

Interbank Market Discipline and Its Effectiveness: Lessons from Developing Markets

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Interbank Market Discipline and Its Effectiveness: Lessons from Developing Markets

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Abstract

This study explores interbank market discipline and its effectiveness in Kenya and Malawi by examining the factors that drive the quantity- and price-based measures of market discipline, and the effectiveness of disciplinary mechanisms in influencing commercial banks' capital adequacy ratios. The findings show the differentiating effects that bank risk factors have on interbank volumes and rates in the two countries, and while both quantity- and price-based discipline mechanisms are effective in Kenya, only the price-based discipline is effective in Malawi. The study recommends a review of the rules of engagement in the interbank market targeted at reducing the influence of some banks in the Malawi interbank market. For both countries, policy makers could tighten rules for banks' liquidity management so that deviations are more heavily penalized and banks would be highly incentivized to increase their capital adequacy ratios, in support of prudential regulation and the objectives of monetary policy.

Key words: Interbank Market, Market Discipline, Effectiveness, Developing Countries

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1. Introduction

The interbank market has one critical function of ensuring that the financial sector operates smoothly. This is achieved through its liquidity re/distribution role from surplus banks to banks in deficit.¹ The market also enables banks to trade liquidity in order to meet their reserve requirements and to avoid having to keep extra liquidity ex-ante to cushion themselves from liquidity shocks.² This ensures the efficient allocation of resources and enhances financial intermediation, thereby promoting the objectives of monetary policy (Bruche and Suarez, 2010). Central bank liquidity management operations first hit the interbank market before they “ripple out” to the rest of the financial system and economy. This is done via the interest and credit channels of monetary policy transmission. In this regard, along with serving as an operational target for monetary policy, the overnight interbank rate is an anchor for the whole term structure of interest rates. Therefore, understanding the overnight market in terms of its operational framework and price-setting mechanism is crucial to policy makers in enhancing the effectiveness of monetary policy.

The interbank market remains a focal point for policy makers in Kenya and Malawi, at a time when both these countries are considering a transition to an interest rate-targeting framework and, eventually, inflation targeting. The two markets offer an opportunity to study examples of developing markets, exploring not only their similarities but also their structural differences. The two markets show evident segmentation and lack of complete open trading lines, but differ in their securitization, maturity of trades and exposure to international markets. Based on these features, a study of the two can provide valuable insights into understanding a typical developing interbank market.

An emerging concept in interbank markets is their disciplining role. A well-functioning interbank market is mainly characterized by the existence of a high degree of discipline, so that the market provides signals that lead borrowers to behave in a manner consistent with their solvency (Lane, 1993). In fact, the Basel Committee emphasizes the necessity of enhancing market discipline in its third Basel II pillar (BCBS, 2006). Banks have traditionally been regulated and supervised in order to protect them from failure and to maintain the safety and viability of the financial system. However, the ongoing rapid developments in technology and financial sophistication have challenged the ability of central bank regulation and supervision to foster sound financial systems (Jones, 2000). As such, policy makers

have increasingly looked to the marketplace as a potential additional monitor of the risk-taking behaviour of banks (Flannery, 1998).

The role of interbank market discipline has continued to attract widespread interest from policy makers as a complement to macroprudential regulation (Nieto, 2012). This is due to the view that the latter has failed to adequately discipline banks because of information asymmetry and a weak legal environment (Andrievskaya and Semenova, 2013). It can be argued that a disciplined interbank market provides incentives to limit excessive risk-taking by banks by introducing additional costs to banks that adopt such strategies. The presence of an effective disciplining mechanism in this case would mean that less regulatory intervention would be needed as players are forced by their counterparts to adjust their buffers and behave appropriately. An interbank market disciplining mechanism affects the behaviour of participating banks and influences the volume of funds traded as well as prices in the market. In the disciplining mechanism, ideally each bank monitors the activities of co-participants in the market, and therefore the whole system, which amounts to conducting a peer monitoring mechanism among the participating banks, in a way that is different from the traditional regulatory oversight provided by the central bank (Furfine, 2001).

Exploring market discipline as a potential support for prudential regulation has been necessitated by two recent developments that have refocused attention on an analysis of the risk-taking behaviour of banks. First is the global financial crisis that started in 2007/08, which resulted in the freezing up of interbank markets and related short-term lending. This unleashed exogenous systemic risk that is still present in various economies. There was market failure, but there was also regulatory failure. The second is the transition from Basel I to Basel II, and then Basel III, during which concerns about a “one-size-fits-all” type of official bank regulation for emerging economies have been sidestepped, leaving open the option of exploiting “market discipline” as a complementary regulatory tool (Murinde, 2010).

Even with an increased focus on market discipline, the strong link between central banks and interbank market operations cannot be downplayed. As most central banks pursue their principal objective of price stability, the implementation of policy decisions via the tools of monetary policy – such as open market operations – is mostly conducted through, and is dependent on, a well-functioning interbank market. The interbank market is typically characterized by transactions that are conducted on the basis of clearly defined rules, which are set and agreed on among participating members. But the intertemporal liquidity shocks that hit the interbank market can only be neutralized by means of central bank operations increasing or decreasing the aggregate supply of liquidity, implying that the overnight interbank market is inextricably linked to central bank operations affecting the supply of and demand for reserves. The strength of the link between central bank and interbank market operations would be dependent on the structure of the existing interbank market.³

This study comparatively examines the interbank market discipline and its effectiveness in Kenya and Malawi as case studies for exploring the interbank markets in developing countries. As pointed out earlier, there are a few marked differences

between the two markets. First, while the interbank market in Kenya involves totally unsecured trades transacted on an overnight maturity basis, trades in the Malawi interbank market comprise both secured and unsecured components over overnight and over-a-day maturity.⁴ A second difference relates to the exposure of the two markets to international markets. The Kenyan interbank market is about four times larger than that of Malawi, based on the number of participants as well as their regional footprint. At least six Kenyan banks continue to expand across the growing Eastern Africa market. As such, the evolution of the interbank market in Kenya, for example, would have direct implications for the banking sector in the region.⁵ By contrast, there are no Malawian banks operating in East Africa outside Malawi.

There are a few common features that bind the two markets together. At the policy level, both countries are gradually transitioning from a monetary aggregate to an interest rate-targeting framework, and will eventually move to an inflation-targeting monetary policy framework. In an interest rate-targeting framework, policy makers would be keen to align the interest rate operational target (mostly an interbank rate) to the policy rate. In pursuit of this, both central banks conduct open market operations to influence the level of bank reserves (which are the interbank market tradable funds), and thus interbank rates. For the Reserve Bank of Malawi (RBM), the current rule is that the interbank rate (IBR) should not be allowed to deviate by more than 800 basis points below the policy rate and not more than 200 basis points above the policy rate. A similar framework is applied in Kenya, but the only differentiating factor is that Kenya's framework does not specify an exact (predetermined) quantified range/corridor for the interbank rate. This study, therefore, offers an opportunity to compare these two markets, one with a somewhat stronger commitment to aligning short-term interest rates around the policy rate.

Additionally, in terms of trading patterns, there are no open trading lines across all banks in the market, but rather established bilateral credit lines created through a continuous credit profiling process that the participants conduct among each other. This is evident in both the markets. The market also shows some evidence of segmentation based on size so that disadvantaged banks are charged higher interest rates, even when some banks are holding excess liquidity. Figures A1 and A2 in the Appendix show trends over time in respective interbank market volumes, interest rates and the policy rates in Kenya and Malawi for the period January 2003 to December 2015.⁶ It is evident in both countries that the interbank rates have no constant variance around the policy rate, which is an indication of inefficiency in the transmission of policy signals. In addition, there seems to be no close relationship between the price and quantity in the market, pointing to evidence that factors that drive the price are somewhat different from those that influence the quantities traded. This indicates the possibility of the existence of both quantity- and price-based market disciplining mechanisms in the two markets.

While the above scenario may be a reflection of a number of developing countries' money markets, many studies devoted to the examination of market discipline have focused on different market stakeholders, such as subordinated debt providers,

bank stockholders, and retail and corporate depositors, while the interbank market remains relatively less explored. This is the case in both developed and developing country contexts. Even then, most previous studies have focused on the existence of market discipline, but little effort has been directed at establishing the degree to which market discipline is effective (Nier and Baumann, 2006; Dinger and Von Hagen, 2009; and Liedorp et al, 2010).

This study, unlike previous studies that mainly focus on the quantity-based market discipline, also explores the price-based market discipline (adopting the approach of Furfine, 2001) and the effectiveness of the two disciplining mechanisms (as in Andrievskaya and Semenova, 2013) in the case of two developing markets. The study borrows the argument that little attention has been given, in both developed and developing markets, to assessing the effectiveness of the market disciplining mechanisms – whether price- or quantity-based (Nier and Baumann, 2006). While the study provides a foundational first line of formal description of interbank market pricing and quantity models in Malawi, it builds on previous literature on Kenya by Murinde et al (2015) and Oduor et al (2014). These previous studies, respectively, focused on the quantity-based disciplining mechanisms (excluding analyses of their effectiveness), and the impact of the existing interbank trading networks on the effectiveness of monetary policy using older data series.

In examining the quantity-based and price-based market disciplining mechanism, the goal is to establish whether banks that borrow from other banks through the interbank market are able to access volumes of funds or get fair prices because of their lower risk levels (in support of the peer-monitoring hypothesis), or not (evidence for the contagion effect if interbank borrowing aligns positively with bank risk levels). Essentially, the study investigates the disciplining mechanisms in the two interbank markets and ascertains whether they are strong enough to constrain excessive risk-taking by participating banks. Furfine (2001) argues that as banks lend significant amounts to one another on an uncollateralized interbank market, they expose themselves to significant credit risk. In this regard, lending banks have an incentive to monitor their counterparts, ration quantities of loans extended and/or price these loans as a function of, among other factors, the risk characteristics of the borrowing bank. A market disciplining mechanism is effective if it provides an incentive scheme, or when it results in a higher capital buffer for banks, or whether it motivates banks to choose a lower probability of default (Nier and Baumann, 2006). Establishing an effective market disciplining mechanism can potentially complement official bank regulation, which supports the achievement of monetary policy objectives in Kenya and Malawi.

In this regard, the objectives of this study include: first, to ascertain the status of the price- and quantity-based interbank market disciplines. To do this, the study empirically estimates the degree of influence of bank risk characteristics on interbank borrowing volumes as well as interbank borrowing rates. Second, to establish the role of interbank borrowed volumes and interbank borrowing rates (identified as the disciplining mechanisms) in banks' incentives to increase their capital buffers. The

study focuses on the period January 2009 to December 2015 – a more recent period when compared to periods covered by previous studies. This provides an opportunity to review market performance after the global financial crisis that extensively affected risk assessment in financial markets, including the interbank markets. In the case of Kenya, a more recent sample particularly offers an opportunity to establish the role of some recent events that significantly affected the interbank market, such as changes in the institutional and operational framework, and occasional gridlocks in government expenditure that affected market liquidity, which had not been witnessed in previous periods.⁷ For Malawi, a policy concern has been that the interbank market rate does not give a true reflection of liquidity conditions in the market. This study should provide some guidance for understanding the operations of the interbank market, particularly its market disciplining role, and thus help enhance the effectiveness of monetary policy.

This rest of the paper is organized as follows: Chapter 2 outlines the operational structure of the two interbank markets. Chapter 3 presents a brief review of the relevant literature on interbank market discipline and its effectiveness, while the econometric procedures are discussed in Chapter 4. Chapter 5 presents the data and estimation results, and Chapter 6 draws some policy implications.

2. Operational structure of interbank markets in Kenya and Malawi

This sub-section describes the two interbank markets, outlining their trading structures in terms of collateralization, loanable funds, loan tenures and currency denomination, participants, how trade transactions are sealed and how credit lines are established.

Interbank market in Kenya

The interbank market in Kenya is a market purely for commercial banks to trade reserves. Over the period covered by this study, each bank by law was required to operate two reserve accounts: one for meeting statutory reserve requirements and the other for clearing interbank obligations, henceforth called the clearing account. These accounts are closely linked to each other because the clearing account is a source of funds for meeting the statutory reserve requirements. Up to 2011, required reserve ratios were observed on a daily basis. However, this was reviewed in 2011 and became a monthly averaging system with the 14th working day of each month being the last day of the reserves maintenance period.⁸

The main day-to-day determinants of individual banks' reserve demands are the transactions flows through the banking system. Some of these are highly predictable, such as the monthly cycle of wage and salary payments or the annual cycle of corporate tax payments, most of which are largely distributive and temporary in nature. Other flows emerge as random shocks, which may be either aggregative or distributive and either permanent or temporary, or a combination. Under the reserve averaging system, banks can have a shortage or excess of reserves for several days during the maintenance period provided the average is satisfied by the end of the period. This means that commercial banks can manage the predictable component of transactions flows without excessive recourse to the interbank market or the central bank on a day-to-day basis. This helps to decrease daily and intra-day fluctuations in the overnight rate. Reserve averaging enables the central bank to delegate to commercial banks much of the process of reserve management in the face of stochastic shocks.⁹

The interbank market in Kenya only trades funds on an overnight basis, uncollateralized and all in the domestic currency (Kenya shilling). The market is used by banks to smooth out payments of maturing obligations of both customers and

other commercial banks, as well as to provide a source of funds to meet statutory cash reserve requirements. Currently, 42 of the 43 licensed commercial banks trade in the interbank market.¹⁰ In terms of timing, the interbank market is open between 8.30am and 4.30pm, but with two rather distinct sessions. The first session (8.30am–3.30pm) allows banks to trade funds to settle interbank customers' payments/demands. The second session (3.30pm to 4.30pm) is dependent on the outcome of the first session, and allows banks to square their positions by trading their excess funds with other banks that find themselves with cash requirements. In this second session, banks also settle bank-to-bank obligations. Whenever there are shortages in this session, banks resort – as a measure of last resort and at a punitive rate – to borrowing funds from the Central Bank of Kenya (CBK) discount window.

Bilateral lending and borrowing agreements are not open to all banks; instead there are established lines of credit. The credit lines are created through a credit profiling process that banks conduct on each other: assessing the creditworthiness of the other banks, done on the basis of size (considering the parent company if it is a subsidiary), asset base and also ownership (either foreign, local private or local public). Banks with relationships at ownership level would have open credit lines with each other even if their asset bases are not strong enough. The credit lines establish lending and borrowing exposure limits for other banks, both in terms of volumes it can trade and whether or not the bank can actually trade. The terms of the credit lines are reviewed regularly as the creditworthiness of banks change. Each bank has at least one credit line with another bank, but the exposure volumes and interest rate applied would vary.¹¹

In terms of settlement of interbank transactions, all interbank payments are effected through the Kenya Electronic Payments and Settlement System (KEPSS). The deals are concluded bilaterally between banks (originating standardized payment instructions through SWIFT) in real time through Real Time Gross Settlement (RTGS). Transactions are initiated by lenders with excess funds or borrowers seeking funds via the Reuters screen, to which all banks have access. The CBK provides an intra-day liquidity facility (ILF) that allows banks to access additional funds from the central bank to meet their huge maturing obligations when there is a risk of overdrawing on their clearing accounts, due to the fact that RTGS does not permit overdrafts on their clearing accounts.¹²

In a liberalized interest rate regime such as that in Kenya, the interbank rate serves as an important benchmark for setting interest rates of other financial products, as it reflects the availability of liquidity in the economy. In fact, movements in the interbank interest rate form an important input into open market operations of the CBK. Kenya's banking sector consists of 43 commercial banks, of which 6 are large, 15 medium, and 22 small.¹³ All these banks can potentially trade in the interbank market, implying that there can be at least 1,806 possible transactions per day in the interbank market. In reality, however, only an average of about 250 daily deals are recorded in a typical complete year, implying that most participants in the market trade with the same institutions repeatedly. The market is fragmented, with

large banks serving specific lines of credit and market niches, but not contributing to competition in the sector.¹⁴ This adversely impacts the operations of the market, including the ability to efficiently allocate resources. As the interbank market in Kenya is the most immediate source of liquidity for banks, interbank market inefficiency problems can indicate widespread lack of risk-sharing behaviour between banks. In extreme cases, disruptions in the interbank market could pose a threat to the stability of the financial system because the market is vital for banks' liquidity management.

In recent years, one policy concern has been occasional extreme volatility arising from liquidity distribution and availability in the market. To mitigate this, some reform initiatives have been implemented, such as the introduction of the collateralized horizontal repo market, to even liquidity distribution in the market with a view to enhancing its stability.¹⁵ This initiative, however, encountered some operational bottlenecks that have hindered its effectiveness.¹⁶ Under this backdrop, the interbank market has remained very volatile.

Interbank market in Malawi

The interbank market in Malawi is structured just as the one in Kenya, in terms of the purposes it serves and the relationship between the market and the RBM. With regard to the conduct of monetary policy, the overnight interbank rate is the operating target. RBM recognizes the need to have a clear understanding of the interbank operations, especially on the factors that drive interbank rates for effective monetary policy implementation (Reserve Bank of Malawi, 2016). The interbank rate in this market is sensitive to the changes in the Monetary Policy Rate (MPR) and reflects underlying conditions in the market.¹⁷

Unlike in Kenya, where trades in the interbank market mature after one day, the transactions in the Malawian market are characterized by different maturity profiles. Over 90% of trading (in terms of volumes) matures overnight. Another difference is that the market trades funds on both a collateralized and uncollateralized basis and all transactions are carried out in the local currency (Malawi Kwacha). Participants in the market comprise 12 commercial banks and one discount house.¹⁸ The market is used by these players to clear maturing cash obligations of both customers and other commercial banks, as well as to provide a source of funds to meet the statutory cash reserve requirements.

In terms of timing and settlement of transactions, the interbank market is open for one session per day, between 8.00am and 4.00pm. Transactions on the interbank market are initiated by either lenders with excess funds or borrowers seeking funds. For an interbank trade to be effected, dealers interact via phone on the availability of excess funds to lend or to satisfy their demand at the end of the day. The average interbank rate for the previous day, which is usually posted on the RBM website, acts as a benchmark for setting the interbank rate for the day. If a lending bank perceives

that the market is liquidity constrained, it will charge their trading partner a rate that is above the previous day's average rate, and vice versa. As in Kenya, interbank deals (loan amounts and interest rates) are concluded bilaterally between participating commercial banks on a one-to-one basis; information that is not available to the market players. Payments instructions are originated on SWIFT and effected through RTGS.¹⁹ The interbank market does not have indicative quotes posted on a trading (Reuters) screen.

There are a number of issues related to the interbank market in Malawi. A quick look at the data on the interbank market in Malawi reveals some evidence of price discrimination and liquidity rationing. For example, large banks are perceived as less risky compared with small banks, on average, and thus when they are borrowing in the interbank market, they are charged lower interest rates when compared with small banks. Conversely, when small banks are borrowing from large banks, the rate is significantly higher. It can, therefore, be seen that lending/borrowing relationships play a crucial role in this market. While it is easier for some banks to borrow from the market, other banks find it difficult to access funds at the existing market interest rates. It is, therefore, not surprising that some banks have to seek access to the Lombard facility from the RBM at a relatively higher rate than the prevailing interbank market rate, even if these banks are holding large volumes of liquidity. Against this backdrop, the interbank market rate does not give a true reflection of the liquidity condition in the market.

3. Literature review

Based on the integral functions of the interbank market as discussed, policy makers have been led to (re)examine the interbank market with a view to ascertaining the extent to which they can rely on the market, especially the potential market disciplining role, in enhancing efficiency in the conduct of monetary policy. However, both in developed and developing markets little research has been carried out on the interbank market when compared with the bond, equity or foreign exchange markets (Furfine, 1999; Hartmann et al 2001). Most studies that have delved into examining market discipline have mainly focused on different market stakeholders, such as subordinated debt providers, bank stockholders, and retail and corporate depositors, while the interbank market remains relatively less explored, both in developed and developing country contexts. Even then, most previous studies have focused on the existence of market discipline, but little effort has been directed at establishing the degree to which market discipline is effective (Nier and Baumann, 2006; Dinger and Von Hagen, 2009; and Liedorp et al, 2010).

In particular, and as far as is known, while no literature exists on the operations of the interbank market in Malawi, two studies exist for Kenya. Murinde et al (2015) investigate whether the interbank market in Kenya is an effective peer-monitoring and market discipline device, and thus complements official regulation over the sample period 2003.1–2011.1. The study, however, focused on the quantity-based market discipline assuming the price is endogenous. Related literature on the interbank market in Kenya, such as that by Oduor et al (2014), reviewing the period June 2003–September 2012, assessed the role that market segmentation played in the efficiency of the interbank market in Kenya and the extent to which the segmentation and inefficiencies in the interbank market impeded monetary policy. It specifically analysed interbank pair-wise network exposures and tested convergence and equality of interbank rates across the existing market tiers to draw conclusions on the nature of segmentation.

The interbank market is assumed a priori and often modelled in the literature as a centralized exchange in which banks smooth liquidity shocks (for example, Ho and Saunders, 1985; Bhattacharya and Gale, 1987; and Freixas and Holthausen, 2005). Other authors argue that the market is decentralized with deals struck bilaterally between pairs of banks (Stigum and Crescenzi, 2007). This defining market feature may give rise to market intermediaries (Duffie et al, 2005) and segmentation, where

small banks may be considered riskier than large banks, with the latter being regarded as “too-big-to-fail”. On this basis, some recent studies recognize the bilateral nature of the interbank market (for example, Allen and Gale, 2000; Freixas et al, 2000; and Leitner, 2005) and conclude that there are tiers in the interbank market. Understanding the lending-borrowing interlinkages in the interbank market is therefore important for banks that use it to engage in unsecured borrowing and lending of funds. It is also important for monetary authorities, as the interbank market lies at the heart of monetary policy especially when there are potential domino and contagion effects in the event of a default. In this regard, for the successful conduct of monetary policy, it is crucial to understand the functioning of the money market as well as the behaviour of the money market participants (Galac et al, 2007).

Market discipline has been discussed in the literature in terms of market monitoring, where the lender’s assessments of the condition of the borrower are reflected in its security prices and borrowing rates (Flannery, 2001). Three forms of market discipline emerge: price-based measures, where lenders raise or lower lending rates depending on the borrower’s risk; quantity-based measures, where lenders restrict or extend access to credit on the basis of the borrower’s risk; and one based on the evidence of maturity shifting, where the length of time the lender is willing to extend a loan is adjusted for borrower risk (Andrievskaya and Semenova, 2013). De Ceuster and Masschelein (2003) review the potential role that market discipline can play in financial regulation, in light of the existing regulatory mechanisms and disciplining power that various market participants have. They argue that more external risk management disclosure is a key condition to strengthen market discipline as a regulatory mechanism, which is consistent with Basel II. Moreover, while the monetary authority 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 of Basel II should focus on increasing transparency and strengthening competition among banks, in addition to emphasizing risk-based capital adequacy. Further, it may be argued that as banking grows more complex, government supervisors of banks are increasingly willing to share the role of policing bank risk with other banks through a peer mechanism in the interbank market.

Market discipline literature has, however, predominantly focused on other markets such as the market for retail and corporate deposits. For example, Hannan and Hanweck (1988) and Ellis and Flannery (1992) focus on price discipline, and Jordan (2000) and Goldberg and Hudgins (1996) study quantity discipline. Some studies attempted to investigate market discipline in equity pricing (see, for example, Distinguin et al, 2006) and debt security pricing (Goyal, 2005 and Ashcraft, 2008). However, market discipline in the interbank market has received little attention. The few studies that delved into this area have mainly focused on the quantity-based measures of market discipline. This is perhaps because theoretical models assume

the existence of perfect competition in the interbank markets where players are price-takers (Ho and Saunders, 1985; and Clouse and Dow, 2002).

However, empirical evidence suggests the existence of both price- and quantity-based measures of market discipline. Furfine (2001) studied price discipline in the US interbank market by investigating whether banks could effectively be employed as monitors of their peers. The study focused on the period 2 January 1998 to 31 March 1998 to examine the pricing of interbank transactions in the US uncollateralized market, which was argued to expose lenders to significant credit risk. Study findings show that credit risk exposure incentivizes lenders to monitor their counterparts and to price the loans as a function of, among other factors, the credit risk of the borrower. The study models the determinants of interbank borrowers' cost by focusing on different credit risk measures and other bank specific control variables.²⁰ The study finds strong evidence that the interbank rate in the US federal funds market reflects, in part, the credit risk of the borrowing institution. In particular, borrowing banks with higher profitability, higher capital ratios and fewer non-performing loans (NPLs) pay lower interest rates on the interbank market. This suggests that banks in the US can identify and distinguish credit risk among their peers and price interbank loan contracts accordingly. Even with high interest rates charged to risky banks, lending banks would still consider the probability of default by the borrowing bank. In this regard, lending banks would compare the probable high return on their funds against the conceivable loss of the entire principal. In this regard, the discipline of very risky institutions in the interbank market would take the form of quantity rationing rather than higher interest rates on transactions. This evidence is corroborated by King (2008) who also focused on the US interbank market to show that banks with more risk borrow less in the federal funds market.

Using a unique dataset on Portuguese interbank trading, Cocco et al (2009) implicitly test for price discipline. They show that relationships between banks are an important determinant of banks' ability to access interbank market liquidity. While their analysis explicitly controlled for endogeneity of bank relationships, the authors find that: banks with a larger reserve imbalance are more likely to borrow funds from banks with whom they have a relationship, and to pay a lower interest rate than otherwise; smaller banks and banks with more NPLs tend to have limited access to international markets, and rely more on relationships; and relationships are established between banks with less correlated liquidity shocks. These results suggest that relationships allow banks to insure against liquidity risk in the presence of market frictions such as transaction and information costs.

Most of the literature on interbank market discipline has been based on quantity measures of market discipline. Further, the studies that have attempted to measure the effectiveness (see Nier and Baumann, 2006; Dinger and Von Hagen, 2009; and Liedorp et al, 2010) of the market discipline have mainly used quantity-based measures of interbank market discipline. Nier and Baumann (2006), using data for 729 banks in 32 countries over the period 1993–2000, examined the efficiency of interbank market discipline. Measuring interbank market discipline based on interbank volumes,

they tested the extent to which market discipline affects the risk-taking behaviour of banks.²¹ In particular, they analyse the effect of market discipline on the capital buffers. They find strong evidence that market discipline is effective in limiting the risk-taking behaviour of banks. However, they also find that the moral hazard created by assurances of a government bailout reduces the efficiency of the market discipline. This corroborates the argument that increased government intervention in the market tends to lower the efficiency of the market discipline (Rochet and Tirole, 1996) or that the presence of safety nets erodes market discipline (Billett et al, 1998; Demirgüç-Kunt and Huizinga, 2004).

Dinger and Von Hagen (2009) examined quantity-based measures of interbank market discipline covering 296 banks in 10 Eastern and Central European countries over the period 1995–2004. Their specific aim was to test the hypothesis that interbank borrowing relates negatively to the risk levels of banks, or that the peer-monitoring hypothesis is evident. They explore the interbank transaction impact, when exposures are long term and borrowers are restricted to small banks so as to avoid the “too-big-to-fail” concern. They find that long-term interbank exposures are positively related to a lower risk of the borrowing bank, thus confirming the presence of a peer-monitoring mechanism among the banks. However, while focusing on the Dutch interbank market for the period 1998–2008, Liedorp et al (2010) find somehow different results. They test whether banks behave according to the peer-monitoring or contagion hypothesis and find evidence in support of contagion effects; borrowings and lending in the interbank market increase a bank’s risk. Moreover, they find the existence of a spill-over effect from banks from whom a bank borrows. This result was consistent with earlier findings by Upper and Worms (2004) that confirmed the presence of a contagion effect in the German interbank market, especially in the absence of a safety net.

In the aftermath of the global financial crisis, understanding the operations of the interbank market, especially its disciplining role, is important for identifying risks and the impact of interbank contagion. In developing countries, two facts are evident: interbank markets are predominantly uncollateralized and the central bank regulators are not well-equipped to effectively supervise. As such, interbank exposures imply the possibility of direct contagion where the insolvency of a single institution may trigger multiple bank failures (Murinde et al, 2015). 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, primarily, the relationships

among the participating banks. These relationships are what define the market disciplining mechanism in place.

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 an outright failure of other banks, it does have the potential to substantially weaken 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 the 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 the understanding and predicting of interbank market crises. The results corroborate the prediction that prudential regulation by individual banks is insufficient to prevent systemic crises. Hence, this justifies the need for a well-developed market disciplining mechanism.

Other studies have 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. In their analyses, the risk of contagion depends on the precise pattern of interbank linkages. They use balance sheet information to estimate a matrix of bilateral credit relationships for the German banking system and to 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.

In general, interbank market discipline mechanisms continue to gain widespread interest in view of banking problems and bank bailouts that characterized the global financial crisis. Although official government regulation and supervision is necessary, it is patently not sufficient for dealing with systemic risk, of which complexity is increasing as banks adopt more sophisticated technology. Hence, market discipline as a complement to official regulation is important, especially as many African countries (Kenya and Malawi included) seek to transition from Basel I to Basel II. Basel II requirements are consistent with arguments that more external risk management disclosure is a key condition that would enhance market discipline as a regulatory mechanism. In this regard, further examination of the operations of the interbank market, especially its disciplining role, remains important and topical.

Literature on the interbank market in developing countries remains scant. There are a few studies that examine the interbank market, partly analysing its disciplining role and effectiveness. Oduor et al (2014) assess the role that interbank networks play

in the efficiency of the interbank market to support monetary policy. Using a data set spanning the period June 2003–September 2012, they show that the Kenyan interbank market is inefficient in supporting monetary policy.²² Through a network analysis, they examine interbank exposures in lending and borrowing across different bank categories based on volumes and interest rates. They find that interest rates charged across different sizes of banks are statistically different; suggesting the presence of market segmentation. They conclude the market is inefficient due to the inability of the banks to redistribute liquidity following events that skewed its distribution. The inefficiency was attributed to a lack of open credit lines across different bank categories that spiked volatilities in government deposits at the central bank.

Murinde et al (2015) examine the peer-monitoring role of the interbank market in Kenya over the period 2003.1–2011.1. They specifically investigate whether there is a peer-monitoring mechanism in the interbank market that complements bank regulation. To eliminate biases that could arise from endogeneity between interbank borrowing and bank risk, the study ran a Hausman-Taylor panel regression model.²³ The study finds evidence for the presence of peer-monitoring in the interbank market as it finds an inverse relationship between interbank activity (interbank volume-based measure of interbank market discipline) and bank risk levels, after controlling for differences in bank characteristics, and developments in the macroeconomy and time. Based on the results, they argue that regulators can use dynamic interbank borrowing activities among large and small banks as market signals to identify banks that are perceived as risky in the market. However, the study also finds that if a bank continues to increase its net interbank position (ratio of interbank assets to total assets), it can reduce risk only to a certain degree, beyond which any further rise in interbank position starts to increase risk.

Evidence for Kenya indicates the presence of both peer-monitoring and contagion effects depending on how a bank chooses its net interbank assets relative to its total assets (Murinde et al, 2015). There is limited evidence so far on how exactly peer-monitoring effectively supports prudential regulation via adjustments in bank ratios, apart from the information that the mechanism supplies to the regulators. How the mechanisms affect critical bank ratios – such as capital ratios – has not been explored. Evidence for Malawi is non-existent on interbank market discipline, let alone a discussion of its efficiency. This study attempts to fill this gap in the literature.

4. Econometric procedure

Status of interbank market discipline

The study first establishes the status of the interbank market discipline before analysing its effectiveness. We follow a standard approach used in literature, which involves determining how borrowings on the interbank market react to the information about bank characteristics, including bank risk (see, for example, Andrievskaya and Semenova, 2013). A simple econometric model, modified to include macroeconomic variables, is considered and specified as follows:

$$MD1_{it} = \beta_i + \alpha BF_{i,t-1} + \rho I_{i,t-1} + \omega MACRO_t + \varepsilon_{i,t} \quad (1)$$

where the dependent variable $MD1_{it}$ is a quantity-based measure of market discipline. The subscripts i and t represent bank i at time t . We assume lenders restrict or extend access to credit on the basis of borrower risk. The quantity-based measure of market discipline as used in the literature is the rate of growth of interbank borrowing, captured using the natural logarithm of interbank borrowing volume (Andrievskaya and Semenova, 2013). The explanatory variables in model (1), $BF_{i,t-1}$ and $I_{i,t-1}$ capture bank fundamentals that characterize bank risk-taking and are an indicator of the bank's involvement in the interbank market, respectively.

Based on an approach adopted by Andrievskaya and Semenova (2013), we capture bank fundamentals based on liquidity, earnings (indicator of bank performance), capital adequacy, quality of assets (whether performing or non-performing), quality of bank management and, as suggested by Oduor et al (2014), a measure of bank size. In terms of their actual measurement, the adequacy of capital is measured by the ratio of regulatory capital to risk-weighted assets of bank i (calculated based on the respective CBK and RBM guidelines), the capital adequacy ratio (CAR); the quality of bank assets is represented by the ratio of bank excess reserves to total assets (Res_assets ratio); and the ratio of NPLs to total loans (asset_quality). The inclusion of excess reserves is important because it also reflects the role of central bank operations in the interbank market.²⁴ The quality of bank management is proxied by the ratio of overhead costs to total bank revenues (mngt_quality); earnings or bank performance in terms of

profitability is captured by return on assets (ROA) for each bank i . Liquidity conditions in each bank are represented by the liquidity ratio (Liq_ratio).²⁵ All these measures are based on the respective Kenyan and Malawian central bank guidelines and definitions. The measure for the bank's involvement in the interbank market (Involve) is estimated by the ratio of the value of each bank's interbank borrowing to total liabilities.

The variable MACRO represents a vector of macroeconomic fundamentals, which serve as control variables. The variables as adopted from literature include: overall consumer price index to capture general pricing conditions in the economy, real gross domestic product (GDP) per capita to capture general economic development, and growth rate of real GDP per capita to measure cyclical effects on bank risks (as assumed by Murinde et al, 2015). The parameters β_i , α , and ρ represent the constant, a vector of coefficients for respective variables capturing bank fundamentals, and a coefficient for banks' participation in the interbank market, respectively. The term $\varepsilon_{i,t}$ represents the random disturbance terms for bank i in period t .

The status of quantity-based market discipline is described by the extent to which either or all the variables representing bank risk characteristics significantly influence interbank borrowed volumes. We follow a similar approach to describe the price-based measure of market discipline; modifying Equation 1 by replacing the natural logarithm of interbank market volume with average interbank borrowing rate, as in Equation 2:

$$MD2_{it} = \phi_i + \gamma BF_{i,t-1} + \lambda I_{i,t-1} + \tau MACRO_t + v_{i,t} \quad (2)$$

where the dependent variable $MD2_{it}$ is an indicator of the price-based measure of market discipline; the average cost of borrowing from the interbank market. We assume that lenders in the interbank market raise or lower prices depending on borrower risk. This is consistent with the hypothesis that high risk banks are charged higher rates when they borrow in the interbank market than low risk banks (Furfine, 2001). As such, when banks face higher borrowing rates as they seek to access liquidity in the interbank market, they would be compelled or incentivized to build capital buffers, which is therefore an effective disciplining mechanism. Enhanced capital buffers improve banks' risk profiles and thus facilitate enhanced access to funds through a reduced price. The rest of the explanatory variables remain as defined before. Similarly, the existence of the price-based market discipline is confirmed if either or all the variables representing bank risk characteristics significantly influence the interbank borrowing price.

Effectiveness of price- and quantity-based measures of market discipline

The objective here is to examine whether market discipline is connected with incentives to restrict a bank's risk of default. Andrievskaya and Semenova (2013) argue that the risk of default depends on the underlying asset risk and leverage which, in turn,

depends on a bank's capital buffer. Therefore, we test the hypothesis that an effective market disciplining mechanism (either quantity- or price-based) incentivizes banks to build their capital buffers, essentially improving their capital adequacy ratios. This implies that banks would be incentivized to choose a lower probability of default. In particular, we examine the effect of market discipline on the level of a bank's capital (measured by the CAR). As such, the econometric model as specified by Andrievskaya and Semenova (2013), but modified to include macroeconomic variables, is given as:

$$CAR_{it} = \alpha_i + \theta CAR_{it-i} + \varphi X_{it-i} + \sigma Z_{it-i} + \varepsilon_{it} \quad (3)$$

Where CAR_{it} is an indicator of a bank's capital strength, measured by the capital adequacy ratio.

A lagged dependent variable is included to capture all other variables not included in the specification and so isolates the effect of market discipline indicators.²⁶ The explanatory variable X_{it-i} captures the quantity-based measure of discipline, the logarithm of interbank borrowed volumes, and Z_{it-i} is a measure of the price-based measure of discipline, the average interbank borrowing rate for bank i at time $t-i$ (i lags included because it takes time for CAR to adjust). Because of potential endogeneity between interbank activity measures (volumes and prices) and a bank's CAR, the variables X and Z are included in Equation 3 as predicted values from Equations 1 and 2. In this case, the generalized method of moments-based panel instrumental variable technique (Arellano and Bond, 1991) is considered for analysis.

5. Data and estimation results

This section describes the data used for the study, the estimation results for the status and effectiveness of the quantity- and price-based measures of market disciplining mechanisms, and on the basis of the discussion of the results, draws some conclusions and policy implications.

Data

This study uses bank level panel data for Kenya and Malawi: per quarter, spanning the period 2009Q1 to 2015Q4.²⁷ The dataset covers the following variables: total interbank borrowing volume, average interbank rate, total regulatory capital, risk-weighted assets asset quality measure, bank excess reserves, total assets, earnings in terms of ROA, liquidity ratio, overhead expenses, assets with short-term maturity, liabilities with short-term maturity, real GDP per capita and real GDP per capita growth, as well as total bank liabilities. All the data, except ratios, are measured in US Dollars to facilitate cross-country comparison.²⁸ Bank-level financial indicator data were collected from various quarterly published financial reports of individual banks, and macroeconomic data were collected from the respective central banks and national statistics agencies. The number of banks considered for analysis was 42 for Kenya and 12 for Malawi, targeting those that participate in the interbank market.²⁹

The banks have different ownership structures. For example, of the 42 banks in Kenya, there are 22 local private, 13 foreign (of which six are listed on the securities exchange), and seven local public (listed) banks. For the Malawian banks, there are four local private banks, three foreign (with one listed), and five local public banks that were in operation during the study period. Table A3 in the Appendix provides descriptive statistics for all the variables of interest for banks in Kenya and Malawi. The sample data indicate that while the quarterly interbank borrowing rate in Kenya averaged 8.0%, spread between 28.7% and 1.0%, the average quarterly borrowing rate in Malawi over the same period stood at 14.4%, spread between 39.9% and 2.6%. Similarly, banks borrowed an average of US\$52.1 million in each quarter in Kenya, which varied from as low as US\$0.03 million to a maximum of US\$4,093.9 million. Interbank borrowing in each quarter and per bank in Malawi averaged US\$4.2 million, spread between US\$0.59 million and US\$13.9 million. Based on the respective positioning of the measures of median values, the data indicate that in

both countries interbank borrowing rates are skewed to the right while the interbank volumes are skewed to the left. This is consistent with the hypothesis that the markets are somewhat segmented.

The capital adequacy ratios as measured by the ratio of core capital to risk-weighted assets are largely the same, but the average dispersion is higher in Malawi than in Kenya. This is an indication of greater variability of banks in Malawi than in Kenya. Comparing interbank market tradable funds (excess reserves ratio of total assets), Kenyan banks hold on average about 7% of their assets, while their Malawian counterparts hold about 13%. Despite holding relatively higher excess reserves ratios, the liquidity ratios in Malawi (at an average of about 22%) are much lower than the average liquidity ratio in Kenya (46%). Comparing quality of assets, as measured by the ratio of NPLs to total loans, indicates that while the NPL ratio of total loans averaged 11% in Kenya over the study period, the ratio stood at 15% in Malawi – an indication of a relatively elevated credit risk profile in Malawi. This is corroborated by the measure of asset quality's relatively higher variability for Malawian banks compared with that for their counterparts in Kenya.

Commercial banks' total overhead costs averaged about 34% of total revenues in Kenya, which is slightly higher than that of banks in Malawi that stood at 29%. This measure indicates the quality of management of banks based on how efficiently resources are used in the running of banks. This measure proxies the likelihood of a bank running into liquidity problems as most of the overhead costs considered are not transitory; they are mostly personnel expenses. In this regard, banks in Malawi are more likely to use the interbank market as a source of funds to meet overhead costs than their counterparts in Kenya. This is consistent with the lower liquidity ratios in Malawi compared with the average liquidity ratio in Kenya.

Bank size, which is hypothesized to influence interbank activity, is measured using the logarithm of total bank assets. The average value of bank assets in Kenya stood at US\$330.4 million over the study period, spread between US\$5.5 million and US\$4,582.5 million. Conversely, Malawi bank assets were much lower and averaged US\$69.0 million, spread between US\$0.9 million and US\$772.8 million. In terms of bank performance, Kenyan banks' return on assets averaged 2.7%, compared with an average return on assets of 7.0% earned by their counterparts in Malawi. This may be explained by a relatively less competitive structure in Malawi, supported by fewer players. Bank involvement, reflecting how a bank is exposed to the interbank market, and measured by the ratio of total interbank borrowing to other bank liabilities, averaged 0.50 in Kenya and was spread between 0.00 and 13.31, while their Malawian counterparts' involvement recorded a mean of 0.59 with dispersion within a narrower range of between 0.00 and 5.76.

In terms of the macroeconomic environment, inflation in Kenya remained lower and less volatile compared with that of Malawi. While the per capita quarterly real GDP for Kenya averaged US\$245.6, fluctuating within a range of US\$221.4 and US\$270.4, that of Malawi was about half of Kenya's: averaging US\$119.8 and spread in a narrower range of between US\$109.9 and US\$121.5. The inclusion of per capita real GDP in the analysis of the interbank market isolates the effects of other economic activities

on the interbank market. The growth rate of per capita real GDP is also included to capture cyclical effects of economic activities on the interbank market. Per capita real GDP growth for Kenya averaged -0.5%, with a maximum of 15.5% and a minimum of -13.5% over the period. The Malawi experience is different as per capita GDP growth averaged 1.6% over the same period, even though it was spread between -1.2% and 3.7% (see Table A3 in the Appendix).

Estimation results

The first objective of this study was to examine the market disciplining role based on the quantities borrowed as well as borrowing rates. We estimated Equations 1 and 2 to, respectively, measure the quantity-based as well as price-based market discipline, as described in the previous chapter. The second objective was to examine the feedback effects of the disciplining mechanism (quantities and prices) on capital buffers of banks.

Interbank activity can impact a bank's portfolio allocation, especially by influencing how a bank makes decisions about its risk-weighted assets. As such there would be potential endogeneity between interbank activity and a bank's capital adequacy ratios (Furfine, 2001; and Andrievskaya and Semenova, 2013). Following this, Equations 1, 2 and 3 are estimated using a panel instrumental variable technique that minimizes any form of simultaneity and endogeneity biases. Before the instrumental variable approach was employed, the Breusch-Pagan and Hausman tests results were used to guide the choice of appropriate models for the data. Fixed-effects models (for both quantity-based as well as price-based measures of market discipline) were found to be appropriate for data that combine Malawian and Kenyan data sets. We therefore proceeded to estimate joint fixed-effects models and incorporating time effects, guided by the measures of R-squared for the within fixed-effects and between fixed-effects models).³⁰ The inclusion of time effects in our models partly accounts for the seasonality that may be present in monetary variables. We therefore introduced a dummy variable, represented by 1 for Kenya and 0 for Malawi, to derive the country-specific coefficients from the joint regression analysis.

Quantity-based disciplining mechanism

Estimation results of interbank market borrowing volumes and prices activity in Kenya and Malawi are presented in Table 1. The results were obtained based on a panel two-stage least squares estimation procedure where country-specific effects were generated by incorporating interactive terms between the variables outlined in Equations 1 and 2, with a dummy variable specified as 1 for Kenya and 0 for Malawi. The models control for time-fixed effects. Once country fixed effects were identified, specific country coefficients were derived. The robustness of the results was confirmed based on a Hausman asymptotic chi-square-based test, and the Sargan Lagrange multiplier-based identification test that, respectively, ascertain the consistency of estimates generated and the validity of instruments used.

From the results, it is evident that the factors driving interbank market activities in Kenya and Malawi have differentiated effects. The second column of Table 1 shows that when interbank borrowing rates are higher, banks borrow more in Malawi, which is against expectations for a well-behaved demand curve in a competitive market. The uniqueness of this result can be associated with the earlier discussed market peculiarities with regard to borrowing patterns in Malawi. Banks in Malawi that participate in the interbank borrowing and lending markets are predominantly the large ones (mostly highly capitalized and with large asset bases). As noted before, the interbank rate largely moves in the same direction as interbank volume. This result is corroborated by the positive and significant coefficient on the capital adequacy ratio (CAR) as well as bank size measure (size) for Malawi within the same period.

The interbank borrowing rate does not seem to significantly influence interbank borrowing volume in Kenya. Unlike in Malawi, banks with high levels of CAR in Kenya borrow lower volumes than their counterparts with lower CAR, as the former participate more in the lending side of the market than on the borrowing side. However, the influence of CAR on interbank borrowing seems to take time in Kenya (first lag is significant in Kenya). Excess reserves as a ratio of total assets (RES_Assets_ratio) in both countries are negatively related to borrowing volumes. This is consistent with expectations as borrowing is necessitated when reserves (including excess) are reduced. However, the adjustment in total reserves as a proportion of total assets in Kenya seems to significantly influence interbank borrowing with a lag.

One of the risk factors considered for analysis is the ratio of NPLs to total loans (Asset_Quality). We find a significant influence of this measure on interbank borrowing, but only in Malawi. We associate this with what was noted in the descriptive statistics on the relatively higher volatility of this measure in Malawi compared with Kenya. The results show that deterioration in the quality of assets (increase in the ratio) is treated by lenders as a risk factor and thus leads to a restriction in the bank's interbank borrowing. This happens with a one-period lag as information on quality of assets held by borrowers takes time to reach potential lenders in the interbank market. We also consider the measure of a bank's involvement in the interbank market (Involve), captured by the ratio of interbank borrowing to other total bank liabilities. Findings show that an increase in the involvement of a bank in interbank borrowing increases its profile for more borrowing. It might be that evidence of a bank having borrowed within the same period is clear proof of its creditworthiness. Bank size, which was earlier hypothesized as a risk measure, was also tested. From the results, large banks (by assets) access more liquidity in the interbank market than their smaller counterparts. The effect is in fact stronger (based on size of coefficient) in Malawi than in Kenya.

The effect of macroeconomic factors was also analysed. Rising inflation, as measured by the logarithm of the consumer price index (CPI), was found to significantly increase volumes demanded from the interbank market within the same period. However, this is only true for Kenya as the effect of inflation on interbank borrowing in Malawi is negative and significant after one lag. The varied effects could be associated with the income or substitution effects that inflation can trigger. It implies that as inflation rises in Kenya, interbank borrowers feel that the benefits that

accrue to them are more than the costs associated with the repayment of the same loan in the future. The reverse would be the case for their Malawian counterparts as borrowers are predominantly large banks. The income effect due to inflation seems to be quite strong for lenders, to such an extent that it would cause a restriction in lending. Growth in real GDP per capita, which reflects an increased demand for liquidity, seems to influence activity positively only in Malawi, not in Kenya.

As hypothesized earlier, bank ownership structure is argued to be one of the most important variables that characterize the Kenya and Malawi interbank markets. It can define lending and borrowing policy and liquidity management frameworks, as well as risk management. We tested its effects on interbank borrowing in the two countries by introducing ownership variables in four categories: *Foreign_public*, *Foreign_private*, *local_public* and *local_private*, depicted as dummy variables.³¹ We exclude *local_public* banks from analyses to avoid exact multicollinearity, making it the reference category for interpretation. From the study findings, it is evident that foreign banks (both public and private) borrow on average less than local public banks. However, local private banks borrow more on average than local public banks. This is only the case in Malawi. In Kenya, the influence of bank ownership seems to be significant only with respect to local private banks, where this category borrows on average less than their local public counterparts. Local private banks in Kenya are considered more risky because they are run by corporate entities not subjected to public scrutiny, which would be present when a bank is listed on the stock market (public). In this case, there is more information concealed regarding the operations of local private banks when compared with public banks. A look at the descriptive statistics indicates that one-third of the banks in Malawi are local private banks (four out of 12) while there are only seven out of 42 public banks in Kenya. This explains the fact that despite being privately run (with minimal disclosure of information), these banks can still use their influence in the market to access more credit than their local public counterparts (of which there are five).

The interbank borrowing model estimated accounts for over 46% variation in interbank borrowing in the two countries. The specification is robust, as confirmed by a significant Hausman test that rejects the consistency of a simple ordinary least squares regression (at a 10% level of significance) and accepts that the instruments used in the regression were valid (non-rejection of Sargan identification test statistic).

Price-based disciplining mechanism

The interbank rate model in Equation 2, with results presented in columns 4–6 of Table 1, was also analysed to establish the status of the price-based disciplining mechanism in the two countries. In particular, we examined the effect on interbank borrowing rates of bank fundamentals that include bank risk characteristics such as CAR, asset quality, bank size and ownership structure, while controlling for macroeconomic factors such as inflation and real GDP per capita growth. As discussed under the interbank borrowed volumes model, interbank volumes relate positively to the interbank borrowing rate, on average, for Malawian banks. However, this peculiarity is

not evident in the Kenyan interbank market as interbank volumes relate significantly and negatively to price, as expected. It is also worth noting that in Kenya, there seems to be a unidirectional influence from interbank volume to interbank rate, and the reverse is not significant. This perhaps confirms our earlier hypothesis that the information content for the price is somewhat different from that of the volume.

From the risk measures, it is evident that banks with improved asset quality (lower asset quality ratio) face lower borrowing costs compared with their counterparts with poor quality of assets (higher ratios of NPLs to total loans). As with the interbank volumes model, we find this to be significant only in Malawi and not in Kenya. This is therefore a disciplining mechanism for banks as banks perceived to have assets depicting high credit risk are considered to have higher risk and are thus penalized with higher borrowing costs. In addition to this risk measure, bank size seems to play a significant role in determining borrowing rates both in Kenya and Malawi. Large size banks (by assets) enjoy lower costs compared with their smaller counterparts. However, there are differentiated effects in that bank size significantly affects borrowing costs in the immediate period in Malawi, but take one lag for Kenyan banks. This could reflect differences in information search costs and structure of reporting for banks in the two markets. Perhaps because of the small number of players in the Malawian interbank market, it costs less (time-wise) for banks to obtain information from their counterparts than for the Kenyan banks that have to assess a larger number of counterparts and/or have to depend on banking supervision reports generated by the CBK on a biannual basis. The role of CAR in the price model indicates that increased capital buffers reduce borrowing costs, albeit with differentiated effects (by magnitude, not direction of influence) between the two countries. Highly capitalized banks are perceived as less risky in both countries relative to their risk weighted assets, as they are able to reduce their probability of default.

Ownership structure seems to play a key role in both markets, although with heterogeneous effects. For example, while foreign public banks seem to enjoy relatively lower borrowing costs compared with local public banks in Malawi, foreign public banks in Kenya face higher borrowing costs when compared with their local public counterparts. The local public banks enjoy assured contingent support from the government in Kenya in the event that they should face liquidity problems due to their significant government shareholding. In Malawi, foreign public and private banks face less competition from local banks because of their adoption of highly developed liquidity management techniques and as such are perceived to be less risky when compared with their local public counterparts. This is only evident in Malawi and not in Kenya. Foreign private banks are relatively smaller than foreign public banks and therefore face stiff competition from the local public banks to the extent that they appear much riskier than the latter group. This explains the smaller coefficient for foreign private banks, even when both are negative. Local private banks are charged higher borrowing costs in both countries compared with their local public counterparts. This category of banks is deemed riskier due to the fact that they are relatively less covered by contingent government insurance in the event of liquidity challenges.

Table 1: Estimation results for interbank activity in Kenya and Malawi

Variable	Interbank borrowed volumes model		Interbank borrowing rate model	
	Malawi	Kenya	Variable	Coefficient [std error]
constant	5.0845 [5.6816]	5.0845 [5.6816]	constant	0.1166** [0.0542]
IB_bor_rate	2.3872* [1.4402]	--	ln_IB_bor_volume	0.0659*** [0.0232]
IB_bor_rate (-1)	--	-3.9249 [3.5820]		
CAR	4.0357*** [1.0644]	--		
CAR(-1)	--	-6.8423*** [1.4368]	CAR(-1)	-0.0738** [0.0437]
RES_Assets_ratio	-1.4971* [1.3011]	--		
RES_Assets_ratio(-1)	--	-1.5426* [2.8847]		
Asset_quality (-1)	-2.9833** [1.1844]	-0.2019 [0.2055]	Asset_quality	1.1233** [0.5664]

continued next page

Table 1 Continued

Variable	Interbank borrowed volumes model		Interbank borrowing rate model	
	Malawi	Kenya	Malawi	Kenya
	Coefficient [std error]		Coefficient [std error]	
Involve	1.6987*** [0.3522]	1.0112*** [0.3437]		
RGDP_percap_growth	13.1389*** [4.6581]	--	RGDP_percap_growth	0.9124* [0.5178]
RGDP_percap_growth (-1)	--	-1.9825 [2.6701]	RGDP_percap_growth(-1)	--
ROA	--	4.7609 [3.7739]		-0.6598 [0.4442]
ROA(-1)	-4.3839 [3.2973]	--		
ln_CPI	--	2.0178*** [0.5266]	ln_CPI	0.2107** [0.0196]
ln_CPI(-1)	-2.1508*** [0.7853]	--	Bank size	-0.0168*** [0.0123]
Bank size	1.9113*** [0.3558]	0.1609** [0.0804]	Bank size(-1)	--
Foreign_Public	-0.6604*** [0.2481]	-0.0969 [0.2102]	Foreign_Public	-0.0941** [0.0405]
				-0.0159** [0.0106]
				-0.0086** [0.0036]

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Table 1 Continued

Variable	Interbank borrowed volumes model		Interbank borrowing rate model	
	Malawi	Kenya	Malawi	Kenya
	Coefficient [std error]		Coefficient [std error]	
Foreign_Private	-0.5290*** [0.1424]	--	Foreign_Private -0.0026* [0.0016]	--
Local_private	3.1167*** [0.4759]	-0.4237*** [0.1581]	Local_private 0.0705* [0.0365]	0.0071* [0.0041]
Adj R-squared	0.4654		0.6820	
F stat (p-value)	6252.47 (0.0000)		19146.55 (0.0000)	
Hausman Test	23.86 (0.0926)		185.27 (0.0000)	
Sargan LM test (p-value)	18.09 (0.9983)		20.68 (0.1100)	

*** p<0.01, ** p<0.05, * p<0.1

Figures in brackets are standard errors.

Both model specifications include time effects, which are excluded due to space limitations.

Effectiveness of the disciplining mechanisms

The second stage of the instrumental variable technique adopted for analysis involves the analyses of the feedback effects of the disciplining mechanism on capital buffers of banks. In particular, we estimate a CAR model with predicted interbank borrowing volumes (in logarithms) and the interbank borrowing rate as independent variables.³² We assume CAR requirements take on an autoregressive process because in both countries there are prudential minimum requirements for this variable that banks have to observe over time. In this case, banks' adjustments of CAR take into consideration its past levels. In addition, introducing a lagged dependent variable to the estimation helps avoid including an extended list of independent variables that influence CAR, which have already been incorporated in the first-stage regressions.

Estimation results of Equation 3 are presented in Table 2. We run joint regressions of the CAR model, but introduce country dummy variables to derive country-specific coefficients. We incorporate the predicted values of interbank volumes and the interbank rate generated from the first-stage panel instrumental variable regressions of Equations 1 and 2. All the robustness checks, particularly the Hausman test and the Sargan instrument validity test, indicate that the choice of the instrumental variable technique was well justified.

Table 2: Results of estimation of feedback effects of interbank activity (volume and interest rate) on capital buffers

	Malawi CAR Coefficient	Kenya CAR [std error]
Constant	-0.0100 [0.0074]	-0.0100 [0.0074]
CAR (-1)	0.8420*** [0.0207]	0.6721*** [0.0273]
Log [interbank borrowed volumes (-1)] {Predicted}	-0.0041 [0.0031]	-0.0117** [0.0028]
Interbank borrowing rate (-2) {Predicted}	0.0489** [0.0197]	0.0443** [0.0178]
Adj R-squared	0.9617	
F stat.	948.50	(0.0000)
Hausman test (chi-sq asymptotic test)	610.08	(0.0000)
Sargan identification LM test	133.48	(0.0000)

*** p<0.01, ** p<0.05, * p<0.1

Figures in brackets are standard errors.

From the results in column 2, i.e., the Malawi CAR model, the autoregressive term seems to indicate a strong effect on the CAR compared to the case in Kenya, where inertia plays a less significant role in terms of magnitude of influence. In terms of examining the effectiveness of disciplining mechanisms, we expect that an effective

mechanism should be characterized by a situation where a bank rationed of liquidity and/or charged a higher rate when it seeks to borrow from the interbank market should be incentivized to build its capital buffers. Enhanced capital buffers, as empirically confirmed in the interbank borrowing rate model results (Table 1), reduce borrowing costs. Build-up in capital buffers or an upward adjustment of the CAR reflects either a build-up in core/regulatory capital and/or a reduction in risk-weighted assets – predominantly loans extended to the private sector.

Despite having the expected sign, the coefficient of the predicted interbank volume variable for Malawi is not significant. This indicates an ineffective quantity-based disciplining mechanism. However, the coefficient for the interbank borrowing rate is significant and carries the expected sign. It implies that when banks face higher costs of borrowing in the interbank market, they are effectively incentivized to increase their CAR. This happens after a 2-period lag, which is consistent with the fact that adjustments in capital buffers take time. The ineffective quantity-based disciplining mechanism for banks in Malawi can be associated with the fact that in this market, banks that participate actively in the borrowing side are large and borrow relatively larger volumes compared to the smaller banks. In this case, there is no incentive for banks to increase their CAR when they fail to get the required amounts. It appears that the concept of “too-big-to-fail” in Malawi is heavily entrenched, to the extent that it overshadows the influence of risk on banks’ access to liquidity.

For Kenya, it is quite evident from the significant coefficients of predicted interbank borrowed volumes and rates that both quantity- and price-based disciplining mechanisms are effective. The coefficients also possess the expected negative and positive signs, respectively. It appears that as large banks focus more on participating in the lending side of the market and small banks participate in the borrowing side, as is the case in Kenya, it is possible to see an effective disciplining mechanism because small banks do not have the “muscle” to adopt excessive risk-taking.

Discussion of results

The results indicate that interbank borrowing volumes in Malawi are positively and significantly determined by: banks’ CAR, real GDP per capita growth, involvement of a bank in the interbank market, and bank size. Highly capitalized banks are deemed less risky and thus can access interbank funds in Malawi, while their counterparts in Kenya seem to participate more in the lending side of the market. Real GDP growth suggests mixed effects on interbank borrowing in the two countries: positive and significant in Malawi, but negative and insignificant in Kenya. It implies that expansion in economic activity (in per capita terms) in Malawi enhances the creditworthiness of borrowers in the interbank market, but only to access more volumes of funds. The role of a bank’s involvement in the interbank market implies that banks’ increased share of their liabilities due to their interbank market activities does not portray a bank as highly risky, hence does not limit its chances of obtaining

funds from the interbank market, assuming all other factors remain the same. This is the case in both countries.

Bank size, measured by the logarithm of bank assets, relates positively to banks' borrowing volume in the interbank market. This can be interpreted from the point of view that an expansion in bank size implies a reduction in the riskiness of a bank, thus facilitating a bank's access to loans in the interbank market. While this is the case in both Kenya and Malawi, the notion of bank size is a critical factor in Kenya's interbank market, consistent with arguments by Oduor et al (2014).

However, there are a few variables that negatively and significantly influence interbank borrowing, such as banks' excess reserves position (as a ratio of total assets), quality of assets (ratio of NPLs to total loans), and inflation. From this perspective, banks holding excess reserves borrow less from the interbank market. While this is expected, it spells out the importance of ensuring effective liquidity management by banks to reduce their need to borrow from the interbank market. In addition, banks with poor quality assets are regarded as highly risky and thus their liquidity is rationed in the interbank market. This effect is significant only in Malawi, not in Kenya despite its coefficient depicting the expected sign. Rising inflation that reflects rising price risk would also increase demand for liquidity to meet growing expenditures. This is the case in Kenya. In Malawi, it appears that with increasing inflation, banks would be denied liquidity. While this effect is evident in the immediate period in Kenya, it takes one lag in Malawi.

When we control for bank ownership and local public banks as reference category, we find that foreign banks that are listed on local stock markets (*foreign_public*) and foreign private banks, borrow relatively lower amounts than local public banks. This is because most foreign banks' lending and borrowing policies are determined offshore and their liquidity management techniques are relatively more advanced than their local counterparts. At the same time, because there are relatively more, local private banks borrow relatively more than local public banks in Malawi, but relatively less in Kenya. They can borrow relatively less than public banks in Kenya. The study finds that the role of foreign banks in Kenya is not significant in influencing interbank borrowed volumes. In Malawi, local private banks suffer more liquidity shocks than their public counterparts as the latter include some government-owned banks. Local public banks have more cautious liquidity management frameworks and therefore would relatively use the interbank market less as a source of funds. Local private banks in Kenya borrow relatively less than local public banks. This is more of a credit rationing exercise for private banks rather than being a demand issue. These banks suffer higher risk because they are most often family businesses and thus public scrutiny of their operations is limited. As such, they are perceived to be riskier than the listed (public) banks.

Considering the price-based measure of market discipline, we find that the interbank borrowing rate in Malawi increases as the quality of bank assets worsen, and also when the size of the borrowing bank is small. Poor quality of assets indicates increasing credit risk, which means higher borrowing costs for the bank engaging in the interbank

market as a source of funds. Smaller banks are also perceived as riskier than their larger counterparts. In addition, highly capitalized banks in Malawi (who also possess high CAR) seem to borrow at relatively lower rates than their less capitalized counterparts. The participation, and in fact domination, of large banks who in most cases are highly capitalized on the borrowing side of the interbank market in Malawi explains this trend. These banks take advantage of their size to borrow at lower rates and lend at higher rates within the same period. They effectively take advantage of existing arbitrage opportunities, supported by their relatively stronger market power over the rest of the participants. For Kenya, the interbank borrowing rate increases significantly with bank size (albeit with one lag) and with a decline in volumes traded. Asset quality does not seem to influence interbank borrowing costs as banks that hold huge volumes of NPLs happen to be the large banks. It therefore appears that their size overshadows any form of credit risk characteristics that they may possess.

In this regard, we can define the price-based disciplining mechanism on the basis of bank size and asset quality for Malawi and on the basis of bank size alone in Kenya.

In analysing the feedback effects from interbank borrowing volumes and rates on capital buffers of banks, we use a dynamic panel instrumental variable model. Results indicate that while quantity- and price-based disciplining mechanisms are effective in Kenya, only the price-based measure is effective in Malawi. The results also show that, apart from the effects of inertia, an increase in the predicted estimate for the interbank borrowing rate (measure of price-based disciplining mechanism) leads to an increase in the CAR of banks. That is, banks effectively adjust their CAR following periods of higher interbank borrowing costs. This effect is significant after two periods. For Malawi, where large, mostly highly capitalized banks (with high CAR) participate in interbank borrowing, there seems to be more concern about the interest rate than about the volumes traded. This is perhaps because of the large banks' interest in taking advantage of arbitrage opportunities, as discussed before, which tends to overshadow considerations of volumes traded. As such, the price in Malawi becomes an effective disciplining mechanism. The ineffective quantity-based disciplining mechanism for banks in Malawi can be associated with the fact that in this market banks that participate actively in the borrowing side are large ones that borrow relatively larger volumes compared to smaller banks. In this case, there is no incentive for banks to build their CAR when they fail to get the required amounts.

In Kenya, it is quite evident from the significant coefficients of predicted interbank borrowed volumes and rates that both quantity- and price-based disciplining mechanisms are effective. The coefficients also possess the expected negative and positive signs, respectively. The effectiveness of the two disciplining mechanisms is supported by the fact that, unlike in Malawi where large banks participate in the borrowing side, large banks in Kenya participate more in the lending side of the market, and small banks participate in the borrowing side. In these circumstances, and from the demand side, a disciplining mechanism would be effective from both the perspective of quantity and price, as borrowers (predominantly small banks) seem not to have the "muscle" to adopt excessive risk-taking.

6. Conclusions and policy implications

The first objective of this study was to examine the market disciplining role based on quantities borrowed as well as borrowing rates. The characteristics of the quantity- and price-based market disciplines in Kenya and Malawi were studied. The second objective of the study was to examine the feedback effects from interbank borrowed volumes and interest rates charged to adjustments in the CAR of banks, i.e., to investigate the effectiveness of the disciplining mechanisms in influencing incentives for banks to reduce their probability of default.

Due to potential endogeneity between interbank activity and capital buffers, we considered a panel instrumental variable technique, in particular the two-stage least squares approach that seeks to minimize endogeneity biases. The first-stage regressions establish the determinants of interbank volumes and rates. These determinants include risk factors that then define the disciplining mechanism. The second objective was analysed involving a second-stage regression that incorporated the predicted estimates of interbank volumes and rates as independent variables, respectively reflecting the quantity- and price-based measures of market discipline.

From the estimations, results indicate the heterogeneous effects of identified factors on interbank markets in Kenya and Malawi. The interbank borrowed volumes in Malawi increase due to increases in CAR, banks' involvement in the interbank market, growth in real GDP per capita and bank size, but decline as excess reserves increase, asset quality deteriorates, and inflation rises. Foreign banks, whether private or public, seem to borrow less than their local public counterparts due to their relatively more effective liquidity management frameworks. Local private banks borrow more than their public counterparts due to the perceived risk associated with their lack of public scrutiny, as they are not listed on the stock market. In Kenya, interbank borrowing increases with inflation, interbank involvement of banks, and bank size, but declines with an increase in excess reserves position, and CAR (although after one lag). Local private banks in Kenya borrow relatively less than the local public banks because they are perceived to be riskier. The notion that public banks (which include those with government shareholding) would not be allowed to face extreme liquidity problems helps to improve their risk profile.

From the analyses of interbank rate models, this study finds the interbank rate in Malawi significantly driven by real GDP per capita growth, bank size and CAR. Growth in real GDP per capita implies higher earnings, including interbank market earnings.

Large banks as measured by total assets are perceived as less risky and thus pay lower rates when they borrow from the interbank market. Banks with high CAR pay less for interbank funds due to their perceived better risk profile compared to banks with low CAR. In terms of ownership structures, it appears that foreign banks pay less than their local counterparts, due perhaps to perceptions that the former's management structures, including liquidity management frameworks, are more developed. Local private banks pay more than their local public counterparts due to the perceived risk associated with being out of the purview of public scrutiny.

For the interbank borrowing rate model in Kenya, there are fewer significant determinants. One of them is bank size. Increase in bank size reduces interbank borrowing costs. As discussed earlier, this is attributed to the low risk associated with large banks. Bank ownership also matters. We find that of the four categories of banks, only local private banks significantly pay more than their local public counterparts. We find a similar result for local private banks in Malawi.

In terms of effectiveness of market disciplining mechanisms in incentivizing banks to build up their CARs, the results indicate that it is only the price-based market disciplining mechanism that is effective in Malawi. This implies that the factors which determine the interbank borrowing rate in Malawi become very critical in enhancing the role of price in increasing banks' CAR. This confirms support for prudential regulation that recommends the adequate capitalization of banks. This would effectively improve banks' CAR, their risk profile and, consequently, eventually reduce borrowing costs. The lack of an effective quantity-based disciplining mechanism could be associated with the behaviour of large banks that participate predominantly in the borrowing side of the market. These banks are perceived to be "too-big-to-fail" and thus can manipulate the market while taking advantage of any arising arbitrage opportunities. Policy makers in Malawi could therefore consider reviewing the structure of the market to enhance competition for funds and possibly offer an opportunity for effective disciplining mechanisms. This follows an understanding that banks desperately in need of funds to meet genuine liquidity needs would react more significantly to a disciplining measure (as is the case in Kenya) than those who engage in borrowing to take advantage of arbitrage opportunities.

In Kenya, the study finds both quantity- and price-based disciplining mechanisms to be effective. It implies that denial of or restricting access to funds, and/or access to funds at relatively higher rates than market rates, effectively incentivizes banks to increase their CARs. Comparing the Kenyan and Malawian interbank markets, the former market displays more competitive features. For example, there are 42 participants in this market compared with 12 in Malawi. The Kenyan market is relatively more linked to other global markets compared to the Malawian market. This implies that obtaining access to market information is easier in Kenya than in Malawi. Because of these competitive features, changes in banks' risk profiles should lead to market responses that are costly for the banks. In addition, banks in Kenya do not enjoy the same certainty of assurance that the government would support them in the event of a failure, as is the case in Malawi. That means that excessive risk-taking

is minimized in Kenya and elevated in Malawi. This explains the differences in results between the two markets. In this regard, policy makers in Kenya could consider investing more in enhancing competition in the market.

While we identify the differences in the structures of the two interbank markets, we recognize the role of structural and institutional arrangements in the markets. In this regard, policy prescriptions must be tailored to suit specific market settings. From the study findings, we recommend that policy makers in Kenya may take advantage of the established market disciplining mechanism and possibly enhance it to complement prudential regulation. As was established, this may support the emergence of stronger banks characterized by adequate capitalization that improves their risk profiles with direct benefits for the cost of accessing funds in the interbank market.

For Malawi, the quantity-based market disciplining mechanism may not offer support to prudential regulation at present. There is therefore scope for research to identify the structural opportunities for enhancing market discipline, and especially the potential contribution of interbank borrowing volumes in increasing CAR. The apparent role of large banks in the borrowing side of the market could be reviewed to ensure that banks only use the market to resolve genuine liquidity problems. The study recommends a review of the rules of engagement in the interbank market targeted at reducing the influence of large banks in Malawi. This may enhance the role of risk in reducing access to funds by risky borrowers and in so doing, make quantity-based market discipline more effective. In addition, more enhanced liquidity management by banks could help reduce the incentives for large banks in Malawi to engage in arbitrage opportunities, as small banks would rely less on the interbank market as a source of funds. In both countries, policy makers could tighten rules for banks' liquidity management so that banks that deviate from the rules are heavily penalized with more restricted access to credit or higher rates, and would therefore be highly incentivized to build up capital buffers. Higher CARs reduce future borrowing costs by reducing the probability of default. In general, this would lend stronger support to the objectives of prudential regulation.

A notable limitation of this study that could be further explored in future research is establishing whether the adjustments in CAR that are triggered by the disciplining mechanism are driven by changes in regulatory capital or risk-weighted assets, or both.

Notes

1. The other channel for distributing liquidity is through central banks' open market operations via repurchase agreements (repo) that mop up funds from banks with surpluses, and reverse repos that inject funds to banks with deficits.
2. Liquidity shocks in the form of surpluses or shortfalls in a commercial bank's reserves arise from stochastic withdrawals and deposits by customers that create inter-temporal liquidity shocks in banks (Bruche and Suarez, 2010). The other channel for distributing liquidity is through the central bank's open market operations via repos that mop up funds from banks with surpluses and reverse repos that inject funds to banks with deficits.
3. This includes securitization, market size, trading framework, the operational target for monetary policy, maturity profile of trades as well as exposures to global markets.
4. However, unsecured trades in Malawi are more than 98% of total trades.
5. While there are 42 participants (all commercial banks) in Kenya's interbank market, there are 12 commercial banks, including one discount house, participating in the Malawian interbank market. However, the participation of the discount house is minimal.
6. Figure 3 demonstrates interbank exposures across different sizes of banks over a six-month period (June–December 2009).
7. The collapse of two small Kenyan banks in 2015 was attributed to, among other operational irregularities, liquidity and capital deficiencies that arose from poor liquidity management practices. Such practices rendered the banks too risky to borrow from the interbank market. The resultant failure to meet maturing financial obligations (including interbank obligations) triggered their placement in receivership, as CBK moved to safeguard the soundness of the financial system.
8. The CBK introduced averaging of reserves over 30 days in 2011 to minimize excessive volatility in the interbank interest rate and central bank intervention rates. This argument is consistent with literature (see, for example, Gray, 2011).
9. Gray (2011) argues that central bank intervention to inject or drain reserves can typically be carried out relatively smoothly over the maintenance period, as the interaction

of reserve averaging and commercial bank operations accommodate the shocks in payments flows. Hamilton (1996) also argues that while demand for reserves may vary systematically over the reserve maintenance period, these predictable variations in reserve demand should not necessarily create predictable patterns in the overnight rate; banks should be able to eliminate any predictable patterns through arbitrage during the maintenance period.

10. First Community Bank is an exception as it provides Islamic banking products that restrict trading.
11. In commercial banks' liquidity management practices, banks engage in developing relations with counterparts with whom they have unrelated risk exposure to ensure smooth settlement of payments should there be unanticipated upsurge in their cash requirements.
12. The main objective of the ILF was to ensure all transactions were fully settled and the credibility of the payments system was enhanced. Funds availed to banks through ILF are interest-free but are collateralized using Treasury bills or bonds.
13. This is based on the official classification of banks used by the Central Bank of Kenya, which groups banks on the basis of a composite market share index of gross assets, total deposits, total capital, number of deposit accounts, number of loan accounts and total income.
14. See Getenga et al, 2010.
15. Some of the reforms of particular relevance to this study are provided chronologically in Table A1 in the Appendix.
16. The main challenge that has constrained full uptake of the horizontal repo is a legal concern over the realization of collateral in the event that there is a default on the interbank loans, as the security does not shift from borrower to lender.
17. Some of the reforms that are particularly relevant to this study are provided chronologically in Table A1 in the Appendix.
18. In addition, the Reserve Bank of Malawi also participates in this market on a "lender-of-last-resort" basis.
19. This means that the clearing account of the lending bank is debited while the borrowing bank is credited with the amount agreed on bilaterally. Repayments are done reversing the entries on the clearing accounts, which includes the amount borrowed plus the interest that was agreed on. Interest is charged on an annual basis.
20. The paper outlines one of the determinants of interbank transactions interest rates as borrower credit risk. Credit risk is measured by several factors: profitability proxied by

return on assets, ratio of non-accruing loans to total loans, level of bank capitalization, ratio of total capital to risk-weighted capitalization, and ratio of interbank transaction size to borrower's capital. Control variables include characteristics of the borrowing bank, lending bank, total market liquidity, and existing paired relationship between lender and borrower.

21. They define efficiency specifically as "the degree to which market discipline is effective as an incentive scheme" (Nier and Baumann, 2006: 333).
22. Oduor et al (2014) define efficiency of the interbank market as a market with a high degree of depth, with varied instruments spanning different tenors, narrow bid-ask spreads, presence of symmetric information, open credit lines and proper coordination among participants with a clear structure of operations.
23. This approach, based on instrumentation, is argued to fit panel data random effects models in which some of the covariates are correlated with the unobserved individual level random effects (Hausman and Taylor, 1981).
24. Monetary policy impulses hit the interbank market through adjustments in bank reserves held at CBK, which are the tradable funds in the interbank market.
25. Liquidity ratio is calculated as the ratio of assets with short-term maturities (commonly up to 30 days) to liabilities with short-term maturities (up to 30 days). While respective central banks would define the applicable number of days, this measure generally proxies the risk of losing liquidity by a bank during the operational period.
26. We assume CAR is an autoregressive process because monetary authorities set out CAR limits that banks have to observe, which compels banks to monitor this variable overtime.

References

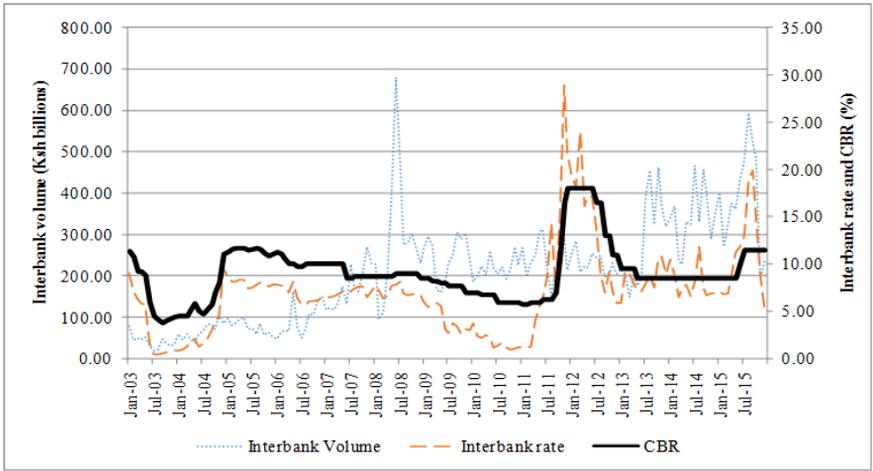
- Allen, F. and D. Gale. 2000. "Financial contagion". *Journal of Political Economy*, 108: 1–33.
- Andrievskaya, I. and M. Semenova. 2013. "Market Discipline and the Russian Interbank Market." Discussion Paper No. 29. Bank of Finland: Institute of Economics in Transition (BOFIT), Helsinki.
- Arellano, M. and S. Bond. 1991. "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations". *The Review of Economic Studies*, 58: 277–97.
- Ashcraft, A. 2008. "Does the market discipline banks? New evidence from regulatory capital mix". *Journal of Financial Intermediation*, 17(4): 543–61.
- Basel Committee on Banking Supervision (BCBS). 2006. *Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework*. Basel, Switzerland: Bank for International Settlements.
- Bhattacharya, S. and D. Gale. 1987. "Preference shocks, liquidity and central bank policy". In W.A. Barnett and K.J. Singleton, eds., *New Approaches to Monetary Economics*. Cambridge: Cambridge University Press.
- Billett, M.T., J.A. Garfinkel and E.S. O'Neal. 1998. "The cost of market versus regulatory discipline in banking". *Journal of Financial Economics*, 48(3): 333–58.
- Bruche, M. and J. Suarez. 2010. "Deposit insurance and money market freezes". *Journal of Monetary Economics*, 57(1): 45–61.
- Central Bank of Kenya. 2009. Daily interbank money market reports. (June 1- December 31).
- Central Bank of Kenya. 2017. "Interbank market data and central bank rate". Accessed via: <https://www.centralbank.go.ke/rates>
- Clouse, J.A. and J.P. Jr Dow. 2002. "A computational model of banks' optimal reserve management policy". *Journal of Economic Dynamics and Control*, 26(1): 1787–1814.
- Cocco, J.F., F.J. Gomes and N.C. Martin. 2009. "Lending relationships in the interbank market". *Journal of Financial Intermediation*, 18(1): 24–48.
- De Ceuster, M. and N. Masschelein. 2003. "Regulating banks through market discipline: A survey of the issues". *Journal of Economic Surveys*, 17(5): 749–66.
- Demirgüç-Kunt A. and H. Huizinga. 2004. "Market discipline and deposit insurance". *Journal of Monetary Economics*, 51(2): 375–99.
- Dinger V. and J. von Hagen. 2009. "Does interbank borrowing reduce bank risk?" *Journal of Money, Credit and Banking*, 41(2–3): 491–506.
- Distinguin, I., P. Rous and A. Tarazi. 2006. "Market discipline and the use of stock market data to predict bank financial distress". *Journal of Financial Services Research*, 30(2): 151–76.

- Duffie, D., N. Garleanu and L. Pedersen. 2005. "Over-the-counter markets". *Econometrica*, 73(6): 1815–47.
- Ellis, D.M. and M.J. Flannery. 1992. "Does the debt market assess large banks' risk? Time series evidence from money centre CDs". *Journal of Monetary Economics*, 30: 481–502.
- Flannery, M.J. 1998. "Using market information in prudential bank supervision: A review of the U.S. empirical evidence". *Journal of Money, Credit, and Banking*, 30(3): 273–305.
- Flannery, M. J. 2001. "The faces of 'Market Discipline' ". *Journal of Financial Services Research* 20: 107–119.
- Freixas, X. and C. Holthausen. 2005. "Interbank market integration under asymmetric information". *Review of Financial Studies*, 18(2): 459–90.
- Freixas, X., P. Bruno and R. Jean-Charles. 2000. "Systemic risk, interbank relations, and liquidity provision by the central bank". *Journal of Money, Credit, and Banking* 32(3): 611–38.
- Furfine, C. 1999. "The Microstructure of the Federal Funds Market." *Financial Markets, Institutions, and Instruments*, 8: 24–44.
- Furfine, C. 2001. "Banks as monitors of other banks: Evidence from the overnight federal funds market". *The Journal of Business*, 74(1): 33–57.
- Galac, T., L. Ivieia and M. Dumieia. 2007. "A simple model of interest rates in the Croatian money market". Paper Presented at the 13th Dubrovnik Economic Conference, Dubrovnik, 27–30 June.
- Getenga, J., P. Gatere, R. Cull, M. Fuchs, J. Randa and M. Trandafir. 2010. "Banking sector stability, efficiency and outreach in Kenya". In C. Adam, P. Collier and N. Ndung'u, eds., *Kenya: Policies for Prosperity*. Oxford: Oxford University Press.
- Goyal, V. 2005. "Market discipline of bank risk: Evidence from subordinated debt contracts". *Journal of Financial Intermediation*, 14(3): 318–50.
- Gray, S. 2011. "Central banks' balances and reserves requirements". IMF Working Paper No. 11/36. Washington, D.C.: International Monetary Fund.
- Hamilton, J.D. 1996. "The daily market for federal funds". *Journal of Political Economy*, 104(1): 26–56.
- Hannan, T. and G. Hanweck. 1988. "Bank insolvency risk and the market for large certificates of deposit". *Journal of Money, Credit and Banking*, 20(2): 203–11.
- Hartmann, P., M. Manna and A. Manzanares. 2001. "The microstructure of the Euro money market". *Journal of International Money and Finance*, 20(6): 895–948.
- Hausman, J.A. and W.E. Taylor. 1981. "A generalized specification test". *Economics Letters*, 8(3): 239–45.
- Ho, T. and A. Saunders. 1985. "A micro model of the federal funds market". *Journal of Finance* 40(3): 977–88.
- Jones, D.S. 2000. "Emerging problems with the Basel Capital Accord: Regulatory capital arbitrage and related issues". *Journal of Banking and Finance*, 24.
- Jordan, J.S. 2000. "Depositor discipline at failing banks". *New England Economic Review*, March/April: 15–28.
- King, T.B. 2008. "Discipline and liquidity in the interbank market". *Journal of Money, Credit and Banking*, 40(2–3): 295–317.
- Lane, T.D. 1993. "Market discipline". *International Monetary Fund Staff Paper*, 40(1): 53–88.

- Leitner, Y. 2005. "Financial networks: Contagion, commitment, and private sector bailouts". *Journal of Finance*, 60(6): 2925–53.
- Liedorp, F.R., L. Medema, M. Koetter, R.H. Koning and I.V. Lelyveld. 2010. "Peer monitoring or contagion? Interbank market exposure and bank risk." Working Paper No. 248. De Nederlandsche Bank, Amsterdam, April.
- Murinde, V. 2010. "Bank regulation in Africa: From Basel I to Basel II, and now at a crossroads". In: C. Bradford and W. Lim, eds., *Towards Consolidation of the G20: From Crisis Committee to Global Steering Committee*. Seoul and Washington, D.C.: Korea Development Institute and Brookings, Chapter 9: 141–68.
- Murinde, V., M.I. Ye Bai, K.N. Kisinguh, C.J. Green and K.S. Tiriongo. 2015. "The Peer Monitoring Role of the Interbank Market in Kenya and Implications for Bank Regulation". European Financial Management Association (EFMA) Conference Paper 0323. Accessed on: http://www.efmaefm.org/OEFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2015-Amsterdam/papers/EFMA2015_0323_fullpaper.pdf
- Nier, E. and U. Baumann. 2006. "Market discipline, disclosure and moral hazard in banking". *Journal of Financial Intermediation*, 15(3): 332–61.
- Nieto, M.J. 2012. What Role, if any, can Market Discipline Play in Supporting Macroprudential Policy? Banco de Espana Occasional Paper No. 1202, Banco de Espana, Madrid.
- Oduor, J., M.M. Sichei, S.K. Tiriongo and C. Shimba. 2014. "Segmentation and efficiency of the interbank market and their implication for the conduct of monetary policy". Working Paper No. 202. African Development Bank, Tunis, Tunisia, April.
- Reserve Bank of Malawi. 2016. "Reserve Bank of Malawi Monetary Statement", Accessed via: <https://www.rbm.mw/MonetaryPolicy/GetContentFile/?ContentID=7879>
- Reserve Bank of Malawi. 2017. Interbank market and bank rate data retrieved from various Financial Market Development Reports. Accessed via link: <https://www.rbm.mw/Statistics/FinancialMarketOperations>
- Rochet, J-C. and J. Tirole. 1996. "Interbank lending and systemic risk". *Journal of Money, Credit and Banking*, 28(4): 733–62.
- Stigum, M. and A. Crescenzi. 2007. *Stigum's Money Market*, 4th edition. New York: McGraw-Hill.
- Upper, C. and A. Worms. 2004. "Estimating bilateral exposures in the German interbank market: Is there a danger of contagion?" *European Economic Review*, 48(4): 827–49.
- Wells, S. 2004. "Financial interlinkages in the United Kingdom's interbank and the risk of contagion". Working Paper No. 230, Bank of England, London.

Appendix

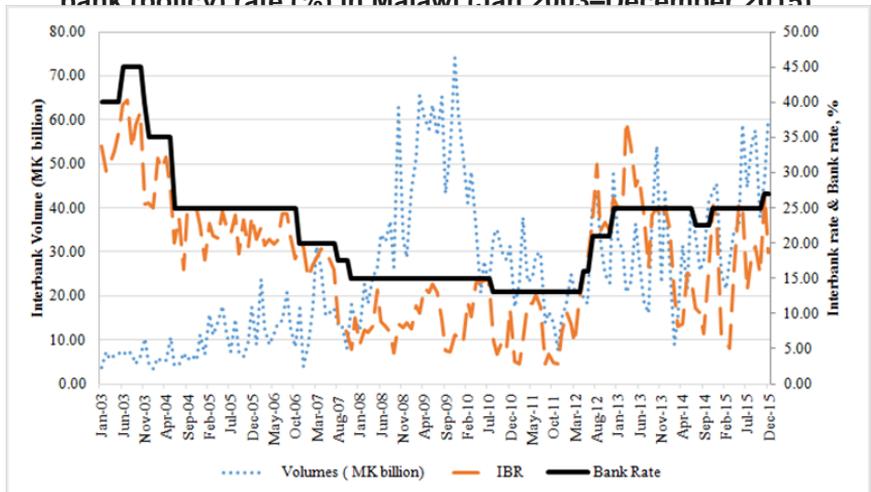
Figure A1: Interbank market volume (Kenya Shilling billions), interbank rate and central bank rate (CBR)* in Kenya (Jan 2003–December 2015)



Source: Central Bank of Kenya website (2017).

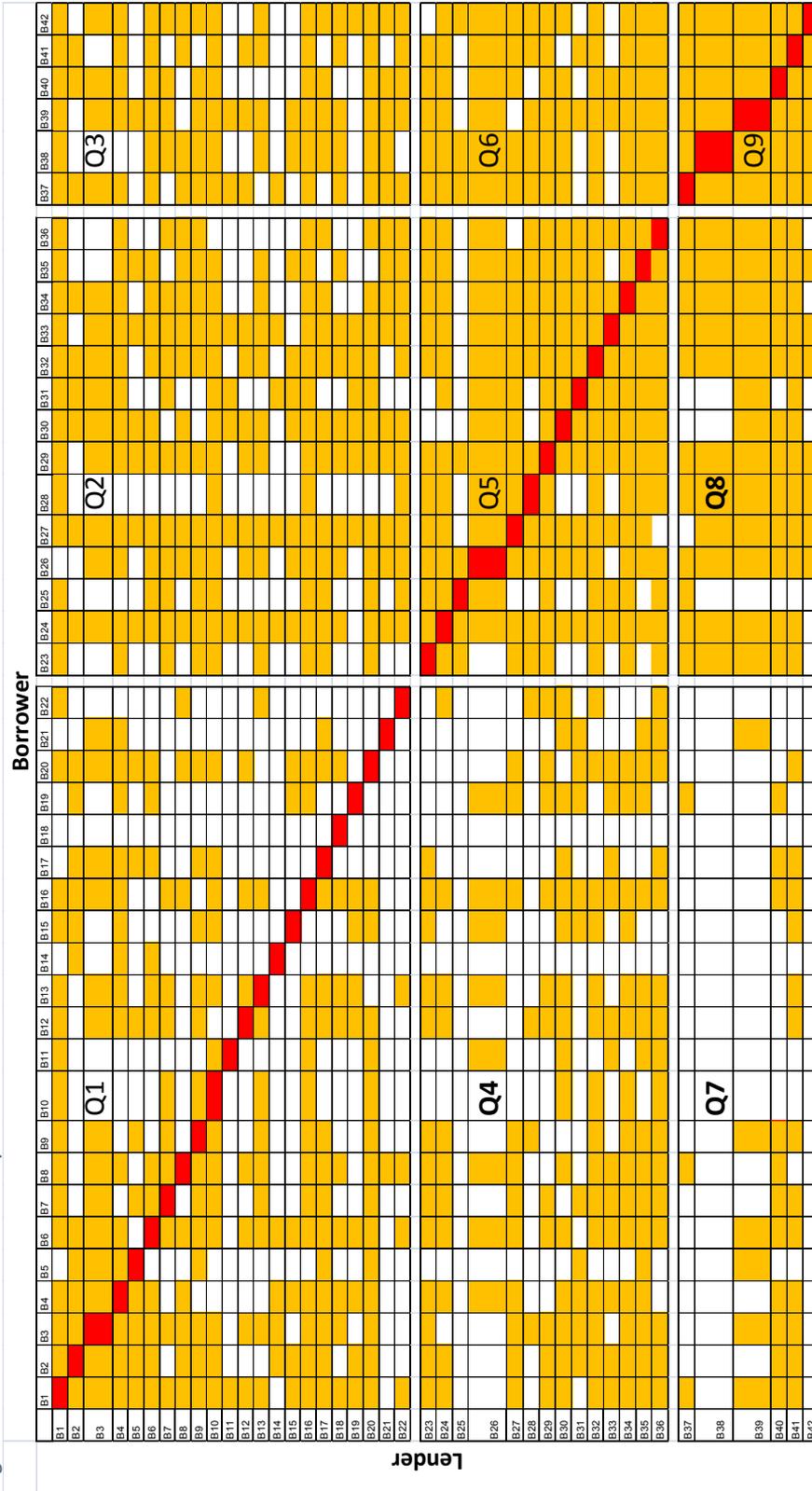
* Prior to June 2006, the policy rate was equal to the 91-day Treasury bill rate plus 3%.

Figure A2: Interbank market volume (Malawi Kwacha billions), interbank rate and bank (policy) rate (%) in Malawi (Jan 2003–December 2015)



Source: Reserve Bank of Malawi website (2017).

Figure A3: Matrix of interbank exposures (June–December 2009)



Source: Central Bank of Kenya (2009)

Notes: The shaded cells (yellow) in the matrix reflect the presence of a trading relationship between the lending bank (row) and the borrowing bank (column). Please note that the cells in the matrix should not be attributed to any specific bank.

Table A1: Events that affected interbank market in Kenya and Malawi

Year	Reform
Kenya	
Feb. 2009	The Banking (Credit Reference Bureau) Regulations of 2008 became effective. These regulations require all licensed banks to share information on NPLs through a credit reference bureau (CRB) licensed by the CBK. The role of a licensed CRB is to collect, collate and process data received from approved sources of information, and generate credit reports to be used by lenders. This was aimed at reducing the cost of credit in the market by minimizing information asymmetry.
1 Jan. 2011	Introduction of a definition of “significantly undercapitalized” and “undercapitalized bank” in the Banking Act, the Central Bank Act and the Microfinance Act, which would enable the central bank to determine whether an institution has a weak capital base, triggering prompt corrective action by the CBK. In line with this, the central bank was given powers to take swift action when an institution exhibits weakness in its capital base or regulatory obligations.
29 Jun. 2011	The CBK revised rules that guide the CBK’s window operations. In particular, the CBR was delinked from being the operational interest rate for the CBK discount window and the discount window rate was set at 8%. Also, it was announced that this rate would be reviewed from time to time and posted on the CBK website daily at 09.00am. In addition, stiff penalties were announced for banks using funds from the CBK window to trade in the interbank market.
11 Jul. 2011 (effective 12 July 2011)	The CBK further revised guidelines on the use of the CBK discount window by requiring that: banks lending in the interbank market are barred from accessing window funds on the same day; during the week (Monday–Friday), banks were restricted from borrowing from the window a maximum of their statutory cash reserves; the window rate was reviewed downwards to 6.25% from 8.00%; and banks were also required to consider liquidating their Treasury bills, bonds or foreign currency positions prior to resorting to the CBK window.
28 Jul. 2011	The CBK announced monetary policy committee (MPC) decisions that included: keeping the CBR at 6.25% and the introduction of weekly (five day) averaging of cash reserves instead of daily, and banks were allowed to deviate from the 4.75% provided the five-day average of 4.75% was met.
12 Aug. 2011 (effective 15 Aug. 2011)	The CBK issued further guidelines on the operations of the CBK discount window, including the following: any bank accessing funds from the CBK window were not allowed to lend in the interbank market either on the same day or the following day; computation of the window rate would be: window rate = CBR + (average interbank rate for the previous day - CBR) + 3% penalty; eligibility to access funds from the CBK window would be determined by, among other things, the individual bank’s foreign exchange trading behaviour over the previous four trading days; and reverse repos were suspended until the stance on monetary policy was changed.
26 Aug. 2011 (effective 29 Aug. 2011)	The CBK issued guidelines on liquidity management and CRR. The guidelines reviewed the formula for the window rate to reflect market conditions by introducing a weight for the gap between the average interbank rate and CBR, and expanded the period for the average interbank rate component. (Average period was not announced, but was 2 days). CBR was set as the minimum rate (floor) for all CBK lending to commercial banks Further, the new guidelines expanded the averaging of cash reserves from weekly to monthly but limited the deviation to a minimum of 3% failure, on which penalties would be effected.

continued next page

Table A1 Continued

Year	Reform
Kenya	
15 Sept. 2011	The MPC held a special meeting due to volatilities in the interbank market and the economy at large that impeded the effectiveness of monetary policy. The meeting adjusted the CBR upwards from 6.25% to 7.00% to rein in inflation and exchange rate instability.
27 Sept. 2011	The CBK announced direct support to corporate demand for foreign exchange by allowing direct purchase of foreign exchange from major corporate earners and direct sales to major importers in the oil sector. Direct sales were not affected.
6 Oct. 2011	The MPC decision to adjust the CBR upwards from 7.00% to 11.00% to tame inflationary pressure, stabilize the exchange rate and re-establish a strong growth base. The MPC also changed its meeting frequency from bi-monthly to monthly, on the first week of the month.
13 Oct. 2011	The CBK issued further guidelines on foreign exchange transactions by banks. The guidelines stipulated that the reverse carry transactions that had been introduced to the market, which were unrelated to economic activity, and which had not been utilized for domestic purposes, were limited to a minimum tenor of one year; foreign currency swaps involving Kenya Shilling was limited to a minimum tenor of seven days; and the foreign exchange exposure limits were reviewed downwards from 20% to 10% of core capital. Banks were given a week to implement this.
18 Oct. 2011	The CBK clarified the foreign exchange guidelines: foreign currency swaps and forward transactions involving Kenya Shilling for non-resident financial institutions will be limited to a minimum tenor of one year.
2 Nov. 2011	An MPC decision adjusted the CBR upwards from 11.00% to 16.50% to provide an enhanced monetary policy tightening stance, effective immediately. Further, the CRR was adjusted upwards from 4.75% to 5.25%, effective from 15 December 2011.
2 Dec. 2011	An MPC decision adjusted the CBR upwards from 16.50% to 18.00% to ease inflation and contain inflationary expectations that were building.
2 Feb. 2012	An MPC decision maintained the CBR at 18% to allow the full impact of a tight monetary policy stance to filter through the market and deliver lower inflation.
6 June 2012	An MPC decision to maintain the CBR at 18% to allow the full impact of a tight monetary policy stance to filter through the market and deliver lower inflation. The MPC also introduced multiple longer tenors on term auction deposits (TAD) of 14, 21 and 28 days as additional instruments for liquidity management. The price ceiling of the TAD was fixed equal to the prevailing CBR level. All other operational terms on TAD remained unchanged.
6 July 2012	An MPC decision to adjust the CBR downwards from 18.00% to 16.50% following the decline of inflation towards its short-term target of 9.00%. The MPC also announced a resumption of its bi-monthly meetings.
6 Sept. 2012	An MPC decision to further lower the CBR from 16.50% to 13.00% to provide a stronger signal for lower interest rates in the market.
8 Nov. 2012	An MPC decision to adjust the CBR downwards from 13.00% to 11.00% to provide a stronger signal for lower interest rates in the market.
11 Jan. 2013	An MPC decision to adjust the CBR downwards from 11.00% to 9.50% to realign market interest rates and enhance credit uptake for increased economic activity.

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Table A1 Continued

Year	Reform
Kenya	
8 May 2013	An MPC decision to adjust the CBR downwards from 9.5% to 8.5% to provide an additional signal that interest rates should continue declining to encourage the private sector to participate in growth-augmenting activities. In the same month, the CBK purchased net US\$191 million from the market to build its foreign exchange reserves following stability in the exchange rate market.
May 2014	CBK sold US\$165.5 million in line with the CBK's exchange rate policy of minimizing exchange rate volatilities. The CBK also announced the introduction of a Kenya Banks Reference Rate (KBRR), which was developed as an outcome of discussions held by the National Treasury, the CBK and commercial banks. This was part of the recommendations to enhance the supply of private sector credit and mortgage finance in Kenya by facilitating a transparent credit pricing framework.
May 2015	The maximum acceptable rate on the TAD, an instrument for monetary policy implementation, was raised to 250 basis points above the CBR. This was aimed at enhancing the effectiveness of the instrument.
June 2015	The MPC raised the CBR from 8.5% to 10.0% to anchor inflation expectations. A new CBK Governor was appointed.
July 2015	An MPC decision raised the CBR from 10.0% to 11.5% to provide a stronger signal that the CBK was enhancing its efforts to anchor inflation expectations. Furthermore, the KBRR was revised upwards from 8.54% to 9.87%. In order to enhance the instruments for effective liquidity management, the MPC introduced a 3-day repo.
Aug. 2015	An MPC decision to retain the CBR at 11.50% in order to anchor inflation expectations. During the same month, one bank (Dubai Bank Ltd) was placed under receivership.
Sept. 2015	An MPC decision to retain the CBR at 11.50% in order to anchor inflation expectations.
Oct. 2015	One small Bank (Imperial Bank Limited) was placed under receivership by the CBK.
Nov. 2015	The CBK placed a moratorium on the licensing of new commercial banks until further notice. This moratorium, however, did not apply to cases relating to resolution, amalgamation and acquisition of banks.
Dec. 2015	The CBK signed an agreement with two banks (Kenya Commercial Bank and Diamond Trust Bank) to provide depositors of the collapsed Imperial Bank access to their deposits (capped at KSh1 million).
MALAWI	
June 2001	The RBM set the minimum liquidity reserve requirement (LRR) at 30%, and each depository institution (commercial banks and discount houses) were supposed to maintain minimum cash balances in relation to the preceding month's total deposit liabilities (including government deposits). The LLR consisted of balances in the main account with the RBM, call deposit account balances with licensed discount houses, and vault cash. However, balances with discount houses to be considered as part of the LRR were not to exceed 25% of the LRR. The minimum LRR specified above was to be maintained as a simple one-week average (Monday–Sunday).

continued next page

Table A1 Continued

Year	Reform
Malawi	
Feb. 2006	The RBM set the minimum LRR at 25%, and each depository institution was to maintain minimum cash balances in relation to the preceding week's total local currency deposit liabilities, including government deposits. In the case of discount houses, the LRR was to apply to non-collateralized deposits from the corporate sector. Non-collateralized deposits with discount houses considered part of the LRR was not to exceed 10% of the LRR. The minimum LRR specified above was to be maintained as a simple one-week average (Monday–Sunday). Monitoring of compliance was to be effective from the first business day of the week.
Feb. 2008	The LRR ratio was set at 15.5% and had to be observed as a simple one-week average (Monday–Sunday).
June 2010	Each depository institution was supposed to maintain required reserves in relation to the preceding fortnight's total deposit liabilities, including government deposits, repurchase agreements, foreign currency deposits and any other liabilities, as stipulated by the RBM from time to time. LRR observance of foreign currency deposits was set at a minimum of US\$200,000 equivalent and the LRR ratio was set at 15.5%. The LRR was set to be observed as a simple two-week average (Monday of the first week to Sunday of the second week of the observance period).
January 2014	The RBM introduced a Lombard facility to its discount window. The Lombard rate was set at 2% above the monetary policy rate. In addition, the RBM revised the guidelines on the rediscount facility and introduced a foreign exchange swap facility to provide banks with alternative avenues (other than the Lombard facility) for managing their Malawi Kwacha liquidity. The LRR ratio was set twofold: at 15.5% to be observed fortnightly, and 12.0% to be observed daily.
November 2015	The RBM set the LRR at 7.5%. Each depository institution is supposed to maintain the required reserves in relation to the preceding fortnight's total deposit liabilities, including government deposits, repurchase agreements, foreign currency deposits and any other liabilities as the RBM may define from time to time. The LRR observance for foreign currency was set at a minimum of US\$200,000 equivalent in Malawi Kwacha. The 7.5% LRR is to be maintained as a minimum on a daily basis during a two-week period, which is from Monday of the first week to Sunday of the second week of the observance period.

Table A2: Definition and measurement of variables

Empirical variables		Measurement of variables	Observed counterparts
MD = an indicator of market discipline that exists in two types	MD1	Rate of growth of interbank borrowing (measured by the natural logarithm of interbank borrowed volume)	Interbank volume
	MD2	Average interbank rate	Interbank rate
BANK = a vector of control variables at the individual bank level	SIZE = bank size	The logarithm of total assets	Total assets
	CAR = capital adequacy ratio	Ratio of total regulatory capital to risk weighted assets of the bank	(a) Total regulatory capital (b) <i>Risk-weighted assets</i>
	Reserves_Assets_ratio	Ratio of bank reserves to total assets	(a) Bank reserves (b) <i>Total assets</i>
	Asset_Quality	Ratio of non-performing loans to total loans	(a) Non-performing loans (b) <i>Total loans</i>
	ASSETS_Growth = total bank assets	Growth rate of total bank assets	Total bank assets
	LQTY_Risk = liquidity risk	Measured by liquidity ratio; computed as ratio of assets of maturity x to liabilities of maturity x (x is usually 30 or fewer days)	(a) Total assets with maturity of x days (b) Total liabilities with maturity of x days
	MGT_Quality = management quality	Ratio of personnel expenses to total revenues	(a) Personnel expenses (b) Total revenues
	EARNINGS = return on assets (ROA)	Net income as a ratio of average total assets	ROA
MACRO = a vector of macroeconomic fundamentals which serve as control variables at the country level	LIQUIDITY= liquidity ratio	Ratio of assets of maturity x to liabilities of maturity x (x is usually 30 days)	(a) Assets of x maturity (b) Liabilities of x maturity
	GDPY = real GDP per capita	The ratio of real GDP to population	(a) Nominal GDPz (b) GDP deflator (c) Population
Indicator of bank's involvement in the interbank market	GROWTH = growth rate of real GDP per capita	Percentage change in real GDP per capita	(a) Nominal GDP (b) GDP deflator (c) Population
	Involvement	Ratio of bank's interbank borrowing to other total bank liabilities	(a) Interbank borrowing (b) Other bank liabilities

Table A3: Descriptive statistics, Kenya and Malawi

Variable (Label)	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Obs.
Kenya								
Average interbank borrowing rate (IB_BOR_RATE)	0.08	0.07	0.29	0.01	0.05	1.07	3.88	1,030
Interbank borrowed value (LN_IB_BOR_VALUE)	3.95	4.36	8.32	-3.62	2.28	-0.62	2.73	1,030
Interbank borrowing frequency (LN_IB_BOR_VOL)	3.84	4.08	6.97	0.69	1.50	-0.44	2.30	968
Capital adequacy ratio (CAR)	0.25	0.19	2.70	0.06	0.18	4.62	44.36	1,159
Reserve assets ratio (excess reserves/total assets) (RES_ASSETS_RATIO)	0.07	0.07	0.27	0.00	0.03	1.03	7.30	1,159
Liquidity ratio (short-term assets/short-term liabilities) (LIQ_RATIO)	0.46	0.42	1.49	0.05	0.17	1.44	6.06	1,159
Asset quality (NPLs/total loans) (ASSET_QUALITY)	0.11	0.06	1.92	0.00	0.17	5.35	41.50	1,157
Management quality (total overheads/total revenue) (MNGT_QUALITY)	0.34	0.24	9.07	-0.30	0.73	9.88	106.43	1,159
Bank size (log(total assets))(SIZE)	5.80	5.64	8.43	1.71	1.39	0.02	1.92	1,159
Return on assets (ROA)	0.03	0.03	0.18	-0.18	0.03	-0.74	8.38	1,175
Involvement (interbank borrowing ratio of other liabilities) (INVOLVE)	0.50	0.22	13.31	0.00	0.84	5.40	59.01	1,147
Log (consumer price index) (LN_CPI)	4.86	4.89	5.10	4.61	0.16	-0.23	1.67	1,176
log (real GDP per cap)								
(LN_RGDP_PERCAP)	5.50	5.50	5.60	5.40	0.06	-0.03	2.55	1,176
Real GDP per capita growth (RGDP_PERCAP_GR)	0.00	0.00	0.15	-0.14	0.07	0.36	3.43	1,176
Malawi								
Average interbank borrowing rate (IB_BOR_RATE)	0.14	0.13	0.40	0.03	0.08	0.51	2.40	300
Interbank borrowed value (LN_IB_BOR_VALUE)	3.15	3.34	6.05	-1.47	1.56	-0.62	3.14	301

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Table A3 Continued

Variable (Label)	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Obs.
Kenya								
Interbank borrowing frequency (LN_IB_BOR_VOL)	3.19	3.33	5.53	0.69	1.13	-0.32	2.41	286
Capital adequacy ratio (CAR)	0.25	0.11	2.05	0.03	0.42	2.89	10.33	108
Reserve assets ratio (excess reserves/total assets) (RES_ASSETS_RATIO)	0.13	0.07	1.91	0.01	0.24	4.39	24.72	229
Liquidity ratio (short-term assets/short-term liabilities) (LIQ_RATIO)	0.23	0.20	1.49	0.01	0.18	2.83	17.38	305
Asset quality (NPLs/total loans) (ASSET_QUALITY)	0.15	0.07	2.67	0.00	0.32	5.66	38.96	253
Management quality (total overheads/total revenue) (MNGT_QUALITY)	0.29	0.45	0.64	0.11	9.84	4.71	25.15	277
Bank size (log(total assets))(SIZE)	4.23	4.20	6.65	-0.15	1.43	-0.70	3.26	299
Return on assets (ROA)	0.07	0.06	0.26	0.00	0.05	0.91	4.00	277
Involvement (interbank borrowing ratio of other liabilities) (INVOLVE)	0.59	0.32	5.76	0.00	0.82	2.98	14.85	305
Log (consumer price index) (LN_CPI)	5.88	5.76	6.54	5.46	0.32	0.60	2.04	336
log(real GDP per capita)								
(LN_RGDP_PERCAP)	4.79	4.80	4.80	4.70	0.04	-2.04	5.17	336
Real GDP per capita growth (RGDP_PERCAP_GR)	0.02	0.02	0.04	-0.01	0.02	-0.59	2.03	336



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