market in Kenya provides a mechanism for peer monitoring and discipline among banks participating in the interbank market, Hence, such market discipline complements the usual regulatory oversight of the central bank and the usual private monitoring candidates. And also regulators can use the time-varying degree of interbank borrowing and lending volume as market signals to identify banks that are perceived as risky by their peers. Furthermore, during the recent economic developments in Kenya there were discussions to explore further transition to Basel III. Given the above evidence on the relationship between banks risks and bank specific characteristics, 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. As expected, capitalization is negatively linked with banks risks, which has implications for the role of capital adequacy and the Basel III regulatory codes. However, by emphasizing the market discipline role of the interbank market in this study, we do not recommend an over-reliance of capital adequacy ratio (CAR) as a regulatory device. Given the nonlinear U-

shape between interbank exposure and bank risk level, official regulator does have a role to play in terms of monitoring the risk contagion due to the overly connected interbank networks. Overall, it is important to bear in mind that in this paper we study the 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 other countries at a relatively early stage of financial development.

References

Allen, F., Gale, D., 2000. Financial contagion. Journal of Political Economy 108, 1-33.

Ashcraft, A.B., Bleakley, H., 2006. On the market discipline of informationally opaque firms: Evidence from Bank borrowers in the federal funds market. Federal Reserve Bank of New York Staff Report, No. 257.

Azam, M., Siddiqoui, S., 2012. Domestic and foreign banks' profitability: differences and their determinants. International Journal of Economics and Financial Issues 2, 33-40.

Barth, J.R., Caprio, G., Levine, R., 2007. The microeconomic effects of different approaches to bank supervision. In: Haber, S., North, D., Weingast, B. (Eds.), The Politics of Financial Development. Stanford University Press.

Barth, J.R., Caprio, G., Levine, R., 2006. Rethinking Bank Regulation: Till Angels Govern. Cambridge University Press, Cambridge.

Barth, J.R., Caprio, G., Levine, R., 2004. Bank regulation and supervision: what works best? Journal of Financial Intermediation 13, 205–248.

Barth, J.R., Lin, C., Ma, Y., Seade, J., Song, F.M., 2010. Do bank regulation, supervision and monitoring enhance or impede bank efficiency? Working Paper. Available from: http://papers.ssrn.com/sol3/papers.cfm?abstract id=1579352

Beck, T., Cull, R., Fuchs, M., Getenga, J., Gatere, P., Randa, J., Trandafi, M., 2010. Banking Sector Stability, Effiency, and Outreach in Kenya. The World Bank, Development Research Group, Finance and Private Sector Development Team Policy Research Working Paper 5442.

Beck, T., Demirguc-Kunt, A., Levine, R., 2009. Financial institutions and markets across countries and over time - data and analysis. Policy Research Working Paper Series 4943.

Beck, T., Fuchs, M., 2004. Structural issues in the Kenyan Financial system improving competition and Access. World Bank policy research working paper 3363.

Berger, A., 1991. Market discipline in banking. Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, 419–437.

Berger, A., Davies, S., Flannery, M., 2000. Comparing market and supervisory assessments of bank performance: Who knows what when? Journal of Money Credit and Banking 32, 641-667.

Central Bank of Kenya, 2009. Bank Supervision Annual Report 2009. Central Bank of Kenya, Nairobi.

Chantapong, S., 2005. Comparative study of domestic and foreign bank performance in Thailand: The regression analysis. The Office of Macroeconomic Policy and Analysis, Monetary Policy Group (MPG), The Central Bank of Thailand, Bangkhunprom, 2005.

Cocco, J.F., Gomes, F.J., Martins, N.C., 2009. Lending relationships in the interbank market. Journal of Financial Intermediation 18, 24-48.

Coen, D; Héritier, A, 2005. Refining regulatory regimes: Utilities in Europe. [Book]. (1 ed.). Edward Elgar.

De Ceuster, M., Masschelein, N., 2003. Regulating banks through market discipline: A survey of the issues. Journal of Economic Surveys 17, 749-766.

Demirgüç-Kunt, A., Detragiache, E., 2002. Does deposit insurance increase banking system stability? An empirical investigation. Journal of Monetary Economics, 49, 1373-406.

Demirgüç-Kunt, A., Kane, E., 2002. Deposit insurance around the globe: Where does it work? Journal of Economic Literature 60, 175-95.

Detragiache, E., Poonam, G., Thierry, T., 2006. Foreign banks in poor countries: Theory and evidence. Washington, DC: Paper presented at the 7th Jacques Polak Annual Research Conference, Hosted by the International Monetary Fund.

DeYoung, R., 1998. Comment on Goldberg and White. Journal of Banking and Finance 22, 868-872.

Dinger, V., Von Hagen, J., 2009. Does interbank borrowing reduce bank risk? Journal of Money, Credit and Banking 41, 491-506.

Farazi, S., Erik, F., Roberto, R., 2011. Bank ownership and performance in the Middle East and North Africa region. The World Bank Middle East and North Africa Region Financial and Private Sector Development Unit & Financial and Private Sector research paper.

Flannery, M., Nikolova, S., 2004. Market discipline of U.S. financial firms. In: Hunter, W.C., Kaufman, G.G., Borio, C., Tsatsaronis, K. (Eds.), Market Discipline across countries and industries. Cambridge, MA: MIT press.

Furfine, C. H., 2001. Banks as monitors of other banks: Evidence from the overnight federal funds market. Journal of Business 74, 33-57.

Gorton, G., Winton, A., 1995. Bank capital regulation in general equilibrium. Wharton Financial Institutions Centre, Working Paper

Green, C., Murinde, V., Bai, Y., Ngoka, K., Maana, I. and Tiriongo S. "The Development of Kenya's Overnight Interbank Market". In: IAD/ADB Spring Symposium 2014: Financing Innovation and Development in Africa. Cambridge Scholars Publishing/IAD Book Series. Forth coming.

Hayashi, F. 2000. Econometrics. Princeton, NJ: Princeton University Press.

Hovakimian, A., Kane, E.J., 2000. Effectiveness of capital regulation at U.S. commercial banks, 1985 to 1994. Journal of Finance 55, 451–468.

Huang, R., Ratnovski, L., 2011. The dark side of bank wholesale funding. Journal of Financial Intermediation 20, 248–263.

Iori, G., Jafarey, S., Padilla, F.G., 2006. Systemic risk on the interbank market. Journal of Economic Behaviour & Organisation 61, 525-542.

Kamau, A.W., 2009. Efficiency in the Banking Sector: An Empirical Investigation of Commercial Banks in Kenya. A thesis submitted in partial fulfilment of the Requirements of Nairobi University for the Degree of Doctor of Philosophy. Nairobi: University of Nairobi

King, T.B., 2008. Discipline and liquidity in the market for Federal funds. Journal of Money, Credit and Banking 40, 295-317.

Lelyveld, I.v., Liedorp, F., 2006. Interbank contagion in the Dutch banking sector. International Journal of Central Banking 2, 99-134.

Liedorp, F.R., Medema, L., Koetter, M., Koning, R.H., van Lelyveld I., 2010. Peer monitoring or contagion? Interbank market exposure and bank risk. De Nederlandsche Bank Working Paper No. 248/2010.

Mistrulli, P.E., 2007. Assessing financial contagion in the interbank market: Maximum entropy versus observed interbank lending patterns. Bank of Italy, Economic Research Department Economic Working Papers No. 64.

Murinde, V., 2010. "Bank regulation in Africa: From Basel I to Basel II, and now at a crossroads", in: Bradford, C., Lim, W. (Eds.), Towards Consolidation of the G20, Chapter 9, 141-168, Seoul and Washington DC: Korea Development Institute and Brookings.

Murinde, V., Mwega, F., Green, C.J., Bai, Y., Maana, I., Ngoka, K., Shimba, C., and Tirongo, S.K., 2012. Interbank Market Operations in Kenya. Consultancy Report for the Central Bank of Kenya, Nairobi, April.

Nier, E., Yang, J., Yorulmazer, T., ALentorn, A., 2007. Network models and financial stability. Journal of Economic Dynamics and Control 31, 2033-2060.

Ngugi, N., Amanja D. & Maana L., 2006. Capital Market, Financial Deepening and Economic growth in Kenya. [Online]. Available from: http://www.csae.ox.ac.uk/conferences/2009-EDiApapers/513-Isaya.pdf [Accessed: 27 May 2010]

Peek, E., Rosengren S., Tootell G.M.B., 1999. Is Bank Supervision Central to Central Banking? Quarterly Journal of Economics 114, 629–53.

Rochet, J., 1992. Capital requirements and the behavior of commercial banks. European Economic Review 36, 1137–1170.

Rochet, J., Tirole, J., 1996. Interbank lending and systemic risk. Journal of Money, Credit and Banking 28, 733-762.

Wells, S., 2004. Financial interlinkages in the United Kingdom's interbank and the risk of contagion. Bank of England Working Papers, No. 230, Bank of England.

Wooldridge, J. M. 1995. Score diagnostics for linear models estimated by two stage least squares. In Advances in Econometrics and Quantitative Economics: Essays in Honor of Professor C. R. Rao, ed. G. S. Maddala, P. C. B.Phillips, and T. N. Srinivasan, 66–87. Oxford: Blackwell.

Table 1: Definition and hypotheses of variables

vector	variable	measurement	hypo.
BANKRISK	LOGNCO	the ratio of net charge-offs to equity, in logarithmic form	
IBP = the interbank position	NIA_TA	The ratio of interbank assets (IA) to total assets (TA)	+/-
	IBL_TA	The ratio of a bank's interbank liabilities (IBL) to total assets (TA)	+/-
IBP^2 = the quadratic form of IBP	squ_NIA_TA	The square of NIA_TA	-/+
	Squ_IBL_TA	The square of IBL_TA	-/+
BANK: bank-specific characteristics	laglognco	One lag of LOGNCO	+
	Ib borrowing rate	Interbank borrowing rate	+
	size_logta	log of total asset	-
	squ_size_logta	The square of size_logta	+
	size_dummy	size_dummy= 3 for category by size = large, 2 for category by size = medium and 1 for category by size = small	-
	foreign	Dummy variable = 1 if at least 51% of capital is owned by foreign shareholders and zero otherwise	-
	public	Dummy variable = 1 for publicly listed bank and zero otherwise	+
	age	the difference between sample year and the year in corporation	+/-
	age_dummy	Dummy variable = 1 for age>= 30 years and zero otherwise	-/+
	CAPITAL	The ratio of total equity to total assets	-
	LLR	Liquid liability ratio	+
	overheads_ta	The ratio of overheads cost to total asset	+
	LOANS	The ratio of total loans to total assets	+/-
MACRO	INFL	Percentage change in the Consumer Price Index (CPI)	+
	growth	Percentage change in real GDP per capita	+
	break	Dummy variable = 1during Q1 2006 and Q3 2011 and zero otherwise	-
Interaction term $(IBP_{it} * BANK_{it})$	size_ibl	interaction between size_dummy and ibl_ta	+
	size_nia	interaction between size_dummy and nia_ta	+
	logta_ibl	interaction between size_logta and ibl_ta	+
	logta_nia	interaction between size_logta and nia_ta	+
	age_ibl	interaction between age_dummy and ibl_ta	-/+
	age_nia	interaction between age_dummy and nia_ta	-/+
	public_ibl	interaction between public dummy and ibl_ta	+
	public_nia	interaction between public dummy and nia_ta	+
	foreign_ibl	interaction between foreign dummy and ibl_ta	+
	foreign_nia	interaction between foreign dummy and nia_ta	+
	break_ibl	interaction between break dummy and ibl_ta	+
	break_nia	interaction between break dummy and nia_ta	+
	rdl	The ratio of total deposit to total loan	
Instrument Variables	lag_ibl_ta	One lag of ibl_ta	
	lag_nia_ta	One lag of nia_ta	
	ibspread	interbank lending rate - interbank borrowing rate	
	reserves	the logarithm of loan loss reserves	

Table 2 Panel data composition and summary statistics

Panel A: Sample composition by three categories								
	Freq.	%	Freq.	%		Freq.	%	Freq.	%
	foreign owner		local owner			private bank		public bank	
public bank	6	66.67	9	26.47	local owner	25	89.29	9	60.00
private bank	3	33.33	25	73.53	foreign owner	3	10.71	6	40.00
small size	5	55.56	17	50.00	small size	18	64.29	4	26.67
medium size	2	22.22	13	38.24	medium size	9	32.14	6	40.00
large size	2	22.22	4	11.76	large size	1	3.57	5	33.33
total	9	20.93	34	79.07	total	28	65.12	15	34.88

Panel B: Summary statistics by categories on the bank average value cross the sample period									
	Observations	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
lognco						**ibspread**			
foreign owner	9	-1.71	1.05	-3.33	-0.03	-0.01	0.22	-0.47	0.19
local owner	34	-1.11	0.67	-2.28	0.17	0.00	0.15	-0.32	0.31
public bank	15	-1.47	0.95	-3.33	0.15	0.07	0.14	-0.18	0.31
private bank	28	-1.11	0.68	-2.28	0.17	-0.04	0.17	-0.47	0.22
large size	6	-1.47	0.23	-1.88	-1.24	0.08	0.15	-0.11	0.31
medium size	15	-1.79	0.47	-3.02	-0.91	0.02	0.14	-0.32	0.29
small size	22	-0.80	0.81	-3.33	0.17	-0.04	0.19	-0.47	0.22
nia_ta						**ibl_ta**			
foreign owner	9	1.31	1.80	0.02	8.48	0.62	0.59	0.02	2.20
local owner	34	1.10	0.88	0.12	2.66	0.37	0.38	0.02	1.24
public bank	15	0.89	0.75	0.12	2.66	0.42	0.31	0.02	1.06
private bank	28	1.45	1.92	0.02	8.48	0.63	0.64	0.02	2.20
large size	6	0.35	0.30	0.12	0.96	0.50	0.28	0.17	1.02
medium size	15	0.70	0.43	0.11	1.40	0.64	0.60	0.05	1.92
small size	22	1.88	2.06	0.02	8.48	0.52	0.59	0.02	2.20
size						**capital**			
foreign owner	9	9.32	1.60	7.47	11.79	0.20	0.12	0.11	0.47
local owner	34	9.00	1.09	6.79	11.57	0.18	0.10	0.10	0.56
public bank	15	9.79	1.41	7.47	11.79	0.18	0.10	0.10	0.47
private bank	28	8.68	0.86	6.79	10.44	0.19	0.10	0.10	0.56
large size	6	11.06	0.67	10.10	11.79	0.12	0.03	0.10	0.17
medium size	15	9.60	0.68	8.54	10.60	0.14	0.02	0.10	0.20
small size	22	8.16	0.51	6.79	8.98	0.23	0.12	0.10	0.56
LLR						**loans**			
foreign owner	9	0.64	0.26	0.31	0.97	0.39	0.25	0.07	0.88
local owner	34	0.42	0.13	0.20	0.77	0.56	0.14	0.08	0.83
public bank	15	0.48	0.21	0.20	0.97	0.51	0.20	0.07	0.88
private bank	28	0.47	0.17	0.26	0.93	0.53	0.17	0.08	0.83
large size	6	0.42	0.11	0.34	0.62	0.51	0.07	0.40	0.59
medium size	15	0.40	0.14	0.20	0.76	0.48	0.16	0.08	0.71
small size	22	0.53	0.21	0.30	0.97	0.55	0.21	0.07	0.88
reserves						**rdl**			
foreign owner	9	2.51	3.05	-3.51	6.85	13.17	29.96	0.73	92.84
local owner	34	3.54	1.14	1.19	6.08	7.97	32.50	0.03	188.49
public bank	15	3.70	2.68	-3.51	6.85	7.65	23.58	0.03	92.84
private bank	28	3.13	0.89	1.19	4.97	9.82	35.69	0.77	188.49
large size	6	5.63	0.83	4.70	6.85	1.60	0.27	1.36	2.09
medium size	15	3.96	0.77	2.94	5.30	4.15	9.24	1.13	37.50
small size	22	2.27	1.56	-3.51	4.01	14.44	43.47	0.03	188.49

Note: Table 2 panel A presents the composition of sample banks. The composition shows that 79% of the banks participate in Kenya interbank market during the sample period are local banks. These local banks are mainly small private banks. Panel B presents summary statistics of the key variables. The summary shows that foreign banks, private banks and small banks seem to have higher and more variable exposures interbank exposures in general than their counterparties.

Table 3 Results of empirical model I: the determinants of banks risks

	baseline model			interbank liability exposure			interbank asset exposure		
lognco	Coef.	t-stat		Coef.	z-stat		Coef.	z-stat	
ibl_ta				-2.842	[-3.76]	***			
squ_ibl_ta				0.482	[2.33]	**			
nia_ta							-0.177	[-5.14]	***
squ_nia_ta							0.004	[3.58]	***
interbankborrowingrate	-0.015	[-1.97]	**	0.015	[0.78]		-0.009	[-1.12]	
size_logta	-2.786	[-8.66]	***	-1.791	[-2.6]	***	-3.416	[-9.73]	***
squ_size_logta	0.125	[7.44]	***	0.077	[2.19]	**	0.154	[8.67]	***
break_dummy							0.162	[3.72]	***
age	0.004	[3.4]	***	0.005	[1.93]	*	0.003	[2.73]	***
foreign	-0.402	[-8.04]	***	-0.406	[-3.33]	***	-0.417	[-7.68]	***
public	0.027	[0.45]		-0.289	[-1.8]	*	0.036	[0.66]	
LLR	0.649	[5.98]	***	-0.173	[-0.54]		0.902	[4.65]	***
capital	-2.978	[-9.26]	***	-2.055	[-2.99]	***	-3.011	[-7.18]	***
loans	1.358	[11.15]	***	-0.386	[-1.33]		1.568	[7.85]	***
overheads_ta	0.511	[4.85]	***	1.542	[4.72]	***	0.426	[5.92]	***
growth							1.437	[4.02]	***
constant	13.288	[8.4]	***	10.374	[3.09]	***	16.359	[9.13]	***
White/Koenker nR2 test statistic	78.225 Chi-sq(10)		***						
GMM C statistic chi2(1)				0.921			4.453	**	
Robust score chi2(1)				0.921				4.453	**
Robust regression				F(1,894)=	63.083	***	F(1,830)=	6.92551	***
1st stage regression sum stat				Partial R-sq.	Robust F(1,895)		Partial R-sq.	Robust F(1,831)	
				0.002	15.3405	***	0.383	15.813	***

Note: 1. Table 3 results support the bank peer monitoring hypothesis. The quadratic forms have significant positive coefficients which indicates that once interbank exposure goes beyond certain level, risk reduction effect reverses. 2. Size (measured by log of total assets) negatively relates to bank risk. The quadratic form: squ_size_logta, which allows for a nonlinear from of the dependence between bank size and risk undertaking, has positive significant link with bank risk. This suggests that as the size of the bank increases beyond a certain threshold, the size advantage may become a disadvantage. 3. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 4. The detailed information of variables refer to Table 1.

Table 4 Results of empirical model II: interacting with size measure

	interbank liability exposure			interbank asset exposure		
lognco	Coef.	z-stat		Coef.	z-stat	
ibl_ta	-10.337	[-6.73]	***			
squ_ibl_ta	0.112	[2.5]	**			
nia_ta				-2.630	[-1.09]	
squ_nia_ta				0.000	[0.08]	
laglognco	0.785	[14.57]	***			
size_logta	-0.669	[-7.54]	***	-0.612	[-2.62]	***
logta_ibl	1.112	[6.57]	***			
logta_nia				0.306	[1.06]	
Ib borrowing rate	0.014	[1.13]				
age	0.001	[0.8]		0.014	[2.39]	**
foreign_owner	-0.316	[-3.98]	***	-0.483	[-4.9]	***
public	0.358	[4.21]	***	-0.057	[-0.79]	
LLR				0.909	[3]	***
capital	-0.095	[-0.25]				
loans	-1.179	[-8.29]	***	2.559	[2.99]	***
overheads_ta	0.331	[2.37]	**	0.303	[1.84]	*
growth				1.336	[3.12]	***
constant	6.400	[8.02]	***	2.528	[1.73]	*
GMM C statistic chi2(1)	1.042			4.15215	**	
Robust score chi2(1)	1.042			4.15215	**	
Robust regression	F(1,866) =	475.59	***	F(1,892) =	5.7374	**
1st stage regression sum stat	Partial R-sq.	Robust F(1,867)		Partial R-sq.	Robust F(1,893)	
	0.002	41.7183	***	0.012	1.63955	

Note: 1. Table 4 presents the results of interbank exposures interacting with size measure 'size_logta'. Results suggest that there is a reverse relationship between bank size and bank risk level. When the less risky banks borrow in the interbank market, the risk reduction effect due to peer monitoring mechanism is smaller. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.

Table 5 Results of empirical model II: interacting with foreign owner dummy

	interbank liability exposure			interbank asset exposure		
lognco	Coef.	z-stat		Coef.	z-stat	
ibl_ta	-2.635	[-4.41]	***			
squ_ibl_ta	0.417	[2.65]	***			
nia_ta				-0.188	[-5.18]	***
squ_nia_ta				0.005	[3.68]	***
size_logta	-1.782	[-2.96]	***	-3.471	[-9.69]	***
squ_size_logta	0.075	[2.44]	**	0.157	[8.66]	***
break_dummy				0.168	[3.89]	***
Ib borrowing rate	0.008	[0.46]		-0.011	[-1.4]	
age	0.003	[1.14]		0.004	[3.39]	***
foreign_owner	-1.271	[-6.87]	***	-0.536	[-7.24]	***
foreign_ibl	1.600	[5.62]	***			
foreign_nia				0.134	[1.93]	*
public	-0.021	[-0.16]		0.038	[0.69]	
LLR	-0.391	[-1.41]		0.948	[4.67]	***
capital	-2.075	[-3.41]	***	-3.108	[-7.23]	***
loans	-0.334	[-1.34]		1.650	[7.99]	***
overheads_ta	1.319	[4.7]	***	0.408	[5.61]	***
growth		[]		1.462	[4.12]	***
constant	10.547	[3.57]	***	16.595	[9.09]	***
GMM C statistic chi2(1)	0.923			4.261	**	
Robust score chi2(1)	0.923			4.261	**	
Robust regression	F(1,893) =	61.2127	***	F(1,829) =	6.30024	**
1st stage regression sum stat	Partial R-sq.	Robust F(1,894)		Partial R-sq.	Robust F(1,830)	
	0.004	19.883	***	0.379	16.4835	***

Note: 1. Table 5 presents the results of interbank exposures interacting with foreign owner dummy 'foreign'. Results suggest that there is a reverse relationship between bank foreign ownership and bank risk level. When the less risky banks borrow in the interbank market, the risk reduction effect due to peer monitoring mechanism is smaller. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.

Table 6 Results of empirical model II: interacting with public dummy

	interbank liability exposure			interbank asset exposure		
lognco	Coef.	z-stat		Coef.	z-stat	
ibl_ta	-2.593	[-4.880]	***			
squ_ibl_ta	0.410	[2.770]	***			
nia_ta				-0.177	[-4.7]	***
squ_nia_ta				0.004	[3.3]	***
size_logta	-1.357	[-2.260]	**	-3.412	[-9.43]	***
squ_size_logta	0.055	[1.830]	*	0.154	[8.41]	***
break_dummy	-0.194	[-1.910]	*	0.161	[3.61]	***
Ib borrowing rate	-0.001	[-0.070]		-0.009	[-1.12]	
age	0.006	[3.340]	***	0.003	[2.8]	***
foreign_owner	-0.327	[-3.450]	***	-0.417	[-7.64]	***
public	-1.194	[-5.960]	***	0.039	[0.65]	
pub_ibl	1.756	[6.100]	***			
pub_nia				-0.005	[-0.09]	
LLR	-0.504	[-2.290]	**	0.900	[4.62]	***
capital	-1.852	[-3.020]	***	-3.005	[-7.27]	***
loans	-0.329	[-1.430]		1.566	[7.82]	***
overheads_ta	0.897	[7.340]	***	0.429	[5.1]	***
growth				1.437	[4.02]	***
constant	8.461	[2.860]	***	16.340	[8.88]	***
GMM C statistic chi2(1)	0.924			4.827	**	
Robust score chi2(1)	0.924			4.827	**	
Robust regression	F(1,892) =	60.5032	***	F(1,829) =	8.00035	***
1st stage regression sum stat	Partial R-sq.	Robust F(1,893)		Partial R-sq.	Robust F(1,830)	
	0.004	24.2693	***	0.378	16.4258	***

Note: 1. Table 6 presents the results of interbank exposures interacting with publicly listed dummy 'public'. Results suggest that there is a reverse relationship between publicly listed banks and bank risk level. When the less risky banks borrow in the interbank market, the risk reduction effect due to peer monitoring mechanism is smaller. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.

Table 7 Results of empirical model II: interacting with age dummy

	age dummy					
	interbank liability exposure			interbank asset exposure		
lognco	Coef.	z-stat		Coef.	z-stat	
ibl_ta	-3.166	[-4.36]	***			
squ_ibl_ta	0.510	[2.68]	***			
nia_ta				-0.041	[-3.61]	***
squ_nia_ta				0.001	[2.27]	**
laglognco				0.776	[28.14]	***
size_logta	-1.779	[-2.57]	***	-0.925	[-4.2]	***
squ_size_logta	0.081	[2.36]	**	0.043	[3.94]	***
break_dummy				0.030	[1.26]	
age_dummy	-1.100	[-5.05]	***	-0.077	[-1.7]	*
age_ibl	1.958	[5.32]	***			
age_nia				0.066	[1.85]	*
foreign	-0.620	[-6.55]	***	-0.055	[-1.53]	
public				0.025	[0.63]	
LLR				0.186	[1.8]	*
capital	-2.251	[-3.1]	***	-0.677	[-2.74]	***
loans	-0.498	[-1.65]	***	0.317	[2.64]	***
overheads_ta	1.495	[4.66]	***	0.096	[2.58]	***
growth				1.516	[7.42]	***
inflation				1.638	[3.62]	***
constant	10.300	[3.06]	***	4.359	[3.97]]	***
GMM C statistic chi2(1)	0.774			3.282	*	
Robust score chi2(1)	0.774			3.282	*	
Robust regression	F(1,896) =	29.2917	***	F(1,863) =	4.72681	**
1st stage regression sum stat	Partial R-sq.	Robust F(1,897)		Partial R-sq.	Robust F(1,864)	
	0.001	19.0631	***	0.375	18.8696	***

Note: 1. Table 7 presents the results of interbank exposures interacting with bank 'age_dummy'. Results suggest that there is a reverse relationship between bank age and bank risk level. When the less risky banks borrow in the interbank market, the risk reduction effect due to peer monitoring mechanism is smaller. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.

Appendix

Table A1 Important events in Kenya interbank market from 2007-2011

Date	Reform	Purpose
June 07	Monetary Policy Advisory Committee (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 Ksh50 million to Ksh20 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 Ksh10 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

Note: 1. Source: Kenya Central Bank (2011)

2. Table A1 in the appendix lists key events in Kenya interbank market from 2007 to 2011 period. We can see that Kenya interbank market is an actively managed and actively used market by Kenya central bank and commercial banks.

Table A2 Correlation matrix of the key variables

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)
crsis_dum	(a)																						
break	(b)	0.61																					
age	(c)	0.00	-0.04																				
foreign	(d)	0.01	0.07	0.40																			
listed	(e)	-0.03	-0.05	0.54	0.37																		
size_dummy	(f)	-0.11	-0.19	0.65	0.19	0.59																	
LLR	(g)	-0.07	-0.12	0.13	0.21	0.04	-0.14																
lognco	(h)	0.03	0.02	-0.21	-0.32	-0.20	-0.45	0.03															
nia_ta	(i)	0.09	0.09	-0.24	-0.12	-0.22	-0.34	0.03	-0.01														
ibl_ta	(j)	0.05	0.05	-0.07	-0.11	-0.07	-0.07	0.03	-0.07	-0.11													
squ_nia_ta	(k)	0.07	0.04	-0.13	-0.11	-0.14	-0.19	0.01	-0.04	0.87	0.17												
squ_ibl_ta	(l)	0.02	-0.01	-0.10	-0.12	-0.09	-0.07	-0.03	-0.08	0.10	0.92	0.37											
size_logta	(m)	0.07	0.02	0.69	0.23	0.54	0.86	-0.15	-0.36	-0.35	-0.13	-0.20	-0.18										
squ_size_logta	(n)	0.07	0.02	0.71	0.23	0.55	0.86	-0.15	-0.35	-0.34	-0.13	-0.19	-0.18	1.00									
capital	(o)	0.03	0.08	-0.24	-0.18	-0.11	-0.37	0.20	0.18	0.15	0.04	0.06	0.08	-0.52	-0.49								
INFL	(p)	0.13	0.12	0.06	-0.02	0.04	0.06	-0.04	0.12	-0.05	-0.14	0.01	-0.12	0.02	0.03	0.06							
gdpy	(q)	0.63	0.74	-0.06	0.05	-0.05	-0.15	-0.05	0.01	0.11	0.05	0.03	0.00	0.02	0.02	0.01	-0.30						
growth	(r)	-0.18	-0.35	-0.06	-0.03	-0.01	0.00	0.13	0.09	0.06	-0.08	-0.01	-0.07	-0.06	-0.06	-0.07	-0.33	0.22					
ibspread	(s)	-0.11	-0.16	-0.11	-0.03	-0.06	-0.01	-0.18	-0.04	0.09	0.03	0.04	0.05	-0.02	-0.03	-0.11	-0.01	-0.15	0.08				
reserves	(t)	-0.06	-0.19	0.44	0.03	0.32	0.64	-0.09	-0.12	-0.18	-0.10	-0.09	-0.12	0.71	0.71	-0.41	-0.02	-0.07	0.18	0.14			
rdl	(u)	-0.06	0.06	-0.08	0.10	0.06	-0.04	-0.13	-0.36	0.10	0.05	0.05	0.08	-0.13	-0.12	0.25	-0.05	0.00	-0.06	0.05	-0.30		
loans	(v)	0.04	-0.01	-0.26	-0.26	-0.01	-0.16	-0.33	0.41	0.10	-0.31	0.06	-0.30	-0.06	-0.05	0.14	0.10	-0.02	0.01	0.00	0.03	-0.33	
overheads_ta	(w)	0.06	0.02	-0.06	-0.14	0.26	-0.12	-0.11	0.29	-0.02	0.12	-0.02	0.08	-0.10	-0.10	0.06	0.06	0.00	0.02	0.02	-0.14	0.00	0.26

Note: Table A2 presents the correlation matrix of the variables. There is no evidence of a correlation pattern that suggests highly collinear variables. 3. The detailed information of variables refer to Table 1.

Table A3 Robustness check with alternative measure of size

	baseline model			interbank liability exposure			interbank asset exposure		
lognco	Coef.	t-stat		Coef.	z-stat		Coef.	z-stat	
ibl_ta				-2.473	[-3.23]	***			
squ_ibl_ta				0.419	[2.13]	**			
nia_ta							-0.182	[-4.67]	***
squ_nia_ta							0.004	[3.19]	***
interbankborrowingrate	0.007	[1.08]		0.029	[1.69]	*	0.022	[3.16]	***
medium_size	-1.059	[-22.77]	***	-0.716	[-4.23]	***	-1.196	[-22.83]	***
large_size	-0.801	[-9.69]	***	-0.738	[-4.08]	***	-0.945	[-13.53]	***
break_dummy							-0.192	[-5.68]	***
age	0.001	[1.09]		0.003	[1.5]		0.000	[0.37]	
foreign	-0.329	[-6.87]		-0.374	[-3.25]	***	-0.324	[-6.25]	***
public	-0.002	[-0.04]		-0.258	[-1.63]		-0.022	[-0.4]	
LLR	0.331	[3.21]	***	-0.249	[-0.81]		0.351	[1.96]	*
capital	-1.212	[-4.89]	***	-0.783	[-1.28]		-0.829	[-2]	**
loans	0.866	[7.65]	***	-0.483	[-1.9]	*	1.412	[4.53]	***
overheads_ta	0.515	[5.2]	***	1.423	[4.66]	***	0.962	[5.05]	***
growth							0.410	[5.58]	***
constant	-1.105	[-10.5]	***	0.548	[2.09]	**	-0.890	[-5.11]	***
White/Koenker nR2 test statistic	87.342 Chi-sq(10)		***						
GMM C statistic chi2(1)				0.972			4.165	**	
Robust score chi2(1)				0.971798				4.16485	**
Robust regression				F(1,894)=	56.495	***	F(1,830)=	11.3903	***
1st stage regression sum stat				Partial R-sq.	Robust F(1,895)		Partial R-sq.	Robust F(1,831)	
				0.0019	13.2155	***	0.3894	15.7517	***

Note: 1. Table A3 presents the robustness test results of interbank peer monitoring role in risk management. Results are largely consistent with Table 3. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.

Table A4 Results of empirical model II: interacting with alternative size measure

	size_dum					
	interbank liability exposure			interbank asset exposure		
lognco	Coef.	z-stat		Coef.	z-stat	
ibl_ta	-8.323	[-2.73]	***			
squ_ibl_ta	0.643	[2.28]	**			
nia_ta				-0.342	[-2.16]	**
squ_nia_ta				0.004	[2.44]	**
size_dummy	-2.650	[-3.75]	***	-0.842	[-9.91]	***
size_ibl	3.693	[2.75]	***			
size_nia				0.184	[1.54]	
break_dummy	-0.161	[-0.91]		-0.206	[-5.05]	***
Ib borrowing rate	-0.007	[-0.27]		0.009	[1.18]	
age	0.013	[3.28]	***	0.008	[5.75]	***
foreign_owner	-0.805	[-4.07]	***	-0.506	[-8.79]	***
public	0.888	[2.58]	***	0.121	[1.8]	*
LLR	1.123	[1.85]	*	0.580	[2.98]	***
capital				-0.748	[-1.65]	***
loans	0.425	[1.02]		1.402	[7.34]	***
overheads_ta	1.080	[1.95]	*	0.326	[4.42]	***
growth				1.394	[3.89]	***
constant	2.857	[2.48]	**	-0.597	[-2.84]	***
GMM C statistic chi2(1)	0.944			4.08021	**	
Robust score chi2(1)	0.944			4.08021	**	
Robust regression	F(1,894) =	69.9999	***	F(1,830) =	11.3422	***
1st stage regression sum stat	Partial R-sq.	Robust F(1,895)		Partial R-sq.	Robust F(1,831)	
	0.001	10.4197	***	0.1527	12.4941	***

Note: 1. Table A4 presents the robustness test results of interbank exposures interacting with the alternative size measure: a single 'size_dummy'. Results are consistent with Table 4. 2. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. 3. The detailed information of variables refer to Table 1.