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De-risking Opportunities for Banks: Examining Productivity of Sectoral Bank Credit Flows

By Samuel Kiemo and Camilla C. Talam

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Abstract

The recent technological advancement and financial innovations, competition from non-bank financial institutions and Mobile Network Operators (MNOs), challenging operating environment in addition to regulatory changes continue to exert pressure for banks in Kenya to modify their business operation models to adapt. Part of this modification emerging strategy involves banks undertaking de-risking actions to minimize the vulnerabilities to cope with risks posed by changing business dynamics. Banks can de-risk by investing in risky assets that provide high returns in their portfolio, such that the high returns compensate for the risk taken. This paper aims to explore the aspect of de-risking by considering how productivity of sectoral bank credit can provide a de-risking opportunity for banks in the long run by leveraging on inter-sectoral linkages that promote growth thus a high return and risk diversification for banks. Using quarterly data for the period 2009 to 2018, the paper applied VAR, VECM methodology. Our findings suggest significant inter-sectoral linkages between agriculture, industry and service sectors. The study finds services sector as the key sector that links all three sectors through which intersectoral linkages persist. Sectoral bank credit positively influence output not only in the sector where it is allocated but also to other sectors. We also find evidence of resource competition between the three sectors which affirms the extent of inter-sectoral linkages and their amplifying effect of inputs such as credit on growth and productivity.

1.0 Introduction

The recent technological advancement and financial innovations, competition from non-bank financial institutions and Mobile Network Operators (MNO's), challenging operating environment in addition to regulatory changes, continue to exert pressure on banks in Kenya to modify their business model to adapt.

Part of the emerging strategy involves banks undertaking de-risking strategies to minimize vulnerabilities to cope with risks posed by changing business environment dynamics. De-risking has been practiced by global financial institutions through the termination of relationships with risky correspondence banks. However, de-risking as a financial concept can be adapted by local financial institutions such banks through three different approaches. Firstly, de-risking can be undertaken as a measure to diversify the bank's assets through reducing high risk weight assets and increasing low risk weight assets, where risk weights are classified as guided by Basel II standardized framework. Secondly, de-risking can be in the form of rebalancing funding of assets, i.e. the liabilities side of banks' balance sheet, by moving away from risky and volatile funding sources towards stable funding sources. Finally, banks can diversify risks by investing in risky assets that provide high returns in their portfolio, such that the high returns compensate for the risk taken. This paper aims to explore this third form of de-risking by considering how productivity of sectoral bank credit can provide a de-risking opportunity for banks in the long run by leveraging on inter-sectoral linkages that promote growth thus a high return and risk diversification strategy for banks.

The aftermath of 2007 - 2009 global financial crises led to massive regulatory and policy changes aimed at raising capital buffers and reducing balance sheet risks. Global financial regulatory bodies such as the Basel Committee introduced new regulatory toolkits generally referred to as the Basel III framework in addition to existing Basel I

and Basel II frameworks. Basel III principles aimed to address loophole's in Basel II and Basel I framework by addressing balance sheet risks emanating from liquidity management through limiting funding risks arising from maturity mismatches between bank assets and liabilities (King 2013, Berner, R., Boudreau & Peskin 2006). These were to be achieved by banks relying on stable funding of their assets by increasing holding of highly rated assets hence reducing assets that require more funding (assets with high risk weights). However, this approach imposes a trade-off between profitability and liquidity for banks, since increasing holding of assets with low risk weights, reduces holding of assets with higher risk weights but equally higher premiums. This worsened the downturn in the financial crisis since declining profitability raised concerns of bank's long run viability. This necessitates banks to explore other de-risking measures that simultaneously address both profitability and stability concerns (Nijathaworn 2009, Shin 2009).

Commercial banks in Kenya experienced moderate risks such as elevated credit risk indicated by rising non-performing assets, which raised financial stability concerns on viability of these banks as at June 2018. The rising credit risk has resulted in declining bank's earnings resulting in capital erosion as shown by declining total capital. Additionally, the asymmetric credit pricing models introduced by interest rates caps in Kenya have exacerbated the already precarious situation. The Kenyan interest capping law assumes homogenous risk levels of all customers hence fixes the bank lending rate at a maximum of four percent basis point above the policy rate. These have led to inefficient credit pricing regime which may to some extent contribute to rising non-performing assets. Additionally, the interest rate caps law has also introduced deposit rate floors at a minimum seventy percent of the policy rate, raising the banks cost of funding. These banks need to reduce their balance sheet risks through portfolio rebalancing shifting away from risky portfolio lending towards assets investments with lower risk weights and earning maximum returns (Bidder, Krainer, & Shapiro 2017).

Wright and Kellman (2017) examine the effects of de–risking by closing lending relationships with clients considered risky. This type of de-risking resulted in declining profitability, credit losses due to reduction in lending, asset-liability mismatch risks, and loss of confidence as an International Financial Center. Wright and Kellman (2017) examined de-risking from a different perspective to the traditional de-risking definition that has a minimal impact on Barbados banking sector. The Financial Conduct Authority (FCA) in the United Kingdom commissioned a study to enhance understanding of de- risking, an emerging trend in 2016. Banks reported that the increased cost of compliance with regulation as the number of regulations increased led to banks adopting de-risking strategies to reduce their overall risk profile. In the U.K., U.S and developed financial systems, de-risking took the form of termination of correspondent banking relationships either with banks in developing countries or other clientele perceived to be risky.

Although this strain of de-risking impacted Kenya with two international banks terminating correspondent banking relationships with banks in Kenya, the impact of this type of de-risking was minimal. Nonetheless, de-risking took a different form in Kenya that has not been studied in the literature that has focused on the de-risking above. This paper fills this gap in the literature by examining a new strain of de-risking that can have less negative impacts than the de-risking strategy that has been explored in the literature or the second that banks in Kenya have adopted over the past years. This paper explores de-risking opportunities for banks, from diversifying investment in higher risk assets which reduces overall risk in the banking book but maintains higher returns, by examining economic inter-sectoral linkages and sectoral bank credit productivity in promoting economic growth. The paper is structured as follows; Section 1 provides the motivation for the study by considering stylized facts of commercial banks in Kenya and macro-financial linkages; Section 2 reviews relevant theoretical and literature underpinning inter-sectoral linkages and bank credit productivity; Section 3 presents the analytical framework for the analysis based on the data and methodology chosen; Section 4 discusses the study's findings and, Section 5 concludes with policy recommendations.

1.1 Stylized facts

The recent financial and technological innovations have continued to exert pressure on Kenya's banking sector driven by increased competition and a rapidly changing global and local regulatory environment. Kenyan banks have over the years used investment in government securities as one of their key de-risking strategies, as shown by their high appetite for government securities before and after the post interest rate caps period. Due to perceived low risks and costs associated with lending to government, therefore the appetite for government paper by commercial banks has always being high.

1.1.1 Bank Balance Sheet Analysis

The analyses of the commercial banks' balance sheet reveal that, one of the de-risking strategies employed by Kenyan banks is that of divesting from lending to the private sector to lending to Government. This trend emerged when the returns on government securities was reasonably high given the additional low risk benefit. Banks have implemented this strategy through acquiring an investment portfolio with various earning dimensions. **Table 1** reveals from 2009 to 2017 banks have steadily divested their assets by moving away from assets such as; cash, deposits & placement; investments and other assets, to safer assets such as; -government securities. Historically, this heavy investment in government securities was correlated with bank stability and is therefore attributed to the bank stability experienced in Kenya from late 1990's to date in Kenya (Kamau 2011). Despite this trend, on aggregate banks continue to focus on their credit intermediary role of lending to the private sector and thus supporting the economy.

Non-performing loans (NPLs) have been rising from 2009 to date as indicated by ratio of NPLs to total assets and, ratio of NPLs to total loans. As per the Prudential Guidelines, banks are supposed to mitigate these elevated risks by increasing loan provisions. However, **Table 2** reveals that loan provisioning has been declining from 2009 to date as indicated by the ratio of provisioning to total loans and ratio of provisions to NPLs. Therefore, this elevated credit risk - and the regulatory changes in past couple of years - make it more costly and harder for banks to support economic growth through provision of private sector credit due to the difficulty in pricing risk and the tight margins that banks have to maintain in order to be viable. Based on the rising credit risk and constrained interest rates under the interest capping regime, lending to the private sector carries a relatively higher risk for the banking sector and may pose a threat to this role of the banking sector, hence the need for de-risking opportunities.

In the ideal situation, the elevated credit risks are mitigated by banks requesting for high value collateral against the loans and advances. However, statistics from developing countries such as Kenya, illustrates that loan recovery rate from distressed assets are very low despite assumed high collateral value. This is attributed to slow judicial and legal process in regard to bankruptcy and debt recovery procedures. Additionally, the loans recovery strategy through collateral in case of default may take a long period of time, exacerbating the fragility of the banking sector. These facts indicate collateralized lending cannot be solely depended on by banks as a de-risking strategy.

The asset quality deterioration indicates the need to re-evaluate the composition of the assets category 'loans & advances', with the aim of reducing risky lending elements in this basket. **Figure 1** reveals majority of bank lending is channeled to the services[1] sector averaging at above seventy percent of the total private sector credit since 2011. Lending to the industry sector follows a distant second averaging at twenty percent of total loans to private sector. However, agriculture sector receives the least credit from banking sectors averaging at five percent over a period 2011-2017. Although, the share of total bank credit to private sector on average has been steadily rising from 2011, its composition has been shifting towards lending to the services sector as banks divest from industry and agriculture sector which have been experiencing rising assets quality deterioration episodes as indicated by rising NPLs especially in the industry sector (**Figure 2**). The declining NPLs in the services sector make this sector more attractive for banks to allocate resources as one of de-risking techniques.

1 Banks credit to private sector has been broadly classified into three classes namely; 1) Agriculture sector, 2). Services sector comprising credit to; i) trade, ii) tourism, restaurant & hotels, iii) transport & communication, iv) real estate, iv) financial services and v) personal/household 3) Industry sector which comprises credit to; i) manufacturing, building & construction, ii) mining & quarrying, iii) energy & water

The balance sheet analysis also reveals Kenyan banks have been engaging in leverage activities to lower risk through a variety of bank funding models. This has been implemented by banks constantly increasing the funding from risky and volatile funding sources to stable funding sources. Despite this shift, as **Table 3** shows banks have continuously relied on deposits as a significant funding financing source from 2011 to date, where deposits as a proportion of total funding averages 77 percent.

This may be attributed to the nature of banking as a resource allocation agent. Nonetheless, banks over time have continuously reduced reliance on funding from the 'other liabilities' funding category which means all other bank liabilities apart from 'shareholder equity' and 'deposits' liabilities. Commercial banks from 2011 have over time shifted banks assets funding from 'other liabilities' fund sources to funding from 'shareholders fund'. This is indicated by the rising share of 'shareholders funds' funding source.

The balance re-adjustment by commercial banks in Kenya has minimized the balance sheet risks but not entirely eliminated them. This is revealed by challenging operating environment of the banking sector as revealed by declining growth of profitability and capitalization. Despite banks persistent holding of assets portfolio dominated by 'loans & advances' and 'government securities', the growth rate of earnings from this asset classes have been declining from 2011 to date (**Figure 3** and **Figure 4**). The declining profitability may explain the declining capitalization growth rate which raises long-term sustainability and viability concerns. With the proposed Government of Kenya fiscal consolidation (**Figure 5**) and the asymmetric credit pricing regime introduced by interest rate capping in Kenya, commercial banks need to re-evaluate their de-risking opportunities in credit allocation to address these viability concerns.

Table 1: Banks Assets Diversification as a Share of Total Assets

Percent	Dec-09	Dec-11	Dec-13	Dec-15	Dec-17
Cash, Deposits & Placements	14	15	13	12	10
Government Securities	22	18	21	20	25
Investments	2	2	2	2	1
Loans	53	57	57	60	57
Other Assets	8	8	7	7	6
Total	**100**	**100**	**100**	**100**	**100**

Table 2. Bank Assets Quality

Ratio (Percent)	Dec-09	Dec-11	Dec-13	Dec-15	Dec-17
Total Capital to RWA	19.6	19.4	23.2	18.6	18.5
Gross Loans Provisions to Gross NPLs	66.3	81.6	70.7	61.6	47.4
Gross NPLs to Gross Loans	7.9	4.4	5.0	6.1	10.7
Gross Loans Provisions to Total Loans	4.2	2.7	2.6	2.6	3.3
Total NPL's to Total Assets	**3.8**	**2.0**	**2.4**	**3.0**	**5.2**

Table 3: Bank Funding Source as a Share of Total Banking Funding

Ratio (Percent)	Dec-09	Dec-11	Dec-13	Dec-15	Dec-17
Deposits	78	81	78	76	77
Other Liabilities	8	4	6	8	5
Shareholders' Funds	14	15	17	17	17
Total	**100**	**100**	**100**	**100**	**100**

Figure 1 Bank Private Sectoral Lending

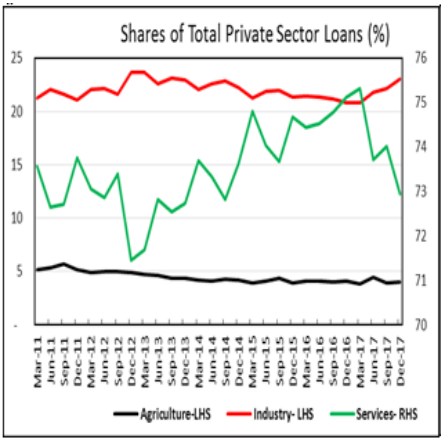


Figure 2: Bank Loans Sectoral NPLs

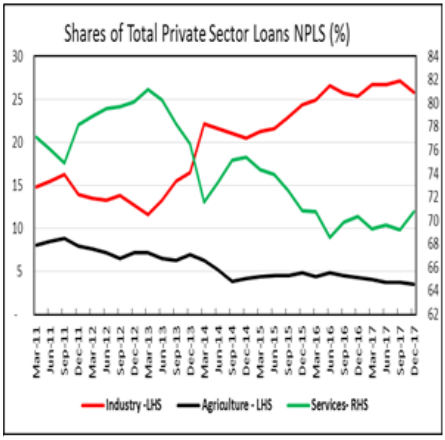


Figure 3: Bank Interest Earnings

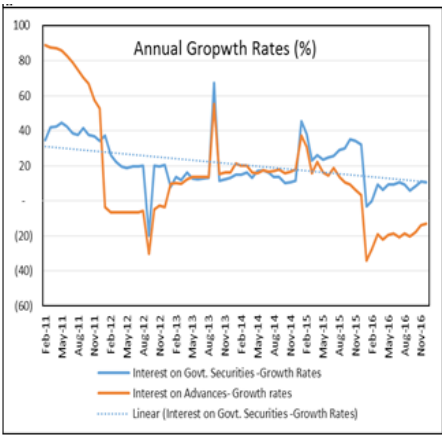


Figure 4: Bank Assets Funding Sources

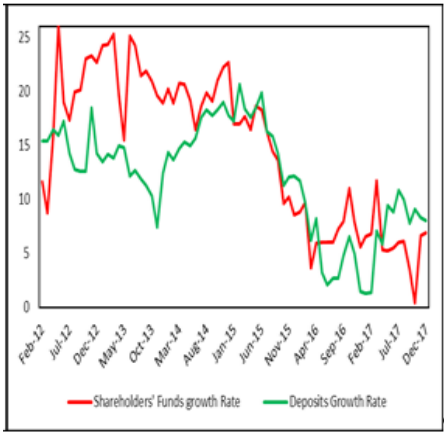
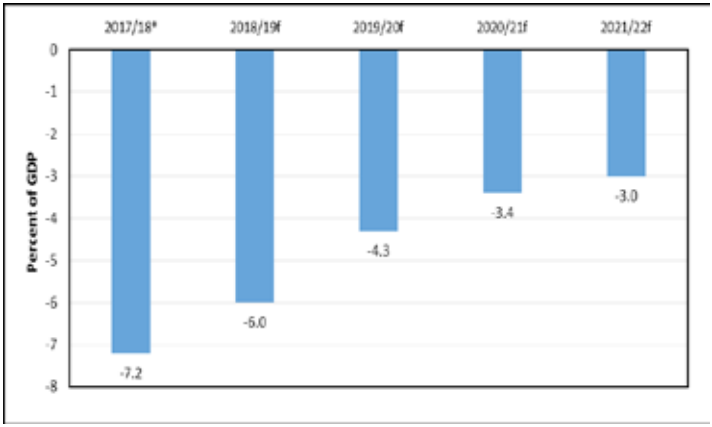


Figure 5. Kenyan Government Fiscal Consolidation has begun and is expected to continue into the medium term



1.1.2 Macro-Financial Linkages

Rajan and Zingales (1998) find that in countries with less developed capital markets, firms that require more financing tend to be credit constrained and thus grow more slowly. Banerjee and Duflo (2014) suggest that credit constrained firms stifle growth depending on the proportion that they contribute to economic growth. In Kenya, agriculture contributed about 30% to GDP in 2016 (**Appendix I**) but receives only 4.6% of total credit on average (**Appendix IV**). On the other hand, both industry and services manufacturing and trade contributed 20 % and 49.5% to total to GDP on average between 2009 and 2017 (**Appendix I**) and both received 21.9% and 73.5% of total credit on average (**Appendix IV**).

The current Government of Kenya have given policy direction focusing on key area of the economy for the period 2018-2021. The identified key sectors commonly referred to 'Big Four Agenda' are housing, manufacturing, agriculture and health. The means massive government investment will be directed to these sectors. Can financial sector players exploit cross-sectoral linkages where lending to a particular sector can have positive effect in a related sector that has linkages with another as a de-risking strategy. For instance, for food security to be attainable, the linkages between agriculture, manufacturing and trade will be will have to exploited, such that lending to manufacturing or trade can support agricultural productivity or vice versa. This paper seeks to address these concerns by examining new de-risking opportunities for commercial banks by examining the sectors where credit allocation lead to an increase in productivity and evaluating where positive inter-sectoral linkages exist such that directing credit to one sector can result in positive increases in productivity in other related sectors.

1.3 Research Objective

The objective of this paper is twofold; firstly, to examine whether there is existence of inter-sectoral linkages and secondly, whether these inter-sectoral linkages promote higher productivity of bank credit with lower overall risk to banks.

2.0 Literature Review

Empirical works (Goldsmith 1969; McKinnon 1973; Greenwood and Jovanovic 1990; Bencievega and Smith 1991; King and Levine 1993; Levine 1997; Levine and Zervos 1998) have set the foundation for both theoretical and empirical studies untangling the link between the financial sector and economic performance via the productivity enhancing investments financed by credit.

Greenwood and Jovanovic (1990) find that financial intermediation and growth are endogenously determined, and that financial intermediation promotes growth through enabling firms to obtain a higher rate of return on capital by financing investments of projects with high rates of return.

Bencivenga and Smith (1991) find that banks through their liquidity management promote growth by enabling the allocation of savings into productive investment thus increasing capital accumulation through altering the composition of capital. The arguments for the finance-growth nexus herein suggests that financial intermediation itself promotes endogenous growth emphasizing elements such as spillover effects and innovation that are growth promoting. Bencivega and Smith (1991) emphasize that countries with an active financial intermediary sector, specifically banks, will tend to have higher equilibrium growth rates.

Wurgler (1999) in a study of 65 countries across 28 industries over a period of 33 years, finds that countries with underdeveloped financial systems invest more than they should in declining industries and invest less than optimal in growing industries, thus distorting the allocation of capital that promotes growth. Rajan and Zingales (1998) find that financial intermediation promotes growth through three main channels; by reducing the cost of finance external to the industry for firms that depend on finance thus enabling these firms to pursue investment

opportunities and supporting new firms entering the market, through an indirect effect on the composition of industries affecting size and concentration of firms that comprise industries and through relaxing financial constraints. To some extent, Rajan and Zingales (1998) argue for positive spill-overs of financing across industries. For instance, they posit that although one industry receives financing, this financing can support growth of new firms in other industries. Fisman and Love (2004) using data on 37 industries in 42 countries across a ten-year period, extend the finance-growth nexus developed by Rajan and Zingales (1998) to test the effect of financial development on intersectoral allocation of capital.

Previous research (Singh, 2016; Gemell et al., 2000; Hazari, 1970) has narrowly examined inter-sectoral linkages that have been alluded to in the microeconomic finance-growth nexus literature. Inter-sectoral linkages have been studied within the sectors as defined by the United Nations Statistics International Standard Industrial Classification. These studies can be differentiated into two key groups based on methodology applied. On the one hand studies like Leontif 1936; Hirshman 1959; Olley & Palley 1996; Tregenna 2008; Fricke et al, 2017, on inter-sectoral linkages have used input-output tables as per the social accounting matrix and calibrated both the backward and forward inter-sectoral linkages, while the other studies (Hazari, 1970; Yao, 1994, 1996, 2000; Tihin and Dawson, 2003; Kaur et al., 2009; Singh, 2010; Singh, 2016) have focused on econometric techniques.

Although Leontif Social Accounting Matrix (SAM) are the preferred methodology for assessing intersectoral linkages enabling identification of forward and backward linkages, they have the following limitations. IO tables may provide erroneous results if data not captured e.g. Fretag and Fricke 2017 find no effect of mobile money on finance and other sectors of the economy using IO tables however, mobile money transactions are not captured in IO tables for Kenya. Informality effects of sectors are not considered which excludes a large proportion of developing economies. Emphasizes on backward linkages on promoting growth whereas the financed-growth nexus is a factor of both backward and forward linkages and assuming

Hazari (1970) aimed to determine the key sectors of the Indian economy to which credit should be extended to spur economic development using the Leontif open static model and classifying key sectors based on technological progress. Hazari's - findings suggest that key sectors are those with significant inter-sectoral linkages with more sectors having backward inter-sectoral linkages than forward inter-sectoral linkages i.e. more sectors are inputs into other sectors than they are outputs. Hazari - recommended that in order to maximize growth in the short run, backward linkages should be considered to a greater extent in decision making.

Singh (2016) using annual data, examined sectoral linkages between the agricultural, industry and service sectors by aggregating the nine key economic sectors in India into three segments, agricultural,

industry and services and applying a three-dimension VAR. Singh - found the existence of inter-sectoral and intra-sectoral long run linkages that impact on the effect of economic policies and specifically allocation and transfer of resources and investment opportunities. Specifically, Singh - found that industry mainly the manufacturing sector, resulted in increase in technical progress, generated productivity spillovers relative to other sectors and provided for economies of scale and modern production techniques. Moreover, Singh concludes that through these long-run inter-sectoral and intra-sectoral linkages affecting investment and outcomes of economic and financial policies, economic growth is endogenously a result. Singh (2010) examine the long-run and short-run relationship between services and non- services sector applying an ARDL-ECM model on annual data for 1950 and 2000, found that a stable cointegrating relationship between services and non-services sectors based on bidirectional causality between services and non-service sectors.

3.0 Research Methodology

The paper will rely on quarterly financial and macroeconomic data. The study will draw insights from the methodology by Singh (2016) and Gemell et al (2000) by assuming the Cobb-Douglas production function specified as follows:

$$Y_t = AK^{\alpha}L^{\alpha\text{-}L} \qquad (1)$$

3.1 Data

Quarterly data from 2009 to 2017 is used in this investigation as the pre-2009 data is not comparable after the rebasing of the GDP in 2009. The study adopted a broad categorization of the Kenya economic sectors into three major classification; 1) Agriculture sector which comprised of; agriculture, hunting & fishing and, forestry; 2) Industry sector which comprised of; mining & quarrying, manufacturing, construction, electricity & water; 3) Services sector which comprised of; trade, accommodation & restaurant, transport & storage, information & communication, finance &insurance, public administration, professional services, real estate, education, health, other services and, FISM[2].

The study apply VAR, VECM- model to capture the long run equilibrium relationships and the short run dynamics. As the study apply VAR, it assumes all the variables (agricultural GDP, industry GDP, Service GDP, agriculture bank credit, industry bank credit, service bank credit, agricultural productivity, industry productivity and service productivity) are endogenous and thus will not a prior prescribe the independent and dependent variables. The lagged variables in the above models we used to ensure there is no endogeneity issue given the data generating processes of the variables used in the study.

2 FISM

3.2 Diagnostic Tests

3.2.1 Unit Root Tests

The study - run unit root tests to confirm the variables are integrated of order I (1) so as to be able to apply the above methodology. The unit root test is applied on the three GDP variables using the augmented Dickey-Fuller (ADF) test, the Phillips Peron (PP) as well as the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests. The unit root tests are undertaken both at a constant and including a trend. The tests confirm that the three variables are integrated of order I (I). The unit root tests fail to reject the null hypothesis (ADF and PP) at first difference, and the KPSS test fails to reject the null of no unit root in first difference (**Table 4).**

Table 4: Augmented Dickey-Fuller Unit Root Test

Augmented Dickey-Fuller Unit Root Test (with intercept)							
Series	**t-statistics**	**Critical Value**	**P-Value**	**Series**	**t-statistics**	**Critical Value**	**P-Value**
Agr_GDP	1.0151	-2.9571	0.9958	D(Agr_GDP)	-3.0407**	-2.9571	0.0417
Ind_GDP	0.4912	-2.9511	0.9839	D(Ind_GDP)	-7.4294***	-2.9511	0.0000
Serv_GDP	2.1241	-2.9458	0.9999	D(Serv_GDP)	-6.8250***	-2.9540	0.0000

H0: Variables Has Unit Root. Note *** and ** statistical significance at 1% and 5% levels, respectively

3.2.2 Cointegration Tests

To test for inter-sectoral interactions, the Johansen test for cointegration is conducted and equation one takes the following form:

$$\Delta\chi_t = AB^1\chi_{t-k} + \Sigma y_i \Delta\chi_{t-i} + \mu + \varepsilon_t \qquad (2)$$

The maximum-likelihood estimator and trace statistics (**Table 5)** indicate that at the lag structure k=2, there is one cointegration relationship between the three non-stationary GDP variables. Due to the presence of a cointegrating relationship, a Vector Error Correction model is estimated based on lag k=2. Following Gemmell, Lloyd & Mathew (2000), Singh (2000) the study estimates three-dimensional VAR to examine the short-run dynamics and the long-run relationship between Agriculture, Industry and Services sectors to establish inter-sectoral linkages. The VAR model takes the form:

$$\chi_t = \phi_t\chi_{t-1} + \phi_2\chi_{t-2} + \phi_k\chi_{t-k} + \mu + \varepsilon_t \qquad (3)$$

Where χ_t is an $(nx1)$ vector of I (I) variables, μ is a $(nx1)$ is a vector of constants, $\varepsilon_t \sim iid(0,\delta^2)$ and $t=1\ldots T$. The model is estimated on quarterly data over the period q1 2009 to q1 2018. Unit root tests (**Table 4)** illustrate that all the GDP variables are non-stationary and integrated of order I (1).

Table 5: Johansen Tests for Cointegration

Maximum Rank	Parms	LL	eigenvalue	trace statistic	5% Critical Value
0	12	-1201.37		58.2358	29.68
1	17	-1178.93	0.72253	13.3646*	15.41
2	20	-1174.64	0.21758	4.7769	3.76
3	21	-1172.25	0.12758		
Maximum Rank	**Parms**	**LL**	**eigenvalue**	**max statistic**	**5% Critical Value**
0	12	-1201.37		44.8711	20.97
1	17	-1778.93	0.72253	8.5877	14.07
2	20	-1174.64	0.21758	4.7769	3.76
3	21	-1172.25	0.12758		

3.3 Testing for the productivity of Bank Credit

The underlying measurement of productivity assumes that marginal product of bank credit equals the average productivity. Therefore, productivity of bank credit is measured as follows:

$$P_{\alpha} = {}^{Agr}GDP/_{Agr}BC \quad (4)$$

$$P_{t} = {}^{Ind}GDP/_{Ind}BC \quad (5)$$

$$P_{s} = {}^{Serv}GDP/_{Serv}BC \quad (6)$$

Where Agr_GDP, Ind_GDP and Serv_GDP are the output from the agriculture, industry and service sectors respectively, while Agr_BC, Ind_BC and Serv_BC are the bank credit from the agriculture, industry and service sectors respectively. Drawing insights from Gemell et al (2000), the process for examining productivity of bank credit is undertaken by running unit root tests on the relevant variables.

The unit root tests confirm that the variables (Agr_GDP, Ind_GDP, Serv_GDP, Agr_BC, Ind_BC and Serv_GDP) are integrated of order I (I). The Johansen cointegation test with lag k=2 confirms that there are three cointegration relationships (**Table 5**), which enables the VEC to be estimated on these variables with a lag k=2.

$$A\_Agr = -0.44\ Agr\_BC - 0.77\ Ind\_BC + 0.05\ Serv\_BC$$

$$A\_Ind = -\ 0.88\ Agr\_BC - 0.035\ Ind\_BC + 0.019\ Serv\_BC$$

$$A\_Serv = -\ 0.021\ Agr\_BC - 0.004\ Ind\_GDP + 0.002\ Serv\_BC$$

4.0 Results and Discussion

From equation (2), in testing for inter-sectoral linkages, the results indicate an error correction term that is negative and significant as expected indicating that service output has a stable long-run equilibrium. The speed of adjustment of service output is 0.014 indicating a slow speed of adjustment of service output when it deviates from its long run equilibrium.

The cointegration vector with significant coefficients indicates a long-run equilibrium relationship between service, industry and agricultural sectors (**Equation 7**).

$$Serv_{GDP} - 22.9Ind_{GDP} - 10.95Agr_{GDP} \qquad (7)$$

Equation (7) indicates that when industrial output increases by 1 percent, ceteris paribus, service output increases by 22.9 percent. Contrastingly, if agricultural output rises by 1 percent, ceteris paribus, service output declines by 10.9 percent. This inverse relationship between agricultural and service output indicates a competition for resources. The implication is that when productivity rises in one sector, given that the factors of production are limited and not mutually exclusive; more resources are allocated to that sector and thus less to a different sector. This inverse relationship between agriculture and services is consistent with that of Gemell et al, (2000).

$$\Delta Serv_{GDP} = 19774 - 0.44\Delta Serv_{GDP\text{-}t} + 0.79\Delta Ind_{GDP} - 0.014$$
$$(5.28) \qquad (-2.47) \qquad (2.60)$$

$$(Serv_{GDP} + 22.9Ind_{GDP} - 10.95Agr_{GDP}) \qquad (8)$$
$$(-2.73)$$

$$R^2=0.69$$

On average, ceteris paribus, the quarterly service output based on the coefficient in equation (8) is KSh 19,774 Million. Service output when in disequilibrium adjusts at a rate of 14 percent per quarter. This implies when shocks occur to sectoral output from industrial or agricultural output, they persist within service output and take approximately, 7 quarters for shocks to dissipate and for service output to revert to its long run equilibrium level. Coefficient of industrial output indicate that short run changes of 1 percent in industrial output, increases service output by 0.79 percentage points, while short run changes in agricultural output of 1 percent diminishes service output by 0.07.

Although, the coefficient of agricultural output in short run is not significant, the sign is consistent with the long run relationship between agricultural output and service output. This inverse relationship reflects the resource competition between the two sectors.

Table 6: Granger Causality Results

Equation	Excluded	chi2	df	prob>chi2
Agr_GDP	Ind_GDP	0.40718	1	0.523
Agr_GDP	Serv_GDP	8.0681	1	0.005
Agr_GDP	ALL	112.81	2	0.000
Ind_GDP	Agr_GDP	0.18954	1	0.663
Ind_GDP	Serv_GDP	18.829	1	0.000
Ind_GDP	ALL	20.691	2	0.000
Serv_GDP	Agr_GDP	11.627	1	0.001
Serv_GDP	Ind_GDP	0.97321	1	0.324
Serv_GDP	ALL	14.141	2	0.001

Granger causality tests (**Table 6**) indicate a bidirectional relationship between agricultural and service output and a unidirectional relationship between industrial output running from industrial output to service output. There is no statistically significant relationship between agricultural output and industrial output. The significant relationship between agricultural output and service output and contrasting lack of a relationship between agricultural output and industrial output is affirmed in Gemell et al, (2000) and is attributed to the relatively high substitutability of inputs such as labor between agriculture and service sectors than between agriculture and industrial sectors.

The results indicate that sectoral bank credit can positively influence increase in output not only in the sector where it is allocated but also to other sectors. Results indicate a positive long run relationship between bank credit to industry and agricultural output. The coefficients indicate that an additional KSh 1 lent to industry increases agricultural output by 2.1 percent. Contrastingly, from the same equation for an additional KSh 1 lent to service sector, agricultural output declines by 1.67 percent.

However, in the short run, an additional KSh 1 lent to service sector yields an increase of 1.65 percent in agricultural output. The different effects of bank credit to service in the short run and in the long run may reflect the sectoral linkages that exist between the two sectors where, agriculture may be an input in service and service an input into future agricultural output, but these effects may dissipate and be outweighed by the resource competition of inputs between the two sectors. For industrial output, there is no significant long run relationship between industrial output and bank credit to industry or bank credit to agriculture and bank credit to service.

Table 7: Regression Results

Dependent Variable:	A_Serv		A_Ind	
Method: ARDL				
Variable	**Coefficient**	**(t-statistics)**	**Coefficient**	**(t-statistics)**
	0.006562***			
Agr_BC(-2)	(3.149368)	0.005284**		
Agr_BC(-3)	(2.070621)	0.000714**		
Serv_BC	(2.647593)	-0.000613**	0.001318*	(1.887282)
Serv_BC(-2)	(-2.10819)			
Serv_BC(-1)			-0.00185***	(-2.787293)
Ind_BC			0.00309*	(2.023156)
Statistics				
Adjusted R Squared	0.372642		0.244211	
S.E. of regression	33.46994		100.6731	
F-Statistic	3.177947		3.261845	
Durbin-Watson Stat	2.087118		1.921411	
Prob (F-statistic)	0.011348		0.018066	

Note ***, ** and * statistical significance at 1%, 5% and 10% levels, respectively

With regard to productivity, although there is no significant long run relationship between industrial productivity and bank credit to agriculture, there is a significant long run relationship between bank credit to service and bank credit to industry, where an additional KSh 1 lent to industry and service, yield to marginal increase in industrial productivity by 3 percent and 1 percent respectively. In the short run, an additional KSH lent to service reduces industrial productivity by 1 percent. This may reflect the resource competition as suggested by the inter-sectoral linkages between industry and service sectors. Service productivity has a positive significant long run relationship with bank credit to service sector but no other significant relationships between service productivity and bank credit to industry and agriculture **(Table 7).**

5.0 Conclusion and Policy Recommendation

The findings indicate significant inter-sectoral linkages between agriculture, industry and service sectors. These inter-sectoral linkages result in amplifying effects on sectoral growth and productivity as affected by bank credit as an input.

These inter-sectoral linkages also reflect resource competition which indicates that banks do lend credit to the most productivity sectors such that when a sector becomes more efficient i.e. produces more given its inputs, credit moves to that sector and declines in the other sectors.

As service sector has inter-sectoral linkages to both agriculture and industry, banks should continue to lend more to service sectors in order to maximize returns as lending to service sector yields growth and productivity effects in the other two sectors.

The results also indicate that although agriculture obtains the least proportion of credit, its productivity increases to a larger extend from lending to industry sector which is an input to agriculture. This paper therefore proposes to banks that it is more productive and has a lower risk for banks to lend to industry than lending to agriculture if the banking sector is to promote agricultural growth and productivity. Banks should also be cognizant of resource competition in their lending so as not to have adverse effects that can be amplified due to the inter-sectoral linkages. The long run and short run inter-sectoral linkages may guide banks' lending decision as to loan tenure to the respective sectors. Further research on how different bank characteristics such as size of bank, type of ownership, etc affect productivity of bank credit allocation would enrich the analysis and thus further guide banks in their lending decisions that can support growth and promote productivity.

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Appendices

Appendix I: Contribution to GDP by Sectors (%)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture Sector	26.1	27.8	29.3	29.1	29.4	30.4	33.1	35.1	34.5
Industry Sector	21.0	20.8	21.0	20.7	20.1	19.3	19.0	19.1	19.1
Services Sector	52.9	51.4	49.7	50.2	50.5	50.3	47.9	45.8	46.4
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Appendix II; Sectoral Constant GDP Annual Growth Rate (%)

	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture Sector	10.1	2.4	3.1	5.4	4.4	5.3	4.7	1.6
Industry Sector	8.7	7.2	4.2	5.3	6.1	7.3	5.7	3.6
Services Sector	7.3	6.1	4.7	5.4	6.0	6.0	6.7	6.9
Overall	**8.3**	**5.3**	**4.2**	**5.4**	**5.6**	**6.1**	**6.0**	**4.9**

Appendix III: Sectoral Bank Credit Annual Credit Growth (%)

	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture	13.3	25.4	5.08	5.9	16.3	9.05	7.15	-15
Industry	20.4	32.3	25.6	14.1	19.5	13.9	-2.8	1.7
Services	21.4	29.9	8.22	21.1	24.4	11	8.5	-7.5
Overall	**20.8**	**30.2**	**11.7**	**18.7**	**22.9**	**11.6**	**5.91**	**-5.9**

Appendix IV: Share of Sectoral Bank credit to total Credit (%)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agriculture	5.8	5.4	5.2	4.9	4.4	4.1	4.0	4.1	3.7
Industry	20.8	20.7	21.0	23.7	22.7	22.1	22.6	20.7	22.4
Services	73.5	73.9	73.8	71.5	72.9	73.8	73.4	75.2	73.9
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

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