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Does Bank-Lending Channel Exist in Kenya?: Bank-Level Panel Data Analysis

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Abstract

This paper empirically investigates bank-lending channel (BLC) of monetary policy transmission in Kenya using annual bank-level panel data during the period 2001-2008. The study segregates banks on the basis of asset size, capital adequacy, liquidity and foreign ownership. A key finding in the study is that BLC exists in Kenya based on bank capitalization. This result suggests that lending response of Kenyan banks depend on capitalisation- loans of banks with low total capital to risk-weighted assets ratio are hit most by monetary policy than for banks with high capital ratio. The existence of BLC based on capitalization means that monetary policy and prudential regulations (such as the Basel II Accord) should be coordinated.

Keywords: Bank lending channel, monetary policy transmission, simultaneous equations panel data.
JEL Classification Codes: C33, E51, E58, G21

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1. Introduction

This paper investigates whether bank lending channel (BLC) of monetary policy transmission exists in Kenya given the country's financial and capital market liberalisation and structure of bank portfolio. Mishkin (1995) argues that BLC is predicated on the view that banks play a unique role in the financial system because they are well suited to deal with certain types of borrowers, especially small firms, where the problems of asymmetric information is significant. Consequently, contractionary monetary policy that decreases bank reserves and deposits will have an impact on the real economy through its effect on lending to small borrowers.

Ideally BLC is strong in economies characterised by underdeveloped capital markets, limited access to financial markets and weak regulatory framework or lack of transparency in accounting standards. Thus BLC is likely to be strong in developing countries where these characteristics exist. However, several countries in Africa, including Kenya, have undertaken financial reforms since early 1990s aimed at developing and deepening financial markets and increasing the transparency of accounting and regulatory standards. As pointed out by Edwards and Mishkin (1995), such financial reforms and innovations, that have reduced the role of banks in the credit market, limit the potency of BLC.

Much of the literature to date on BLC has focused on the United States and Europe with relatively well-developed financial and capital markets (see e.g. Kashyap and Stein 2000; Kishan and Opiela 2000); Aschraft 2006; Gambarcorta and Mistrulli 2004).

The novelty of our research is three-fold. First, we attempt to provide baseline results on the existence of BLC in Kenya given the stage of financial and capital market development and structure of bank portfolio. Second, we attempt to uncover BLC through the use of a simultaneous equations panel data along the lines of Altunbas, Fazylov and Molyneux (2002) but use variables in levels. The bulk of most relevant literature has tried to uncover BLC through estimation of a reduced-form equation of bank credit, with variables in first differences.

Our main finding is that BLC exists in Kenya during the period 2001-2008 based on capitalisation. The rest of the paper is organised as follows. Section 2 presents the literature review. Section 3 presents the data and methodology while section 4 presents the empirical results. Section 6 presents the summary and concluding remarks.

2. Literature Review

There is a plethora of literature pertaining to BLC in developed countries. In the US, several empirical studies have been done. Kashyap and Stein (1995) find that following monetary contraction, measured by an increase in the federal funds rate, the quantity of loans held by small banks fall while that of large banks do not. Kashyap and Stein (2000) find that the impact of monetary policy, measured by an index based on readings of Federal Open Market Committee documents, on lending is stronger for banks with less liquid balance sheets. Kishan and Opiela (2000) find that loans of small undercapitalised banks are the most responsive to monetary policy, measured by changes in federal funds rate and changes in Bernanke and Mihov (1995) indicator[1]. Aschcraft (2006) used bank size, capitalisation and affiliation to multi-bank holding company and finds that stand-alone bank's lending is sensitive to changes in federal funds rate while affiliated banks is largely unaffected by monetary policy.

In Europe, a number of empirical studies on BLC have been done. Altunbas *et al.* (2002) found that BLC is prevalent for undercapitalised banks operating in small European Monetary Union countries. Gambarcorta and Mistrulli (2004) study Italian banks during the period 1992 to 2001 using short-term interest rates and found that well-capitalised banks can shield their lending from monetary policy shocks as they have easier access to non-deposit fund raising. Opiela (2007) identifies BLC using data on banking system in Poland during the period when deposit guarantees were differentially applied (1995 to 1999) and post-1999. He finds that banks with partial guarantees have a stronger loan response to monetary policy than banks with full deposit guarantee.

[1] This uses "semi-structural VAR" innovations to determine overall stance of monetary policy.

3. Data and Methodology

3.1. Data

The study uses commercial banks' annual audited balance sheet data for the period 2001-2008 collected from the published financial statements and disclosures reports as well as data from the Central Bank of Kenya (CBK). A total of 37 commercial banks which have been consistently in operation within the study period are covered. Peek and Rosengren (1995) methodology in which merged banks are treated as a single bank throughout the sample (i.e.as if the merger took place at the beginning of the sample). The implementation of this criterion left us with a sample of 37 banks out of 40 banks.

The total private sector credit covers both domestic and foreign currency-denominated loans and advances. Total private sector deposits (D) is computed as total domestic and foreign currency-denominated deposits less deposits from central government, local government, commercial banks, and non-bank financial institutions. Prudential measures (liquidity ratio and capital adequacy ratio are computed in line with the prudential guidelines issued by CBK in 2006 (Central Bank of Kenya, 2006). Specifically, liquidity ratio is computed by dividing net liquid assets by short term liabilities (net deposit liabilities plus other liabilities maturing within 91 days). Total capital ratio is computed as total capital (core capital plus supplementary capital) divided by total risk weighted assets.

Non-interest income is computed as shown in part A of table 2 (total of fees and commission income, foreign exchange trading and other non-interest income). The Herfindahl index is computed from the deposit market shares of the banks.

Average deposit rate is computed as a weighted average of the interest rates for local currency-denominated demand, time and savings and all foreign currency-denominated private deposits (translated to domestic equivalent rate using Uncovered Interest Parity (UIP) condition, $i_t^d = i_t^* + \Delta e$). The average lending rate is computed as the weighted average of all local currency-denominated private sector loans and foreign currency-denominated private loans (translated to domestic equivalent rate using UIP, $lr_t = lr_t^* + \Delta e$).

Other variables are collected from Economic Surveys published by the Kenya National Bureau of Statistics (KNBS), CBK bank supervision department reports, and CBK statistical bulletins.

3.2. Empirical Methodologies

3.2.1. Model

Our model draws heavily from Bernanke and Blinder (1988) and assumes that the economy comprises of non-banking sector, the banking sector and the central bank. The central bank implements monetary policy either by changing the cash ratio or controlling the repo rate through conducting open market operations. Banks react by changing the amount of reserves as well as other items on their balance sheet such as holding of government securities.

There are three assets in the model; money (deposits) held by the non-bank private sector with banks, bonds held by the private sector and intermediated loans.

In the money market, a conventional LM curve is assumed. Demand for money arises from the transactions, precautionary and speculative motives and depends on nominal interest rate, real income, and nominal exchange rate. In line with Bernanke and Blinder (1988), we ignore cash (currency outside banks[2]).

$$\ln\left(D/P\right)_{it}^{d} = \beta_{10} + \beta_{\underset{(-)}{11}}\, i_{it}^{tb} + \gamma_{\underset{(+)}{11}}\, i_{it}^{d} + \gamma_{\underset{(+)}{12}} \ln y_t + \gamma_{\underset{(-)}{13}} \ln e_t + \varepsilon_{1it} \quad (1)$$

Where D_t is the nominal deposits (local and foreign currency) held by the non-bank public at a typical bank, P_t is the price level, y_t is real GDP (a scale variable), i_t^{tb} is nominal interest rate on

[2] This is because it is difficult to attribute currency outside banks to a specific bank.

government securities to capture opportunity cost of holding money, i_{it}^{d} is nominal deposit rate to capture own return to money, and $\ln e_t$ is the nominal exchange rate in the spirit of Arango and Nadiri (1981).

The supply of deposits is equal to bank reserves[3], times the money multiplier (Bernanke and Blinder, 1988). The money multiplier is a function of opportunity cost of holding money (i_t^{tb}), the repo rate, and exchange rate ($\ln e_t$).

Equation 2 presents money supply in form of bank deposits;

$$\ln\left(D/P\right)_{it}^{s} = \beta_{20} + \underset{(+)}{\beta_{21}}\, i_t^{tb} + \underset{(+)}{\beta_{22}}\, lr_{it} + \underset{(+)}{\gamma_{21}} \ln\left(R/P\right)_{it} + \underset{(-)}{\gamma_{22}}\, r_t + \underset{(+)}{\gamma_{23}} \ln e_t + \varepsilon_{2it} \tag{2}$$

Where D_t is the nominal deposits (local and foreign currency) held by the non-bank public at a typical bank, P_t is the price level, R_t is the bank reserves (cash ratio requirement, clearing account balances and cash in till), i_t^{tb} is the nominal interest rate on government securities, r_t is nominal repo rate, which is the proxy for monetary policy, $\ln e_t$ is the nominal exchange rate.

There are a number of possible variables to use as a proxy of monetary policy. These include the Central Bank Rate (CBR) introduced in May 2006, Treasury bill rate, repo rate (withdrawing liquidity), and reverse repo rate (injecting liquidity). CBR would have been the most appropriate variable but there are limited observations available. Consequently, we follow Cheng (2006) in using the repo rate as a proxy of monetary policy stance.

In the credit market demand for real credit by the non-bank private sector is given as in equation 3.

$$\ln\left(C/P\right)_{it}^{d} = \beta_{30} + \underset{(-)}{\beta_{31}}\, lr_{it} + \underset{(+)}{\beta_{32}}\, i_t^{tb} + \underset{(+)}{\gamma_{31}} \ln y_{it} + + \underset{(+)}{\gamma_{32}} \ln NII_t + \underset{(-)}{\gamma_{33}} \ln HHI_t + \underset{(-)}{\gamma_{34}} \ln e_t + \varepsilon_{3it} \tag{3}$$

Where C_{it}^{d} is the credit demand (local currency and foreign currency), P_{it} is the consumer price index, i_t^{tb} is the nominal interest rate on government securities, lr_{it} is the lending rate (weighted average of local currency denominated and foreign currency denominated loans), y_t captures the transactions demand for credit, $\ln NII_t$ is the non interest income for banks to capture the effect of other services demand by customers, $\ln HHI_t$ is the Herfindahl index to capture the degree of competition and $\ln e_t$ is the nominal exchange rate.

Testing the hypothesis $\beta_{31} \neq 0$ captures the idea that borrowers cannot fully insulate their real spending from changes in the availability of bank credit.

The credit loan supply is given by equation 4;

$$\ln\left(C/P\right)_{it}^{s} = \beta_{40} + \underset{(+)}{\beta_{41}} \ln\left((1-\tau)\left[D/P\right]\right)_{it} + \underset{(+)}{\beta_{42}}\, lr_{it} + \underset{(-)}{\beta_{43}}\, i_t^{tb} + \underset{(-)}{\gamma_{41}} \ln HHI_t + \underset{(-)}{\gamma_{42}} \ln NII_{it} + \underset{(-)}{\gamma_{43}} \ln e_t + \varepsilon_{4it} \tag{4}$$

Where C_{it}^{s} is the credit demand, P_{it} is the consumer price index, $\ln\left(D/P\right)_{it}$ is the real deposits, τ is the cash reserve ratio requirement, lr_{it} is the lending rate, $\ln HHI$ is the Herfindal index to capture degree of competition, i_t^{tb} is the nominal interest rate on bonds, $\ln NII_{it}$ is the non-interest income for a bank to capture the possibility of substitution with lending, $\ln e_t$ is the nominal exchange rate. The specification of the loan supply equation with deposits as an explanatory variable closely follows Bernanke and Blinder (1988).

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[3] The bank reserves is equal to cash ratio requirement (τ) times the deposits plus cash in till, clearing account and excess reserves balances at the central bank.

3.2.2. Identification of BLC

Our identification strategy follows the work of Altunbas *et al.* (2002) in the use of simultaneous panel data model to take into consideration contemporaneous correlations between and among money market and credit market equations. Our innovation is in the use of variables in levels in the spirit of nonstationary panel data (Baltagi, 2008).

Equations 1, 2, 3 and 4 are used as stated but an interaction term is added in Equations 2 and 4 in the spirit of the models suggested by Kashyap and Stein (1995) to generate two new equations.

$$\ln\left(D/P\right)_{it}^{s} = \beta_{50} + \underset{(+)}{\beta_{51}}\, i_t^{tb} + \underset{(+)}{\beta_{51}} \ln\left(\tau D/P\right)_{it} + \underset{(-)}{\gamma_{51}}\, r_t + \underset{(+)}{\gamma_{52}} \ln e_t + \underset{(-)}{\gamma_{53}}\, z_{it} + \underset{(-)}{\gamma_{54}}\, r_t z_{it} + \varepsilon_{2it} \tag{5}$$

$$\ln\left(C/P\right)_{it}^{s} = \beta_{60} + \underset{(+)}{\beta_{61}} \ln\left(1-\tau D/P\right)_{it} + \underset{(-)}{\beta_{62}} \ln\left(1-\tau D/P\right)_{it} z_{it} + \underset{(+)}{\beta_{63}}\, lr_{it} + \underset{(-)}{\beta_{64}}\, lr_{it} z_{it} + \underset{(-)}{\beta_{65}}\, i_{it}^{tb} + \underset{(-)}{\gamma_{61}}\, z_{it} + \underset{(+)}{\gamma_{62}} \ln HHI_t + \underset{(-)}{\gamma_{63}} \ln NII_{it} + \underset{(-)}{\gamma_{64}} \ln e_t + \varepsilon_{6it} \tag{6}$$

It is, however, important to note that the addition of the interaction terms to the equations 3 and 5 change the definition and meaning of the coefficients (even if the interaction coefficients are not significant). The coefficients no longer measure main effects but rather conditional effects. For instance, the effect of the repo rate on the deposit supply equation (equation 6) becomes $\gamma_{52} + \gamma_{55} Z_{it}$ instead of γ_{52}. This requires z_{it} to be centred at mean zero or categorical in nature, which is done in our analysis. The computation of bank size, liquidity and capitalisation centres them at mean zero. Thus, the effect of the repo rate is equal to γ_{52} if $z_{it} = 0$ i.e. for average bank. The same applies for the credit supply coefficients.

We also test BLC by using a reduced-form credit equation of the form;

$$\Delta \ln\left(C/P\right)_t^S = \theta_0 + \sum_{i=1}^{k} \theta_{1i} \Delta \ln\left(\frac{C}{P}\right)_{t-i}^{S} + \underset{(-)}{\theta_2}\, r_{it} + \underset{(+)}{\theta_3}\, r_{it} z_{it} + \theta_4 i_{it}^{d} + \theta_5 y_{it} + \theta_6 \ln e_{it} + \theta_7 \ln HHI_{it} + \theta_8 \ln NII_{it} + \varepsilon_{81t} \tag{8}$$

The sources of bank's health and heterogeneity (z_{it}) is proxied by bank size (s_{it}), capitalisation (K_{it}), liquidity (L_{it}) and foreign ownership. Size is computed as difference from each time period average as follows;

$$s_{it} = A_{it} - \left(1/N\right)\sum_{i=1}^{N} A_{it} = A_{it} - \bar{A}_{\bullet t} \tag{9}$$

The capitalisation measure is computed as the deviation from period average of excess capital ratio.

$$K_{it} = \left(k_{it} - 0.12\right) - \left(1/N\right)\sum_{i=1}^{N}\left(k_{it} - 0.12\right) \tag{10}$$

Where k_{it} the total capital to risk-weighted assets ratio and 0.12 is is the statutory capital-to-risk-weighted assets ratio.

In the case of liquidity it is noted that liquidity requirements vary from bank to bank depending on cash flows. Over the period of analysis, banks were required to maintain a statutory minimum of 20% of its total liabilities in liquid assets. Considering this statutory minimum and the fact that banks generally hold excess liquid assets, the liquidity measure is computed as difference from each time period average of excess liquidity ratio;

$$L_{it} = \left(l_{it} - 0.2\right) - \left(1/N\right)\sum_{i=1}^{N}\left(l_{it} - 0.2\right) \tag{11}$$

Where l_{it} the actual liquidity ratio and 0.2 is is the statutory liquidity ratio.

This study focuses mainly on the deposits supply (equation 6) and credit supply (equation7), which are important in returning a verdict as to whether BLC exists or not.

3.2.3. Estimation Procedure

We apply simultaneous equations with error components methods which take into consideration cross-equation correlation in the spirit of the Zelner's seemingly unrelated regression (SUR) model as well as providing a platform to estimate "structural parameters" for the system of four equations (Equations 1,6,3 and 7). Specifically, the study uses the error components three stage least squares (EC3SLS) suggested by Baltagi (1981) and expounded in Baltagi (2008, 2009), which takes into consideration "within" and "between" banks error components as well as cross-equation contemporaneous correlation. The structural model is identified with respect to order and rank conditions. The system of equation is written in matrix form and estimated as shown in the appendix.

Most studies on BLC use lagged regressors for credit supply to capture lock in effects. We do not use dynamic panel in our system of equations due to the failure to achieve positive definite matrix of the scaled difference of the error covariance matrices of "within" two stage least squares (W2SLS) and "between" two stage least squares (B2SLS) estimators (Baltagi, 2008: 131). However, a dynamic panel date model in Equation 8 is used and generalised method of moments (GMM) suggested by Arrelano and Bover (1995) applied.

3.2.4. Classification of Sample Banks

In order to empirically distinguish BLC, it is necessary to distinguish constrained and unconstrained banks (Bernanke and Blinder 1992). We use bank size (assets), liquidity ratio, capital-asset ratio and bank ownership.

In terms of bank size, we categorize banks into three asset-size groups, consistent with results from BLC literature that smaller banks tend to be more constrained than large banks. The classification[4] used is as follows: small banks (asset size less than Ksh. 5 billion), medium (assets size between Kshs. 5 billion and Kshs. 15 billion), and Large (asset size greater than Ksh.15 billion).

In terms of liquidity, we use different ranges of the liquidity ratio (net liquid assets to total short term liabilities): less liquid (liquidity ratio than 38 percent), medium liquid (liquidity ratio between 38 percent and 54 percent) and highly liquid (liquidity ratio over 54 percent). The statutory liquidity ratio is 20 percent.

Since most banks have high capital-to-risk-weighted assets ratio, we use a different range of the total capital to risk-weighted assets ratio: less capitalisation (total capital ratio less than 19 percent), medium capitalisation (total capital ratio between 19 percent and 28 percent), and high capitalisation (total capital ratio greater than 28 percent).

A comparison of balance sheet and profit and loss account of bank peer groups based on size, liquidity, capitalisation and foreign ownership yield some noteworthy differences. Table 1 contains arithmetic means of selected balance sheet items for the groups outlined above. Although we cannot make definitive statements about BLC by simply looking at this table, the apparent differences across peer groups can aid in interpreting our regression results later. First, small banks have high liquidity and capital ratios compared to large banks. Small banks adopt this strategy with a view to cushioning themselves against unfavourable deposit and inter-bank money market in Kenya. Second, large, less liquid, less capitalised, and local banks have higher loan to asset ratio, which implies more risk. However, the higher risk position may be tempered by better diversification and implicit too-big-to fail policy.

Table 2 contains means of selected income and expenses by bank peer group. Bank income is generally dominated by loans and advances across all banking groups. However, there are differences across banks income and expenses characteristics. First, although large banks take on high risk in terms of loans-to-asset ratio, the income from loans and advances is less than for small banks. The large banks cover the differences through non-interest income. Second, domestic owned banks earn a higher proportion of income from loans and advances compared to foreign-owned banks (table 2). This is

[4] This is the classification used by the Supervision Department of the Central Bank of Kenya during the period of study.

attributed to the fact that domestic-owned banks invest a higher proportion of their portfolio in loans and advances compared to foreign-owned banks (table 1).

In terms of bank expenses, small, high liquid, high capital and domestic banks have a higher proportion of their costs in interest expenses. Small banks pay high deposit interest rate to customers (table 1) due to limited amounts insured by the Deposit Protection Fund and perception that they are less "stable and secure" compared to the large banks.

In terms of market size, about 84 percent of the deposits are held by the large banks. Domestic-owned banks spend more on interest on customer deposits cost compared to foreign-owned banks (table 2). This is attributed to the fact that domestic-owned banks are perceived as less "stable and secure" and must pay a premium for customers to place deposits with them.

3.2.5. Panel Unit Roots and Panel Cointegration Tests

Non-stationarity in panel data is a problem that can bias estimation results unless there is panel cointegrtion. Consequently panel unit root tests are performed on each series using Im, Pesaran and Shin (2003)[5] and Hadri (2000). IPS test allows for individual bank unit root process while the Hadri (2000) assumes that there is a common unit root process for all banks as well as a null of no unit root. Unit root test show that all the variables are non-stationary, with the exception of inflation rate, which is excluded from the analysis.

The motivation for panel cointegration test is to ensure that the system of equations is not spurious. The study uses residual-based tests suggested by Pedroni (2004) and Kao (1999). These tests extend Engle-Granger two step framework to panel data. Both tests reject the null of no cointegration implying that the system of equations form long-run equilibrium relationships[6].

Table 1: Selected Indicators of Bank Portfolio Management Strategy

Measure	Bank size			Bank liquidity			Bank capital			Bank ownership	
(mean values)	Small	Medium	Large	Low	Medium	High	Low	Medium	High	Local	Foreign
Deposit rate (%)	4.39	5.40	3.32	4.14	4.47	4.15	3.94	4.90	4.11	4.47	3.70
Lending rate (%)	14.95	13.33	12.76	15.09	13.12	13.84	12.96	14.40	14.79	14.72	12.02
Asset size (Kshs.billion)	3.26	7.59	47.10	24.00	20.79	6.26	37.64	6.09	3.48	12.42	29.76
Loans-Deposit ratio	1.24	0.69	0.86	1.07	0.79	1.23	0.83	0.83	1.38	1.19	0.56
Loans-total assets ratio (%)	61	53	63	74.8	57.5	48.2	62.1	62.8	55.9	66.80	42.10
Total capital-Risk weighted assets ratio (%)	35.15	21.81	17.89	20.53	22.32	40.06	17.27	23.55	41.54	26.85	26.37
Liquidity ratio (%)	53.01	48.88	39.89	32.64	44.37	68.20	40.22	43.71	60.61	44.88	57.65
Bank-level money multiplier	9.53	11.61	11.62	10.26	10.89	10.45	11.12	10.65	9.84	9.86	12.40

Notes: Computed from audited financial statements of banks.

[5] Thereafter, IPS tests. Panel unit root results are not included due to space limitations

[6] The panel cointegration tests are not presented due to space limitation

Table 2: Income and Expenses by Bank Category (%)

	Bank size (assets)			Bank liquidity			Bank capitalisation			Bank ownership	
Measure	**Small**	**Medium**	**Large**	**Less**	**Medium**	**High**	**Less**	**Medium**	**High**	**Domestic**	**Foreign**
A. Bank income sources											
Interest Income:	75.6	80.3	68.7	72.5	74.2	76.7	70.7	77.9	75.8	74.5	74.2
Loans and advances	56.1	55.7	47.7	59.5	54.8	46.3	50.6	60.1	51.7	58.6	39.9
Government securities	15.3	21.5	16.5	10.4	14.4	25.9	15.5	14.5	20.1	12.3	29.0
Deposits and placements	3.8	2.4	3.7	2.1	4.0	4.2	3.8	2.7	3.7	3.2	4.3
Other interest income	0.5	0.6	0.9	0.5	1.0	0.3	0.9	0.6	0.3	0.5	0.9
Non-interest income:	24.4	19.7	31.3	27.5	25.8	23.3	29.3	22.1	24.2	25.5	25.8
Fees and commissions income	12.1	10.6	19.5	17.6	14.6	9.7	17.6	12.7	11.1	14.0	14.1
Foreign exchange trading	5.2	5.0	7.7	4.3	7.5	5.9	7.6	4.5	5.3	5.1	8.3
Other non-interest income	7.0	4.1	4.1	5.6	3.7	7.7	4.0	5.0	7.8	6.4	3.5
Total income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
B. Bank expenses											
Interest expenses:	32.1	44.0	26.8	30.2	33.6	34.5	29.8	40.3	30.1	33.7	29.6
Customer deposits	29.6	41.4	23.9	27.4	31.0	31.9	26.9	39.1	26.6	31.1	26.8
Deposits and placements	1.1	2.5	2.4	1.8	2.4	1.1	2.4	1.1	1.5	1.5	2.5
Other interest expenses	1.3	0.2	0.6	0.9	0.3	1.5	0.5	0.1	1.9	1.1	0.3
Operating(non-interest):	67.9	56.0	73.2	69.8	66.4	65.5	70.2	59.7	69.9	66.3	70.5
Staff costs	25.9	21.5	29.2	25.8	25.8	26.5	27.6	24.0	25.9	24.3	31.2
Bad and doubtful debts	9.7	9.6	10.1	12.6	9.6	7.1	10.1	8.2	10.7	11.8	4.2
Occupancy costs	4.1	2.2	2.3	2.5	2.9	4.2	2.3	3.0	4.3	3.3	2.9
Depreciation	4.9	3.3	4.5	4.1	4.5	4.9	4.1	3.7	5.4	4.7	4.1
Other operating expenses	23.3	19.4	27.2	24.8	23.6	22.8	26.1	20.8	23.7	22.3	28.1
Total interest and non-interest	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

4. Empirical Results

The BLC conditions are tested sequentially. First, there must be investors who depend on bank loans for their investments. Second, CBK's monetary policy should be able to influence deposit mobilisation activities of banks. Third, bank loans should depend on deposits held by commercial banks. Finally,

there must be imperfect price adjustment that prevents any monetary policy shocks from being neutral. This condition is simply assumed.

4.1. Investors should be Bank-Dependent

The first condition requires that intermediated loans and capital market financing (e.g. commercial paper and corporate bonds) should not be perfect substitutes for some firms on the liability side of their balance sheets. Thus some firms must be unable to frictionlessly offset a decline in the supply of loans by other form of external finance.

Although it is difficult to prove this condition directly due to lack of firm-level panel data in Kenya, we rely on theoretical and empirical arguments rooted in corporate finance literature presented by Kashyap and Stein (1994) regarding existence of bank-dependent customers when capital markets are imperfect. These include ability to monitor certain types of borrowers in the face of asymmetric information and / or moral hazard (Fama, 1990) and lock-in-effects of banking relationships that make it costly to switch lenders (Sharpe, 1990).

Monetary policy has implications on the internal finance (Carpenter et al., 1995). Carpenter et al.(1995) find that tight monetary policy will reduce demand in interest-sensitive sectors of the economy. Further, the small contractions in demand can generate large proportionate changes in business income and cash flow, especially when a substantial proportion of firms' costs are fixed in the short run. These reductions in the flow of internal finance will lead to lower investment for financially constrained firms, propagating the monetary shock to more sectors of the economy and magnifying its impact on real activity. In Kenya most large firms have a “pecking order of financing choices” as suggested by Caprio and Demiguc-Kunt (1997), whereby they prefer using internal finance before they resort to external finance. According to a survey carried out in 2003/2004 on manufacturing firms in Kenya, retained earnings was ranked first followed by bank loans (World Bank *et al.*2004). Firms with credit rating can resort to financing their activities from the capital market using equity shares and corporate debt instruments (commercial paper and corporate bonds).

For the small and medium sized enterprises (SMEs) their choices are limited to internal finance, micro-finance institutions (MFIs) and banks. The MFIs, have successfully replicated the Grameen Bank model of microfinance in Bangladesh of delivering loans to the “marginal borrowers” by using group guarantees instead of formal collateral. However, they serve a limited number of people, charge very high interest rates and depend to a great extent on donor funding. Additionally, successful MFI institutions have graduated to and now offer formal commercial bank services and non-bank financial intermediaries, mortgage companies and building societies have merged with banks under the “universal banking” policy adopted in the late 1990s.

4.2. Effect of Monetary Policy on the Demand and Supply of Bank Deposits

Several issues can be noted from panel A of table 3 regarding the demand for bank deposits. Generally, the demand for bank deposits is fairly standard. First, as expected, the demand for deposits is downward sloping with respect to the Treasury bill rate (rate of return on holding alternative assets) for all the bank characteristics. Second, the demand for money has a positive relationship with real GDP in line with the transactions demand for money balances. Third, the nominal exchange rate has a positive effect on the demand for bank deposits (local and foreign currency). This is the residual effect of the exchange rate since the average deposit rate already contains its effects through the UIP relationship (Section 3.1).

However, the effect of the deposit rate on the demand for deposits is highly correlated with the one for the Treasury bill rate and therefore removed from the analysis. This is attributed to the fact that a substantial proportion of the deposits are in form of demand deposits, which earn minimal interest. Corporate entities prefer to keep their deposits in short-term form so that they can invest in government

securities. Other depositors use the deposit accounts for safe-keeping and do not expect to earn much interest from their bank accounts.

Panel B of table 3 is the most important for BLC. The supply of bank deposits positively depends on bank reserves and money multiplier, which in turn depends on the repo rate, lending rate, return on 182-Day Treasury bill rate, and exchange rate. First, the supply of bank deposits is upward sloping as expected across all bank characteristics. This means that as the return on government securities increase banks keep less excess reserves, which in turn increases the deposit supply through the rise in the bank-level money multiplier. The coefficient is fairly high, which implies a highly elastic deposit supply curve. This is consistent with an economy where the government financial operations are significant in influencing liquidity in the banking system.

Second, the "unconditional effect" of the monetary policy stimulus (repo rate) on the deposit supply is negative as expected. This implies that, for instance, tightening of monetary policy causes banks to keep high excess reserves, which in turn reduces bank deposit supply through the contraction of the bank-level money multiplier. The coefficient for the repo rate is high and correlated to the Treasury bill rate, which is attributed to the fact that before bidding in the Open Market Operations (OMO), commercial banks compare the returns on government securities with what is offered at the CBK through the repo window.

Third, the "conditional effect" of the repo rate on deposit supply is generally in line with predictions of BLC. In the case of bank size, the "conditional effect" of the repo rate on deposit supply is -12.482+0.353* s_{it} . This coefficient is more negative for small banks with $s_{it} < 0$, which implies that the deposit supply of small banks are more responsive to monetary policy stimuli as expected in BLC. In the case of bank liquidity, the "conditional effect" of the repo rate on deposit supply is -16.197-2.535* L_{it} . This coefficient is more negative for high-liquid ($L_{it} > 0$) than low- liquid ($L_{it} < 0$), which implies that the deposit supply of high-liquid banks are more responsive to monetary policy stimulus contrary to BLC. This makes sense in the Kenyan since high-liquid banks have high cost of funds as seen by the high interest expenses (table 2). The interaction terms for the "conditional effect" of repo rate on deposit supply are statistically insignificant for bank capital and foreign ownership and hence are not used to assess the existence of BLC.

4.3. Effect of Monetary Policy on the Demand and Supply of Bank Loans

Table 4 presents the results for the credit demand and supply. Panel A of table 4 shows that the credit demand is fairly standard. First, the credit demand curve is negatively related to the average lending rate as expected for all the bank characteristics. This means that high lending rates discourage demand for bank credit and vice versa. Second, credit demand is positively related to real GDP for all the bank characteristics. Third, the return on 182-Day Treasury bill rate is positively related to the credit demand as expected. This can be rationalised by the fact that high return on government securities implies costly bond finance for corporate entities, which stimulates the demand for bank credit and vice versa. Fourth, the non interest income (NII) is positively related to the demand for credit as expected. This is explained by the fact that a lending relationship is accompanied with other fee-earning non-lending services from banks. Fifth, there is a negative relationship between the Herfindahl index (HHI) and demand for bank credit in the case of bank size. This implies that in a less competitive environment, the demand for bank credit is less and vice versa. Finally, the nominal exchange rate is positively related to the demand for real bank credit.

Panel B of table 4 presents the bank credit supply results. The credit supply is fairly standard across all bank characteristics. First, the "unconditional effect" of the lending rate on the supply curve is positive as expected implying an upward sloped credit supply curve. Second, the "unconditional effect" of the excess deposits is positive as expected across banking characteristics. Third, the return on 182-Day Treasury bill rate is negative but statistically insignificant implying non-existence of crowding out effect by government. Fourth, the non interest income (NII) is positively related to the

supply of bank credit, which makes sense given the fact that banks provide other services in addition to loans.

Fifth, competition, proxied by the Herfindahl index (HHI), is positively related to the credit supply. This results are in line with Gunji, Miura and Yuan (2009, in which less competitive environment (high Herfindal index) enhances BLC. Finally, the nominal exchange rate is negatively related to the credit supply.

4.3.1. Effect of Monetary Policy on the Supply of Bank Loans Based on Size

Two criteria are used to assess existence of BLC: real excess deposits and the lending rate. With regard to real excess deposits, the "conditional effect" of the real excess deposit on bank credit is $0.280+0.036* s_{it}$. This coefficient is more positive for large banks ($s_{it} > 0$) than for small banks ($s_{it} < 0$), which implies that the credit supply for large banks is more responsive to changes in monetary policy than for small banks contrary to BLC. However, the importance of BLC also depends on the slope of the credit supply curve. BLC is more important the smaller the "conditional effect of the lending rate on the credit supply (steeper supply curve). The "conditional effect" of the lending rate on bank loans is $2.432+1.503* s_{it}$. This effect is smaller for smaller banks ($s_{it} < 0$) than for large banks ($s_{it} > 0$) in line with BLC. This is also confirmed by the generalised method of moments (GMM) results in column 2 of table 5.

The finding is contrary to studies such as Kashyap and Stein (1995, 2000) for the US but can be rationalised on two grounds. First, large banks in Kenya pursue an aggressive asset liability management (ALM) strategy with less liquidity and capital ratios, which makes them exposed to monetary policy stimulus. Second, large banks in Kenya generally provide credit to large corporate customers, which are quite sensitive to marginal changes in rates.

4.3.2. Effect of Monetary Policy on Supply of Bank Loans Based on Liquidity Levels

Column 3 of table 4 presents the results using liquidity as an interaction term. Using the real excess deposit criterion, the "conditional effect" of excess bank deposits on bank credit is $0.679+0.058* L_{it}$, which is higher for high-liquid banks ($L_{it} > 0$) than for low-liquid banks ($L_{it} < 0$) contrary to BLC. With regard to the lending rate criterion, the "conditional effect" of the lending rate is $0.976-4.929* L_{it}$, which is positive for low-liquid banks ($L_{it} < 0$) in line with BLC. This is also confirmed by the GMM results in table 5, which show that low-liquid banks are affected more by monetary policy than high-liquid banks. In view of the contradiction between the real excess deposit criterion and the lending criterion, we conclude that liquidity is not a good measure to assess the existence of BLC in Kenya since it is not a binding constraint on banks.

4.3.3. Effect of Monetary Policy on Supply of Bank Loans Based on Capitalisation Levels

With regard to deposit criterion, the "conditional effect" of excess bank deposits on bank credit is $0.504-0.391* K_{it}$. This coefficient is higher for low-capital banks ($K_{it} < 0$) than for high-capital banks ($K_{it} > 0$) in line with BLC.

With regard to the lending rate criterion, the "conditional effect" of the lending rate on bank credit is $1.863-10.422* K_{it}$. The credit supply curve has a positive sign for the low-capital banks ($K_{it} < 0$) only. This is also confirmed by the GMM results in table 5. This shows existence of BLC based on bank capital. The results are consistent with the finding by Altunbas *et.al.* (2002) for Europe, Kishan and Opiela (2000, 2006) for the US, Gambocorta and Mistrulli (2004) for Italy.

4.3.4. Effect of Monetary Policy on Bank Based on Foreign Ownership

Using the real excess deposit criterion, the "conditional effect" of excess bank deposits on bank credit is 0.573+0.113* $fownership_{it}$. This coefficient is higher for foreign-owned banks ($fownsership = 1$) than for domestic-owned banks ($fownsership = 0$) contrary to BLC. The lending rate criterion is not used since the interaction term is statistically insignificant. Nonetheless, we conclude that foreign-owned banks respond to monetary policy more than domestic-owned banks contrary to the finding by Ashcraft (2006) for the US in which stand-alone banks are affected more by monetary policy than affiliated banks. This can be rationalised on the fact that foreign-owned banks are quite sensitive to marginal changes in interest rates.

Table 3: EC3SLS Results for Deposit Demand and Supply using Interaction Terms (Equations 1 and 6)

Equation	**Size** ($z_{it} = sit$)	**Liquidity** ($z_{it} = Lit$)	**Capital** ($z_{it} = Kit$)	**Foreign-ownership** ($z_{it} = fownership_{it}$)
Panel A: Deposit Demand				
Constant	-0.001(0.952)	-0.001(0.951)	5.7e-04(0.985)	-2.3e-04(0.993)
Real GDP (log)	1.032(0.000)***	1.030(0.000)***	1.047(0.000)***	1.042(0.000)***
182-day Tbill rate	-0.964(0.025)**	-0.964(0.015)**	-0.954(0.008)***	-0.959(0.010)**
Exchange rate (log)	0.213(0.012)**	0.215(0.006)***	0.184(0.009)***	0.196(0.008)***
Panel B: Deposit Supply				
Constant	0.015(0.210)	0.006(0.415)	0.011(0.304)	0.002(0.730)
Real bank reserves (log)	0.534(0.000)***	0.751(0.000)****	0.657(0.000)***	0.779(0.000)***
Repo rate	-12.482(0.000)***	-16.198(0.000)***	-14.026(0.000)***	-15.762(0.000)***
182-day Tbill rate	12.615(0.000)***	16.539(0.000)***	14.166(0.000)***	15.944(0.000)***
Exchange rate (log)	1.111(0.000)***	0.811(0.000)***	0.930(0.000)***	0.751(0.000)****
z_{it}	0.382(0.000)***	-0.190(0.050)*	-1.096(0.000)***	0.385(0.000)***
Repo rate* z_{it}	0.353(0.090)*	-2.534(0.039)**	-1.291(0.402)	0.017(0.978)
Lending rate	-0.191(0.425)	-0.263(0.305)	-0.083(0.727)	-0.021(0.937)
Sample size	37 banks, 8 years	37 banks, 8 years	37 banks, 8 years	37 banks, 8 years

Notes: The results are estimated as one system. The R-square for deposit demand equations are: 0.9513(size), 0.9461(liquidity), 9364(capital) and 0.9415(foreign-ownership). The R-square for deposit supply equations are: 0.9705(size), 0.9712(liquidity), 0.9609(capital) and 0.9828(foreign-ownership).

Table 4: EC3SLS Results for Credit Demand and Supply (Equations 4 and 7)

Equation	**Size** ($z_{it} = sit$)	**Liquidity** ($z_{it} = Lit$)	**Capital** ($z_{it} = Kit$)	**Foreign-ownership** ($z_{it} = fownershi$)
A: Credit Demand				
Constant	-2.99e-05(0.999)	0.001(0.942)	6.01e-04(0.984)	5.73e-04(0.981)
Lending rate	-4.726(0.000)***	-3.119(0.0008)	-2.833(0.000)***	-1.744(0.009)
Real GDP (log)	0.606(0.000)***	0.617(0.000)***	0.540(0.000)***	0.568(0.000)***
182-day Tbill rate	2.633(0.000)***	1.766(0.000)***	1.692(0.000)***	1.139(0.000)***
Real NII(log)	0.668(0.000)***	0.524(0.000)***	0.540(0.000)***	0.467(0.000)***
Exchange rate (log)	1.597(0.000)***	1.005(0.001)***	1.057(0.001)***	0.585(0.025)***
HHI (log)	-0.672(0.002)***	-0.272(0.227)	-0.236(0.280)	0.051(0.781)
B: Credit Supply				
Constant	8.38e-04(0.903)	0.008(0.199)	0.004(0.805)	0.001(0.908)
Real excess deposits (log)	0.280(0.000)***	0.679(0.000)****	0.504(0.000)***	0.577(0.000)***
Lending rate	2.432(0.000)***	0.976(0.031)**	1.863(0.000)***	1.417(0.032)**
182-day Tbill rate	-0.345(0.407)	0.173(0.535)	0.146(0.637)	0.287(0.411)
HHI (log)	1.351(0.000)***	0.818(0.000)***	1.110(0.000)***	0.851(0.000)****
Real NII(log)	0.222(0.000)***	0.094(0.000)***	0.240(0.000)***	0.280(0.000)***
Exchange rate (log)	-0.693(0.010)***	-0.115(0.531)	- 0.504(0.010)**	-0.139(0.533)****

Table 4: EC3SLS Results for Credit Demand and Supply (Equations 4 and 7) - continued

z_{it}	0.093(0.127)	-0.504(0.000)***	1.457(0.000)***	-0.707(0.000)***
Rexcess deposits (log)* z_{it}	0.036(0.000)***	0.058(0.022)**	-0.391(0.000)***	0.113(0.000)***
Lending rate* z_{it}	1.503(0.000)***	-4.929(0.000)***	-10.422(0.000)***	-0.644(0.296)

Notes: The results are estimated as one system. Sample size is 37 banks over 8 years. The R-square for credit demand equations are: 0.9513(size), 0.9433(liquidity), 9735(capital) and 0.9236(foreign-ownership). The R-square for credit supply equations are: 0.9705(size), 0.8856(liquidity), 9866(capital) and 0.9914(foreign-ownership).

Table 5: GMM Estimation Results for the Equilibrium Credit (Equation 8)

Variable	**Size** $z_{it} = sit$	**Liquidity** $z_{it} = Lit$	**Capital** $z_{it} = Kit$	**Ownership** $z_{it} = fownership$
$\Delta Credit_{t-1}$(log)	0.732 (0.000)	0.590(0.000)	0.735(0.000)	0.795(0.000)
z_{it}	0.263(0.000)	-0.867(0.000)	-0.936(0.000)	NA
Δ Repo rate	-0.140(0.623)	-0.034(0.903)	0.232(0.284)	-0.009(0.777)
Δ Repo rate * z_{it}	-0.334(0.000)	3.814(0.005)	0.452(0.000)	0.089(0.758)
Δ GDP(log)	-0.807(0.051)	-1.366(0.002)	-0.369(0.313)	-0.804(0.077)
Δ Deposit rate	0.625(0.238)	0.466(0.282)	-0.189(0.662)	0.375(0.492)
Δ Exchange rate (log)	-0.273(0.113)	0.281(0.135)	0.043(0.785)	-0.222(0.129)
Δ NII(log)	-0.059(0.008)	0.054(0.003)	-0.007(0.738)	-0.017(0.476)
Δ HHI(log)	-0.183(0.036)	-1.419(0.000)	-0.471(0.152)	-0.727(0.066)

Notes: Since ownership is a dichotomous variable its inclusion causes singularity problem

Instrument Variables: $\Delta Credit(\log)(-2)$, ΔRepo rate(-2 to -6), Δ GDP(log)(-2 to -3), ΔDeposit rate(-2 to -6), ΔExchange rate (log)(-2 to -6), ΔNII(log)(-2 to -4), and ΔHHI(log)(-2 to -6)

5. Summary and Concluding Remarks

The aim of this study was to check the possible existence of a bank lending channel in Kenya during the period 2001 to 2008. Our premise in this paper has been that to provide a sharp test of the BLC, one has to estimate directly a system of "structural" money and credit market equations allowing for asymmetries in loan supply across banks depending on their asset size, liquidity, capitalization and foreign ownership.

We use bank-level annual panel data for the period 2001 to 2008 and our main conclusion is that BLC exists in Kenya based on bank capital only. This suggest that lending response of a Kenyan bank depends on its capitalisation- loans of banks with low total capital to risk-weighted assets ratio are hit most by monetary policy than for banks with high capital ratio.

The finding of BLC implies a number of issues in Kenya. First, monetary policy can have effects on investment and aggregate activity without affecting interest rates. This means that the interest rates are not the only measures to gauge the stance of monetary policy, which has implications on modelling investment functions in Kenya. Second, the quantitative impact of BLC in Kenya is sensitive to a number of institutional characteristics of the financial market. Third, prudential bank regulation, particularly the capitalisation should be harmonised with monetary policy. Fourth, the effects of monetary policy on borrowers and banks are asymmetric in Kenya. Fifth, bank credit can be used as a nominal anchor (intermediate target) for monetary policy and a leading indicator for

economic activity in Kenya. Finally, presence of BLC implies existence of socially inefficient allocation of scarce resources since the most profitable investment might be denied funding by banks. This is in sharp contrast to the traditional textbook interest rate channel, whereby only the least socially productive investment projects remain unfunded after monetary policy contraction (Cecchetti, 1995).

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Appendix: Procedures for Performing EC3SLS

The system of the four structural equation is written in matrix form as follows

$$y = Z\delta + \varepsilon \tag{A1}$$

Where

Where $y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} \ln\left(\frac{D}{P}\right)^d_{it} \\ \ln\left(\frac{D}{P}\right)^s_{it} \\ \ln\left(\frac{C}{P}\right)^d_{it} \\ \ln\left(\frac{C}{P}\right)^s_{it} \end{bmatrix}$, $Z_j = \left[Y_j, X_j\right]$, $Z = diag \quad Z_j = \begin{bmatrix} Z_1 & 0 & 0 & 0 \\ 0 & Z_2 & 0 & 0 \\ 0 & 0 & Z_3 & 0 \\ 0 & 0 & 0 & Z_4 \end{bmatrix}$

$$Diag \quad Z_1 = \left(i_t^{tb}, i_{it}^{d}, \ln y_t, \ln e_t\right), Diag \quad Z_2 = \left(i_t^{tb}, lr_{it}, \ln\left(\tau\frac{D}{P}\right)_{it}, r_t, \ln e_t, z_{it}, r_t z_{it}\right),$$

$$Diag \quad Z_3 = \left(lr_{it}, \ln y_{it}, i_t^{tb}, \ln NII_{it}, \ln HHI_{it}, \ln e_t\right), \text{and}$$

$$Diag \quad Z_4 = \left(\ln\left(1-\tau\frac{D}{P}\right)_{it}, \ln\left(1-\tau\frac{D}{P}\right) z_{it}, lr_{it}, lr_{it} z_{it}, i_t^{tb}, z_{it}, \ln HHI_t, \ln NII_{it}, \ln e_t\right)$$

$$\delta = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{bmatrix} = \begin{bmatrix} \beta_{10}, \beta_{11}, \gamma_{11}, \gamma_{12}, \gamma_{13} \\ \beta_{50}, \beta_{51,}\beta_{52,}\gamma_{51}, \gamma_{52}, \gamma_{53}, \gamma_{54} \\ \beta_{30}, \beta_{31}, \beta_{32,}\gamma_{31}, \gamma_{32}, \gamma_{33}, \gamma_{34} \\ \beta_{60}, \beta_{61}, \beta_{62}, \beta_{63,}\beta_{64,}\beta_{65}, \gamma_{61}, \gamma_{62}, \gamma_{63}, \gamma_{64} \end{bmatrix}, \ \varepsilon = \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{5it} \\ \varepsilon_{3it} \\ \varepsilon_{6it} \end{bmatrix} = \begin{bmatrix} \mu_{1i} + v_{1it} \\ \mu_{5i} + v_{5it} \\ \mu_{3i} + v_{3it} \\ \mu_{6i} + v_{6it} \end{bmatrix}$$

The coefficients are specified in such way that endogenous variables coefficients are in the form of β_{ij} while exogenous variables coefficients are of the form γ_{ij}. The estimation procedure in Baltagi (2008: 131-132) is then applied[7].

[7] The estimation is implemented in Stata/SE version 11.