

## *Original Paper*

# The Sensitivity of Central Bank Interest Rate on Commercial Banks' Stock Market Returns in Kenya

Micah Odhiambo Nyamita<sup>1\*</sup> & Martine Ogola Dima<sup>2\*\*</sup>

<sup>1</sup> Lecturer, Tom Mboya University College, Kenya

<sup>2</sup> Board Member, Migori County Public Service Board, Migori, Kenya

\* E-mail: mnyamita@yahoo.com

\*\*E-mail: martine.dima@yahoo.com

Received: October 9, 2021      Accepted: October 29, 2021      Online Published: November 18, 2021

doi:10.22158/jepf.v7n5p72

URL: <http://dx.doi.org/10.22158/jepf.v7n5p72>

### ***Abstract***

*Commercial banks occupy a significant position in the transmission of monetary policy through the financial market. Furthermore, commercial banks have assets and liabilities which are interest rate sensitive, and their stock returns are believed to be particularly responsive to changes in the central bank base lending rates. Therefore, this study investigated the sensitivity of central bank interest rate changes on stock returns of listed commercial banks in Kenya for nine year period, from 2006 to 2014. The study used a hybrid of cross sectional and longitudinal quantitative surveys method, applying GMM panel data regression model on the secondary data from the 11 listed commercial banks in Kenya. The study found out that there is a significant strong positive sensitivity of average annual changes in central bank interest rates (CBR) on the stock returns of the listed commercial banks in Kenya, from 2006 to 2014, measured using CAPM. Hence, listed commercial banks' managers in Kenya should monitor, keenly, the changes in the central bank interest rates and make investor related decisions accordingly.*

### ***Keywords***

*interest rate, stock market returns, commercial banks, capital asset pricing model, generalized method of moments*

## **1. Introduction**

The impact of monetary policy, such as the central bank interest rate sensitivity, on banks' stock market returns has been a main concern for bank managers, regulatory authorities, academic communities and investors. The failure of most commercial banks have been particularly linked to the adverse impacts of

fluctuations in interest rates (Kasman, Vardar, & Tunç, 2011). Korkeamäki (2011) found out that most commercial bank managers view interest rate sensitivity as the second most significant risk factor, after credit risk. In addition, determination of the relationship between commercial banks' stock market returns and their financial risk parameters, such as central bank interest rate changes, can provide financial managers and commercial banks' regulators with additional information, including information on how to improve commercial banks' stock market returns through better management of interest rates sensitivity.

Traditional asset pricing theories assert that the value of an asset equals the present value of the future cash flows derived from the asset (Lumby & Jones, 2015). Changes in the central bank interest rate can affect individual bank's stocks by changing the expectation of future cash flows and the required rate of return (Yin & Yang, 2013). Yin and Yang (2013) argued that an increase in the central bank interest rate signals a contractionary monetary policy to the market and leads to an expectation of less cash inflow in the future. At the same time, the shareholders' required rate of return increases, as the increase in the central bank interest rate increases market interest rates and returns in bond. It is also expected that a decrease in the central bank interest rate should have the opposite effect.

The popular post Keynesian's theories, including Keynes liquidity preference, neoclassical synthesis ISLM and Basil Moore's Horizontalist or endogenous money are the major theories of interest rate (De-Juan, 2007; Wray, 1992). However, for post-Keynesian monetary theory to be truly distinct from various neoclassical versions of money theory, both the loanable funds approach and the natural rate of interest concept incorporated in the neoclassical synthesis ISLM theory had to be discarded (Lavoie, 1996). Hence, the Horizontalism theory of interest rates proposed by Horizontalist, such as Basil Moore, was proposed (De-Juan, 2007). The Horizontalist theory claims that the central bank of a country is in a position to set nominal rates and even real rates of interest by adjusting the nominal rates to the actual or expected inflation rate (Lavoie, 1996). The theory argues that what the rate of interest exactly depends on is not really significant provided it does not necessarily increase with the level of economic growth. The Horizontalist highlights that the rate of interest can be determined exogenously with respect to the income generation process (Rochon, 2006). Hence, the theory asserts that the rate of interest is exogenous. The central bank only indirectly influences the monetary aggregates and it can fix the base interest rate with absolute precision, within the limits of existing conventional financial knowledge (Frijns, Indriawan, & Tourani-Rad, 2015). Consequently, base interest rate is an administered rate, analogous to the rates set by managers of oligopolies selling their products, such as commercial banks.

A lot of countries in Sub Saharan Africa, still experience high levels of interest rates, even though majority of them have undertaken structural adjustment reforms that leads to the liberalisation of interest rates in several countries in the region, including Kenya (Were & Wambua, 2014). However, Were and Wambua (2014) argued that "two decades after the financial sector in Kenya was liberalized in the early 1990s to allow market-determined interest rates, concerns about high interest rates have

continued to persist and attracted a lot of debate in both public and policy forums". In addition, Tarus, Chekol, and Mutwol (2012) argued that interest rates were liberalized in Kenya with the main objective of improving efficiency in the intermediation process by reducing the interest risks, which in turn was to improve the listed commercial banks' stock returns. According to the authors, this still seems to be a major challenge within the Kenyan banking sector. Therefore, this study attempted to investigate the sensitivity of central bank interest rates on stock returns of listed commercial banks in Kenya.

The banking system through its ability to give credit and offer savings services can be influenced, and to some extent their stock market returns are affected, by the interest rate levels. Therefore, changes in interest rates are watched closely by bond and fixed income traders, as the resulting price fluctuations will affect the overall market returns of the securities (Gitman, Joehnk, & Hubbard, 1999). Korkeamäki (2011) argued that corporate managers, including those of commercial banks, view changes in interest rate as the second most significant risk factor, after credit risk.

Given the importance of banking institutions in facilitating financial intermediation, several studies have been conducted in Kenya on the changes of interest rates, mostly to identify the determinants of interest rate spread (Tarus et al., 2012; Were & Wambua, 2014). Others such as Irungu (2013); Okech (2013) and Githae (2012) have looked at the effect of interest rate spread on the financial performance of commercial banks in Kenya. This study in addition attempted to contribute to the epistemology of financial management in the area of interest rate by focusing on the trend of the changes of central bank (CBK) rates in Kenya for nine year period, from 2006 to 2014, and how these changes impacts on the stock returns of listed commercial banks in Kenya. The CBK rates were the main focus since the commercial banks have no influence on their determinations.

Section 36 (4) of the **Central Bank of Kenya Act** specifies that the Central Bank shall publish the lowest rate of interest it charges on loans to banks and that rate shall be known as the **Central Bank Rate**. The level of the base lending rate is reviewed and announced by the **Monetary Policy Committee** at least every two months and its movements, both in direction and magnitude, signals the monetary policy stance. The central bank rate is the base interest rate for all monetary policy operations in order to enhance clarity and certainty in monetary policy implementation. The Kenyan commercial banks, including the listed ones, then set their individual lending rates based on the central bank base lending rate, which may have either a positive or negative influence on the individual commercial banks' performance.

Risk being part and parcel of the market and an investor can also get negative returns in case of wrong speculations, the capital asset pricing model (CAPM) is one of the best measures of stock returns for listed firms such as commercial banks, since the measure incorporates risk factor as one of the variables for determining stock returns (Lumby & Jones, 2015). Olweny (2011) argued that CAPM has a number of assumptions and some of them do not hold in the real world, but he noted that the measure is still useful in evaluating financial decisions. In addition, Najand and Noronha (1998) also noted that the direction of causality and the specification of the relationship between stock returns and monetary

policy factors, such as interest rate sensitivity still remains unresolved.

The level of prevailing market interest rates may provide a single instrumental variable representing the changes in the investment opportunity within an economy (Tai, 2000). According to Tai (2000), this implies that studies might want to include the interest rate sensitivity as one possible extra-market factor which affects the stock returns of firms, using the capital asset pricing model (CAPM). Therefore, many studies have suggested that changes in interest rate is one of the major factors in most of the stock markets which influence stock returns of firms such as commercial banks (Fernandez-Perez, Fernández-Rodríguez, & Sosvilla-Rivero, 2014; Frijns et al., 2015).

In other words, monetary policy decisions, such as central bank interest rates, influence various short-term interest rates which in turn, affect the discounted present value of expected future cash flows and may thus increase or decrease stock returns of firms (Zare, Azali, & Habibullah, 2013). The authors noted that most studies have come to a general consensus that stock returns are inclined to monetary policy decisions of the central bank, such as interest rates. Furthermore, according to Yin, Yang, and Handorf (2010), how bank stock returns react to monetary policy changes, such as central bank interest rates, not only reveals their effect on bank performance but also barometrically determines the efficacy of monetary policy in regulating the economy.

In addition, during the financial crisis period, banks have become the main subject of many monetary policy interventions, especially through the central bank interest rates (Fiordelisi, Galloppo, & Ricci, 2014). In line with the above argument, it is particularly important to understand what the main determinants of bank stock returns and their response to monetary policy changes are (Ricci, 2015). According to Fiordelisi and Molyneux (2010) bank common stock prices and bank stock returns, depend on both macroeconomic and bank-specific factors. Among these factors, a crucial role is played by changes in monetary policy, such as central bank interest rate changes, because of the interest rate sensitivity of both bank assets and liabilities (Yin & Yang, 2013). Yin et al. (2010) present a detailed discussion of how interest rate changes may affect bank stock returns.

However, most of these studies have found that interest rate sensitivity is a major factor for the overall stock market returns, amongst other factors such as bank size, funding sources and soundness of the bank (Yin & Yang, 2013). Few studies, such as Yin and Yang (2013); Kasman et al. (2011); Yin et al. (2010) and Tai (2000), which have looked at interest rate as a determinant of stock returns of commercial banks have been done from developed economies with more efficient stock markets like United States (US). Thus, it is interesting to examine whether the changes of central bank interest rates have a potential influence on stock returns of commercial banks from a developing economy region with a developing stock market, such as Kenya. Hence, this study attempted to analyse the extent of stock market returns of listed commercial banks in Kenya over the nine year period, from 2006 to 2014 using CAPM, and determine how stock returns relates with the changes of central bank interest rates.

Commercial banks play an essential role in the economy of a nation, such as Kenya, by undertaking financial intermediation functions (Were & Wambua, 2014). Commercial banks are involved in

receiving funds from the public by accepting demand, time and saving deposits or borrowing from the public or other banks, and using such funds as whole or in part for granting loans, advances and credit facilities and for investing funds by other means (Tarus et al., 2012). According to Tarus et al. (2012) there are 44 commercial banks operating in Kenya and the sector has experienced higher interest rate sensitivity over the nine year period, from 2006 to 2014. According to the Central Bank of Kenya (2014a) report, 11 of the 44 commercial banks have been listed on the Nairobi Securities Exchange.

The financial services within the commercial banks in Kenya have remained expensive, as evidenced by high interest rate sensitivity and account fees (Beck et al., 2010). Furthermore, Barako and Gatere (2008) also argued that in a survey conducted by the Central Bank of Kenya, a number of financial institutions in Kenya, including commercial banks have no risk management frameworks, which always help organisations to manage risks such as interest rates sensitivity. In the recent economic recovery strategy, the government of Kenya acknowledged that the commercial banks in Kenya, including the listed banks were experiencing difficulties that would undermine the achievement of the objectives set out in the strategy, including inadequate returns from the banking sector and persistence of wide interest rate sensitivity leading to a high cost of credit (Beck et al., 2010). Therefore, this study endeavoured to contribute towards the economic recovery strategy by identifying the trend of the sensitivity of interest rates in Kenya for nine year period, from 2006 to 2014, analysing the extent of stock returns of listed commercial banks in Kenya over the nine year period, from 2006 to 2014 and investigating the sensitivity of interest rates on stock returns of listed commercial banks in Kenya.

Several alternative theories of interest rate have been developed (Brillant, 2014). According to De-Juan (2007) the theories can be classified into classical and post Keynesian. The classical theory, also referred to as loanable funds approach, was proposed by classical economist, Keynes who held the view that economic activities were guided by some kind of invisible hand i.e. through the self interest motive and price mechanism, and that government interference was unnecessary (Keynes, 1937; Ohlin, Robertson, & Hawtrey, 1937; Wray, 1992). According to loanable funds theory, the interest rate is simply the price of loan, and is therefore governed by the supply of and demand for loan, with no influence from the government economic policies, such as the banking system (Brillant, 2014). Although the theory has a certain amount of validity, it has been criticized by many economist, such as Keynes (1937) and Ohlin et al. (1937). The critics argued that the theory assumes money is borrowed entirely for the purchase of capital assets which is not true, since money can also be borrowed for purchase of consumer goods.

The main proponents here are Keynes, John Hicks and Basil Moore. The post Keynesian's theories, also referred as monetary theories, include Keynes liquidity preference, neoclassical synthesis ISLM and Basil Moore's Horizontalist or endogenous money (De-Juan, 2007; Wray, 1992). Keynesian liquidity preference theory, which is also called the monetary theory of interest rate, was put forward by Keynes in 1936 (Brillant, 2014). In other words, Keynes rejected the classical loanable funds theory when he defined the interest rate as a reward for not hoarding money (Wray, 1992). Unlike the Keynesian liquidity preference theory where interest rate is determined by the stock equilibrium, in the ISLM

model, however, the interest rate is determined at the point where the goods, bonds and monetary markets are in equilibrium. In other words, interest is determined as a result of both stocks equilibrium and the flows equilibrium (Gerrard, 1995).

The Horizontalist theory claims that the central bank of a country is in a position to set nominal rates and even real rates of interest by adjusting the nominal rates to the actual or expected inflation rate (Lavoie, 1996). The theory argues that what the rate of interest exactly depends on is not really significant provided it does not necessarily increase with the level of economic growth. The Horizontalist highlights that the rate of interest can be determined exogenously with respect to the income generation process (Rochon, 2006). Hence, the theory asserts that the rate of interest is exogenous.

In other words, the Horizontalist theory argues that the base interest rate is not a market phenomenon, but a bureaucratically determined rate, which may be more or less influenced by the political class and national financial systems (Lavoie, 1996). The country's central bank has discretionary control over the interest rate. However, according to the theory, the central bank only indirectly influences the monetary aggregates and it can fix the base interest rate with absolute precision, within the limits of existing conventional financial knowledge (Frijns et al., 2015). Consequently, base interest rate is an administered rate, analogous to the rates set by managers of oligopolies selling their products, such as commercial banks.

Kenya has one stock market, the Nairobi Securities Exchange (NSE), where the debt securities of the listed corporations, such as bonds and preference shares are bought and sold. The market has increased in activities over the past periods, attracting even state-owned corporations, which are partially owned by the government (Randa & Gubbins, 2013). The authors argued that the securities' market is booming with securities' prices rising strongly in the past. The stable average market capitalization over the five-year period of the study, with a high growth of 40% recorded in 2010, driven by strong performances across all sectors of the economy in the same year. Nonetheless, the NSE index has shown some slight decline, but with an increase of 1 186 points (36.5%) in 2010. The stability of the stock exchange is believed to allow listed corporations, such as commercial banks, to have an option of raising external finance through the stock market. Hence, the stock market activity, measured the return, may have an impact on the individual stock returns of listed commercial banks.

On the other hand, the banking sector in Kenya has undergone noteworthy transformation over the last decade or so (Randa et al., 2013). The authors argued that these reforms have improved the resilience of the sector to domestic and international shocks. They also noted that the state presence in the sector has been shrinking, and with it the share of non-performing loans in bank portfolios. Randa et al. (2013) also argued that Kenyan banks are doing better than their counterparts in Sub-Saharan Africa in terms of the share of lending to small and large corporations. Though the weighted average of commercial banks' lending rates have been increasing over the study period, from the lowest of 13.32% in 2007 to 20.04% in 2011, the overall domestic credit has been grown by 124%, from Kshs. 671 Billion in 2007

to Kshs. 1.5 Trillion in 2011 (Central Bank of Kenya, 2014b). On the other hand, the outstanding debt of the government has also increased by 82%, from Kshs. 715.5 Billion in 2007 to Kshs. 1.3 Trillion in 2011.

In the recent economic recovery strategy, the government of Kenya acknowledged that the commercial banks in Kenya, including the listed banks, were experiencing difficulties that would undermine the achievement of the objectives set out in the strategy, including inadequate market returns from the banking sector and persistence of wide interest rate sensitivity leading to a high cost of credit (Beck et al., 2010). Therefore, this study attempted to contribute towards the economic recovery strategy by identifying the trend of the central bank interest rates in Kenya for nine year period, from 2006 to 2014, analysing the extent of stock market returns of listed commercial banks in Kenya over the nine year period, from 2006 to 2014 and investigating the sensitivity of the central bank interest rates on stock market returns of listed commercial banks in Kenya.

## 2. Methodology

The study applied a hybrid of cross sectional and longitudinal quantitative surveys. Rindfleisch, Malter, Ganesan and Moorman (2008), in their study of cross-sectional versus longitudinal, argue that both the designs have limitations and a combination gives a strong output. Therefore, the combination of the techniques allowed the researcher to investigate effects of debt financing across corporations and also get the trend over a period of nine years from 2006 to 2014.

The population was defined in terms of the number of commercial banks established under the banking Acts of Kenya as at June 30, 2014. The population frame data was from the Central Bank of Kenya. According to the Central Bank of Kenya (2014a) report, there are 44 established commercial banks in Kenya by June 30, 2014. Eleven of the 44 commercial banks have been listed on the Nairobi Securities Exchange.

The sample size for the study was made up of the eleven listed commercial banks in Kenya selected using stratified non-probability sampling technique. The non-listed commercial banks were excluded from the study, since their stock returns are not based on their stock market performance. According to Zhang, Wang, Su, Liu, Shen and Bi (2007), a census study is more straightforward and suitable to be used in a local setting where the population frame exists with certainty. The study therefore, used a census technique and collected data from all the 11 listed commercial banks in Kenya.

The study used secondary data both in the computation of individual stock market returns and the relationship between the changes in CBK rate and stock market returns. The CBK interest rates was collected from the Central Bank of Kenya official website while the stock market returns variables for the period from 2006 to 2014, to be used in equation 2 and 4 were collected from the Nairobi Securities Exchange (NSE) market. The stock market variables included the daily ordinary share prices of the listed commercial banks, daily NSE price index and the published financial statements of the banks, all for the period from 2006 to 2014.

## 2.1 Data Analysis

The descriptive statistical analysis method was used to identify the trend of central bank interest rates and analyse the extent of stock returns of the listed commercial banks in Kenya over the nine year period, from 2006 to 2014. A panel data regression analysis, using the general method of moment (GMM method), was also done using the capital asset pricing model (CAPM). CAPM is one of the best measures of stock market returns for listed firms such commercial banks, since the measure incorporates risk factor as one of the variables for determining stock returns (Lumby & Jones, 2015). Consequently, this study applied the CAPM model given below to calculate the individual monthly stock returns for listed commercial banks over the study period.

$$E(R_j) = R_f + (R_m - R_f) B_j \quad (1)$$

Where  $E(R_j)$  represents the required rate of return of a security, and  $R_f$  represents the risk-free rate. While,  $R_m$  is the expected market return and  $B_j$  represents the systematic risk of security j. Capital Asset Pricing Model therefore can be used to calculate the expected stock return for ordinary shares of firms, such as listed commercial banks. Risk premium is the market risk premium  $(R_m - R_f)$  weighted by the index of the unsystematic risk  $B_j$  of an individual security. If the general economy is static and industry characteristics are unchanged, and management policies have continuity, the measure of  $B_j$  of a security is relatively stable when calculated for different time periods. If the condition of stability does not exist, then the value of  $B_j$  varies over different periods. Beta of the security is calculated as:

$$B_j = \frac{Cov(j, m)}{\delta^2 m} \quad (2)$$

Where  $Cov(j, m)$  represents the covariance between the security's return and the market, and  $\delta^2 m$  is the market variance systematic risk is referred to as market beta.

On the other hand, panel regression model of the form used by Yin and Yang (2013) was used to determine the relationship between stock market returns of listed commercial banks in Kenya and the changes in the central bank interest rates, applying the GMM regression method. The basic model of the relationship between bank stock returns and changes in the central bank interest rate as suggested by Yin and Yang (2013) is as follows:

$$R_{it} = \alpha + \gamma_m \cdot R_{mt} + \gamma_u \cdot \Delta I_{ut} + \varepsilon_t \quad (3)$$

Where  $R_{it}$  is the holding-period return of the  $i$ th bank stock from  $t = 1$  to  $t$ ;  $R_{mt}$  is the market return, a control variable, representing the one-month holding period return of the market index on the day of the event (the announcement of a change in the central bank interest rate) and  $\Delta I_{ut}$  is the component of central bank interest rate changes.

This helped in determining the effect of central bank interest rate on the stock returns of listed commercial banks in Kenya over the fifteen year period. To establish the significance of individual variables in the regression model, the T-test was applied at 95% levels of confidence. Under the system-GMM estimator procedure, the form of panel regression equation 3 was changed into equation 4 as follows:



$$R_{it} = \alpha + \beta R_{it-1} + \gamma_m \cdot R_{mt} + \gamma_u \cdot \Delta I_{ut} + \varepsilon_t \quad (4)$$

The new variable  $R_{it-1}$  is the lagged value of the banks stock return, with its coefficient  $\beta$ . The presence of the lagged dependent variable  $R_{it-1}$  controls for autocorrelation or serial correlation within the dependent variables (Fiordelisi & Molyneux, 2010). In addition, the data analysis was done using both the Statistical Package for the Social Sciences (SPSS) and Data analysis and Statistically Software (STATA) and the presentations and discussions of the results shown in chapter four.

### 3. Results

Table 1 illustrates the summary statistics of the variables used in the study. The average price per ordinary share of listed commercial bank was measured in Kenya shillings. Table 1 shows that the maximum average price during the study period, from 2006 to 2014, was Kshs. 313.703 and the minimum average price was Kshs. 9.15, with a mean of Kshs. 81.522. On the other hand, the price return is the measure of annul relative change of average price of listed commercial banks over the study period. Table 1 shows that the maximum price return was 0.273 (27.3%) and the minimum was -0.106 (-10.6%), with a mean of 0.015 (1.5%). This implies that, though for some years the annul price decreased, on average there was annual relative increase of average ordinary share prices of listed commercial banks over the nine year period, from 2006 to 2014.

**Table 1. Summary Statistics**

Variable	Mean	Std. Dev.	Min	Max	Observations
Average Price (Kshs)	81.522	74.011	9.150	313.703	78
Price return	0.015	0.052	-0.106	0.273	78
CBR (%)	9.316	2.640	5.750	18.000	78
Change in CBR	-0.002	0.040	-0.136	0.110	78
Risk free rate (%)	7.957	2.793	2.460	20.560	78
NSE index	4345.764	720.545	3009.323	5973.375	78
Market return	0.010	0.029	-0.044	0.087	78
CAPM rate of return (%)	3.783	1.950	0.395	9.956	78
CAPM return	0.018	0.081	-0.075	0.311	78

Table 1 also illustrates the listed commercial banks' rate of return calculated using Capital Asset Pricing Model (CAPM) and the relative annul change of the same, i.e., CAPM return. The maximum CAPM rate of return from Table 1 is 9.956%, minimum of 0.395% and an average of 3.783%. It is interesting to highlight that the mean (3.783%) of CAPM rate of return of listed commercial banks in Kenya is less than the risk free rate (7.957%) which is the return on the Kenya Central Bank 91 days' treasury bills. Theoretically, the return on ordinary shares of listed commercial banks (CAPM rate of return) should

be greater than the risk free rate (Firer, Ross, Westerfield, & Jordan, 2012).

In addition, the CAPM return, which is the annual relative change of CAPM rate of return, indicates a positive mean of 0.018 (1.8%). This is slightly higher than the mean of price return (1.5%), though all have shown a mean positive annual relative change over the period. Table 1 also shows the summary statistics of the Central Bank interest rate (CBR) and the annual relative change of the same. The maximum CBR during the period was 18% and the minimum was 5.75%, with a mean of 9.316%. On the other hand, change in CBR, which is the main independent variable of the study, had a maximum value of 0.11 (11%) and a minimum of -0.136 (13.6%), with a mean -0.002 (-0.2%). The table indicates that the annual relative change of CBR was averagely on the decrease but not so much pronounced since the standard deviation value was only 0.04 (4%) compared to 0.081 (8.1%) and 0.052 (5.2%) of the corresponding dependent variables of CAPM return and price return, respectively.

### 3.1 Correlation Analysis

Table 2 presents the Pearson correlation coefficients ( $r$ ) for both the dependent and independent variables used in the study. Table 2 shows that the CAPM return and Change in CBR are positively correlated, which indicates that if CBR increases then there is a possible increase in CAPM return, though not significant.

However, the Table 2 also shows a positive correlation between CBR and CAPM rate of return, and a negative correlation between CBR and CAPM return (change in CAPM rate of return), though both the correlations are significant. Furthermore, the correlation between price return and change in CBR is negative, though not significant. Interestingly, there is also a significant strong positive correlation between price return and market return, suggesting a possible influence of market return on price stock returns of listed commercial banks in Kenya.

**Table 2. Correlation Analysis**

	Average Price	Price return	CBR	Change in CBR	Risk free rate	NSE index	Market return	CAPM rate of return	CAPM return
Average Price	1.000								
Price return	0.075	1.000							
CBR	-0.067	0.116	1.000						
Change in CBR	0.021	-0.395	-0.226	1.000					
Risk free rate	-0.141	-0.069	0.832***	-0.009	1.000				
NSE index	0.316***	0.280**	-0.168	-0.101	-0.271**	1.000			
Market return	-0.047	0.657***	0.093	-0.472	-0.117	-0.011	1.000		
CAPM rate of return	-0.103	-0.141	0.477***	0.045	0.506***	-0.093	-0.190*	1.000	
CAPM return	-0.092	-0.395***	-0.226**	0.624	0.086	-0.053	-0.296***	0.624***	1.000

The symbols \*\*\*, \*\* and \* indicate significance at the 99%, 95% and 90% level of confidence, respectively

### 3.2 The Trend of Central Bank Interest Rates in Kenya

In addition to the aforementioned summary statistics of the Central Bank interest rates, figure 4.1 illustrates the trends of changes in the Central Bank interest rates in Kenya from 2006 to 2014. The figure shows the trends of both the CBR and the 91 days' treasury bills rate (risk free rate).

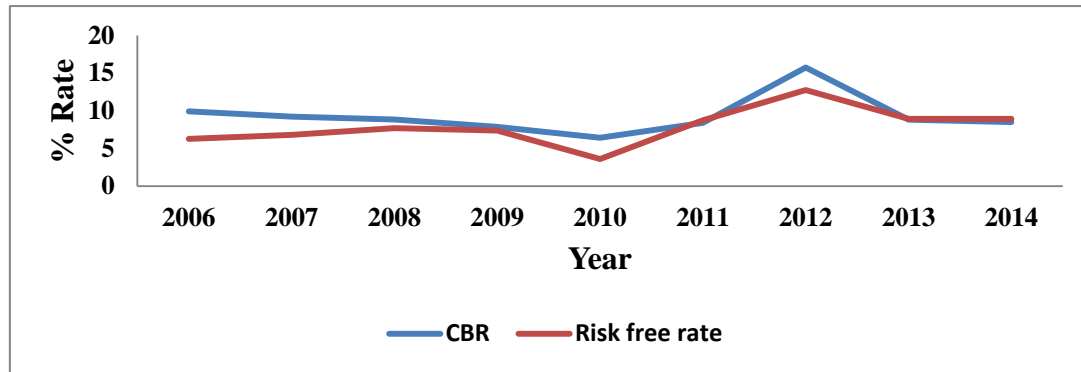


Figure 1. The Trends of Central Bank Interest Rates

Figure 1 shows that both the trends of CBR and risk free rate are somehow similar. However, the risk free rate values are all through below the CBR values. The CBR graph demonstrates a steady low decline trend from 2006 to 2009, with the lowest levels in 2010. Furthermore, the CBR graph shows a sharp incline from 2010, reaching the highest peak in 2012, followed by a decline in 2013 and a steady trend towards 2014. The changes in the Central Bank interest rates have not been very drastic except between 2010 to 2013. Hence, the impact of these changes on the stock returns of listed commercial bank should be expected at minimal levels.

### 3.3 The Extent of Stock Market Returns of Listed Commercial Banks in Kenya

Figure 2 demonstrates the extent of stock market returns of listed commercial banks in Kenya from 2006 to 2014. The figure presents the annual relative changes on price returns and CAPM rate of return, including the annual relative change on market returns.

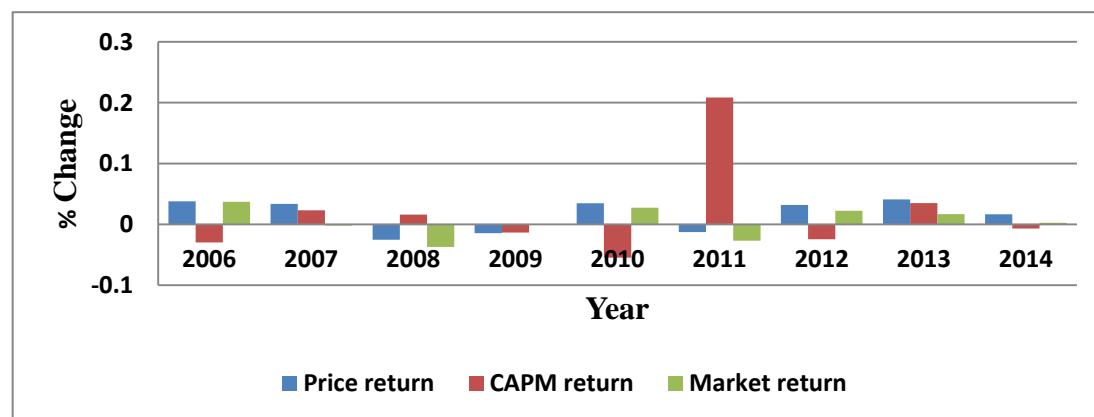


Figure 2. Extent of Stock Returns

The annual relative changes on Price return and market return are demonstrating parallel behaviour throughout the period. They are illustrating increase in 2006, 2007, 2010 and 2012 to 2014. The years when the price and market returns are decreasing includes 2008, 2009 and 2011. This is a sign that the market return might be influencing the price returns of listed commercial banks in Kenya (Lumby & Jones, 2015). On the other hand, Figure 2 shows that the annual relative changes on CAPM return over the nine years were not consistent, with the highest increase in 2011. The figure also demonstrates the lowest decrease on CAPM return in 2010, which corresponds with the lowest levels of CBR and risk free rate in Figure 1. It is therefore interesting to determine the sensitivity of central bank interest rate (CBR) changes on CAPM return of listed commercial banks in Kenya.

### *3.4 The Sensitivity of Central Bank Interest Rate Changes on Stock Returns of Listed Commercial Banks in Kenya*

The main objective of the study was to investigate the sensitivity of central bank interest rate changes on stock returns of listed commercial banks in Kenya for the nine year period, from 2006 to 2014. The objective was achieved using the GMM panel data regression model 4, which applied the CAPM return as the main dependent variable and change in CBR as the main independent variable, with the market return and the lagged CAPM return as control variables. Table 3 presents the GMM panel data regression results for study model three, using these main study variables at 95% level of confidence interval.

**Table 3. GMM Panel Data Regression Results for CAPM Return**

CAPM Return	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
CAPM Return						
L1.	-0.0427	0.1055	-0.4000	0.6860	-0.2496	0.1641
Market return	0.1949	0.3212	0.6100	0.5440	-0.4346	0.8244
Change in CBR	1.3043	0.2403	5.4300	0.0000	0.8333	1.7752
_cons	0.0258	0.0084	3.0800	0.0020	0.0094	0.0422

Arellano-Bond test for AR(1) in first differences:  $z = -3.33$   $Pr > z = 0.001$

Arellano-Bond test for AR(2) in first differences:  $z = -1.68$   $Pr > z = 0.293$

Sargan test of overid. restrictions:  $\chi^2(45) = 65.22$  Probability  $>\chi^2 = 0.026$

The table demonstrates that there is a significant strong positive (1.3043) sensitivity of average annual changes in central bank interest rates (CBR) on the CAPM return of the listed commercial banks in Kenya from 2006 to 2014. The results are reliable since the coefficient of the changes in CBR and the model's constant are significant at 99% interval level of confidence (i.e.,  $p = 0.000$  and  $p = 0.002$ , respectively).

In addition, the validity and reliability tests, measured by the Arellano-Bond test for AR (1&2) and

Sargan test also indicate that the model's results are valid and reliable. According to Bond (2002), the p-value of Arellano-Bond test for AR (1) this should be less than 0.05 and that of AR (2) should be greater than 0.05. While the p-value of Sargan test should be less than 0.05. This is the case for the GMM panel data regression results for CAPM return model (i.e., AR (1)  $p = 0.001$ , AR (2)  $p(\chi^2) = 0.293$  and Sargan test  $p = 0.026$ ).

Therefore, the results indicate that a positive change in central bank interest rate (CBR) is expected to cause 1.3043 times positive change on CAPM return on the stock of a listed commercial bank in Kenya. On the other hand, a negative change in central bank interest rate (CBR) is expected to cause 1.3043 times negative change on CAPM return. This result is contrary to the earlier studies done in more developed economies like United States. Most of these studies such as Madura and Schnusenberg (2000), who tested how monetary policy changes, including federal or central bank interest rates affect bank stock returns over 1974-1996, found out that there is a strong inverse relationship between the central bank interest rate changes and commercial bank stock returns. Applying a different data set that covered 1988-2007, Yin et al. (2010) confirmed the inverse relationship between commercial bank stock returns and central bank interest rate changes.

However, they found that commercial banks' stock returns only respond to surprise changes in the central bank base lending rates. In addition, Yin and Yang (2013) argued that the existing literature on commercial bank stock returns and changes in the central bank interest rate changes suggests that the influence of central bank interest rate changes on commercial bank stock returns vary across banks, depending on specific bank characteristics. This may be the case in this study since the characteristics of listed commercial banks and stock market in Kenya is different with those for developed economies like the United States. In addition, the results in Table 3 also confirms the positive sensitivity finding of change in interest rate on stock returns of Thailand and Malaysian listed companies (Tarazi & Gallato, 2012).

**Table 4. GMM Panel Data Regression Results for Price Return**

Price return	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
Price return						
L1.	-0.0148	0.0878	-0.1700	0.8660	-0.1869	0.1573
Market return	1.2421	0.1935	6.4200	0.0000	0.8628	1.6215
Change in CBR	-0.0747	0.1298	-0.5800	0.5650	-0.3291	0.1798
_cons	0.0052	0.0051	1.0200	0.3070	-0.0048	0.0152

Arellano-Bond test for AR(1) in first differences:  $z = -4.29$   $Pr > z = 0.000$

Arellano-Bond test for AR(2) in first differences:  $z = 1.22$   $Pr > z = 0.223$

Sargan test of overid. restrictions:  $\chi^2(56) = 61.71$  Probability  $> \chi^2 = 0.279$

Nevertheless, the GMM panel data regression for price return demonstrated the negative (-0.0747) sensitivity of changes in central bank interest rates (CBR) on the price return of the listed commercial banks in Kenya as presented in Table 4 below. These results are in confirmation of the previous studies results, though, the negative sensitivity is not significant ( $p = 0.565$ ) and the Sargan test ( $p = 0.279$ ) does not indicate reliability and validity. Table 4 also shows that there is a significant strong positive (1.2421) relationship between the market return and the price return. This implies that the market return has a strong positive influence on the stock prices of listed commercial banks in Kenya.

**Table 5. GMM Panel Data Regression Results for CAPM Return, NSE Index and CBR**

CAPM return	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]
CAPM return					
L1.	0.6678	0.0783	8.5300	0.0000	0.5143 0.8213
NSE index	-0.0003	0.0002	-1.5300	0.1270	-0.0007 0.0001
CBR	0.3452	0.0552	6.2500	0.0000	0.2369 0.4534
_cons	-0.4074	1.1357	-0.3600	0.7200	-2.6333 1.8185

Arellano-Bond test for AR(1) in first differences:  $z = -3.33$   $Pr > z = 0.001$

Arellano-Bond test for AR(2) in first differences:  $z = -1.68$   $Pr > z = 0.093$

Sargan test of overid. restrictions:  $\chi^2(33) = 59.05$  Probability  $> \chi^2 = 0.004$

The study further analysed the GMM panel regression using CAPM return as the dependent variable and Central Bank interest rate (CBR) as the independent variable, with NSE index and lagged CAPM return as the control variables. The corresponding results as presented on Table 5 below also shows that there is a significant ( $P = 0.000$ ) positive sensitivity (0.3452) of CBR on the CAPM return of listed commercial banks in Kenya. The results of this GMM model is also valid and reliable as illustrated by the p - values of Arellano-Bond and Sargan tests (i.e., AR (1)  $P = 0.001$ , AR (2)  $p = 0.093$  and  $p(\chi^2) = 0.004$ , respectively).

Finally, the study did an additional robust test using the GMM panel data regression with CAPM return as the dependent variable and change in central bank interest rate as the main independent variable. The NSE index, market return, CBR and risk free rate were included in the model as control variables. The results as presented on Table 6 further confirms the significant ( $p = 0.000$ ) positive sensitivity (1.2095) of changes in central bank interest rates (CBR) on the CAPM return of listed commercial banks in Kenya. The Arellano-Bond and Sargan tests (AR (1)  $p = 0.010$ , AR (2)  $p = 0.689$  and  $p(\chi^2) = 0.028$ , respectively) also shows validity and reliability of this model results. However, the significant test for all the other control variables and the constant demonstrated insignificant p-values.

**Table 6. GMM Panel Data Regression Results for Robust Test**

CAPM return	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
CAPM return						
L1.	-0.1129	0.2076	-0.5400	0.5870	-0.5198	0.2940
NSE index	0.0000	0.0000	0.6100	0.5410	0.0000	0.0000
Market return	0.2829	0.3260	0.8700	0.3860	-0.3561	0.9219
CBR	-0.0048	0.0074	-0.6400	0.5200	-0.0193	0.0098
Change in CBR	1.2095	0.2868	4.2200	0.0000	0.6474	1.7716
Risk free rate	0.0083	0.0061	1.3600	0.1740	-0.0037	0.0202
_cons	-0.0298	0.0629	-0.4700	0.6360	-0.1530	0.0935

Arellano-Bond test for AR (1) in first differences:  $z =$  .  $Pr > z = 0.010$

Arellano-Bond test for AR (2) in first differences:  $z =$  .  $Pr > z = 0.689$

Sargan test of overid. restrictions:  $\chi^2(44) = 63.67$  Probability  $> \chi^2 = 0.028$

#### 4. Discussion

The aim of this study was to investigate the sensitivity of central bank interest rate (CBR) changes on stock returns of listed commercial banks in Kenya for nine years period, from 2006 to 2014. The study calculated the monthly stock returns of the listed commercial banks using CAPM and stock prices of the individual listed commercial banks. The study then applied the average annual figures in the GMM panel data regression model, with the stock returns as the dependent variable and changes in central bank interest rates (CBR) as the main independent variable.

The key research findings gained from the study focused on the literature and study findings of main research objective. The main objective of the study was to investigate the sensitivity of central bank interest rate changes on stock returns of listed commercial banks in Kenya for nine year period, from 2006 to 2014. The study observed that Commercial banks have assets and liabilities which are interest rate sensitivity, hence, the commercial banks' stock returns are believed to be particularly responsive to changes in the central bank interest rates. However, according to Yin and Yang (2013) there have been only a few studies that focus on how bank stocks react to monetary policy shocks, such as central bank base lending rate.

The literature findings from few studies that have been done, starting with the earlier one of Thorbecke and Alami (1994) found out that commercial banks stock returns are more sensitive to central bank interest rate changes than stocks returns of other industries, have given varied empirical results. Madura and Schnusenberg (2000) found out that there is a strong inverse relationship between the central bank interest rate changes and commercial bank stock returns. Applying a different data set that covered 1988-2007, Yin et al. (2010) confirmed the inverse relationship between commercial bank stock returns and central bank interest rate changes. Furthermore, they found that commercial banks' stock returns

only respond to surprise changes in the central bank base lending rates. Yin and Yang (2013), studying the listed commercial banks of United States for the 10 year period, from 1988 to 2008, also found out that the bank stock returns are negatively related with changes in the central bank interest rates, which was consistent with prior empirical findings in the literature.

However, the research finding of the study demonstrated that there is a significant strong positive sensitivity of average annual changes in central bank interest rates (CBR) on the CAPM return of the listed commercial banks in Kenya from 2006 to 2014. The finding implies that a positive change in central bank interest rate (CBR) is expected to cause 1.3043 times positive change on CAPM return on the stock of a listed commercial bank in Kenya. On the other hand, a negative change in central bank interest rate (CBR) is expected to cause 1.3043 times negative change on CAPM return. This finding is contrary to the earlier studies done in more developed economies like United States. Nevertheless, Yin and Yang (2013) argued that the existing literature on commercial bank stock returns and changes in the central bank interest rate changes suggests that the influence of central bank interest rate changes on commercial bank stock returns vary across banks, depending on specific bank characteristics. This may be the case since in this study since the characteristics of listed commercial banks and stock market in Kenya is different with those for developed economies like the United States.

In addition, the study further finding when CAPM return was applied as the dependent variable and Central Bank interest rate (CBR) as the independent variable, with NSE index and lagged CAPM return as the control variables, also revealed a significant positive sensitivity of CBR on the CAPM return of listed commercial banks in Kenya. Furthermore, the robust test using CAPM return as the dependent variable and change in central bank interest rate, NSE index, market return, CBR and risk free rate as independent variables also confirmed the significant positive sensitivity of changes in central bank interest rates (CBR) on the CAPM return of listed commercial banks in Kenya.

It can be concluded, from the study's findings, that the central bank base lending rate changes may have a strong positive sensitivity on the stock returns of listed commercial banks in Kenya. This may be so since Kenyan is still is under-developed and the main country's stock market (Nairobi Stock Exchange) is not very efficient, making most investment decisions being influenced by the macroeconomic factors such as changes in central bank interest rates. This is confirmed by the study form developing economies of Thailand and Malaysian done by Tarazi and Gallato (2012) for listed companies, which also found a significant positive sensitivity of changes in interest rates on stock returns. Therefore, it can further be concluded that changes in interest rates, including central bank interest rates (CBR) have a positive impact on stock returns of listed companies, particularly banks, form developing and under-developed economies, such as Kenya.



## References

- Barako, D. G., & Gatere, P. K. (2008). Outsourcing practices of the Kenyan Banking sector. *African Journal of Accounting, Economics, Finance and Banking Research*, 2(2).
- Beck, T., Cull, R., Fuchs, M. J., Getenga, J., Gatere, P. K., Randa, J., & Trandafir, M. (2010). Banking sector stability, efficiency, and outreach in Kenya. *World Bank Policy Research Working Paper Series*, Vol.
- Bond, S. R. (2002). Dynamic panel data models: a guide to micro data methods and practice. *Portuguese economic journal*, 1(2), 141-162. <https://doi.org/10.1007/s10258-002-0009-9>
- Brillant, L. (2014). A reconsideration of the role of forward-market arbitrage in Keynes' and Hicks' theories of the term structure of interest rates. *The European Journal of the History of Economic Thought*, 21(6), 1085-1101. <https://doi.org/10.1080/09672567.2014.972425>
- Central Bank of Kenya. (2014a). *Bank Supervision Annual Report 2014*. Retrieved from Republic of Kenya.
- Central Bank of Kenya. (2014b). *Commercial banks weighted average rates*. Retrieved from <https://www.centralbank.go.ke/index.php/balance-of-payment-statistics/interest-rates-2>
- De-Juan, O. (2007). The conventional versus the natural rate of interest: implications for central bank autonomy. *Journal of Post Keynesian Economics*, 29(4), 645-666. <https://doi.org/10.2753/PKE0160-3477290406>
- Fernandez-Perez, A., Fernández-Rodríguez, F., & Sosvilla-Rivero, S. (2014). The term structure of interest rates as predictor of stock returns: Evidence for the IBEX 35 during a bear market. *International Review of Economics & Finance*, 31(0), 21-33. <http://doi.org/10.1016/j.iref.2013.12.004>
- Fiordelisi, F., Galloppo, G., & Ricci, O. (2014). The effect of monetary policy interventions on interbank markets, equity indices and G-SIFIs during financial crisis. *Journal of Financial Stability*, 11, 49-61. <https://doi.org/10.1016/j.jfs.2013.12.002>
- Fiordelisi, F., & Molyneux, P. (2010). The determinants of shareholder value in European banking. *Journal of Banking & Finance*, 34(6), 1189-1200. <https://doi.org/10.1016/j.jbankfin.2009.11.018>
- Firer, C., Ross, S. A., Westerfield, R., & Jordan, B. D. (2012). *Fundamentals of Corporate Finance* (5th ed.). New York: McGraw-Hill Education (UK) Limited.
- Frijns, B., Indriawan, I., & Tourani-Rad, A. (2015). Macroeconomic news announcements and price discovery: Evidence from Canadian-U.S. cross-listed firms. *Journal of Empirical Finance*, 32(0), 35-48. <http://doi.org/10.1016/j.jempfin.2014.05.001>
- Gerrard, B. (1995). Keynes, the Keynesians and the classics: a suggested interpretation. *The Economic Journal*, 445-458. <https://doi.org/10.2307/2235503>
- Githae, F. K. (2012). *Effects of interest rates spread on the financial performance of commercial banks in Kenya* (Master of Business Administration). University of Nairobi, Nairobi.

- Gitman, L. J., Joehnk, M. D., & Hubbard, G. R. (1999). *Fundamentals of Investing, the Financial System, and Financial Markets*. New York: Addison Wesley Educational Publishers Inc.
- Irungu, P. N. (2013). *The effect of interest rate spread on financial performance of commercial banks in Kenya*. (Masters of Science in Finance), University of Nairobi, Nairobi.
- Kasman, S., Vardar, G., & Tunç G. (2011). The impact of interest rate and exchange rate volatility on banks' stock returns and volatility: Evidence from Turkey. *Economic Modelling*, 28(3), 1328-1334. <http://doi.org/10.1016/j.econmod.2011.01.015>
- Keynes, J. M. (1937). Alternative theories of the rate of interest. *The Economic Journal*, 241-252. <https://doi.org/10.2307/2225525>
- Korkeamäki, T. (2011). Interest rate sensitivity of the European stock markets before and after the euro introduction. *Journal of International Financial Markets, Institutions and Money*, 21(5), 811-831. <http://doi.org/10.1016/j.intfin.2011.06.005>
- Lavoie, M. (1996). Horizontalism, structuralism, liquidity preference and the principle of increasing risk. *Scottish Journal of Political Economy*, 43(3), 275. <https://doi.org/10.1111/j.1467-9485.1996.tb00846.x>
- Lumby, S., & Jones, C. (2015). *Corporate finance theory and practice*. United Kingdom: Cengage Learning EMEA.
- Madura, J., & Schnusenberg, O. (2000). Effect of Federal Reserve policies on bank equity returns. *Journal of Financial Research*, 23(4), 421-447. <https://doi.org/10.1111/j.1475-6803.2000.tb00754.x>
- Najand, M., & Noronha, G. (1998). Causal relations among stock returns, inflation, real activity, and interest rates: Evidence from Japan. *Global Finance Journal*, 9(1), 71-80. [http://doi.org/10.1016/S1044-0283\(98\)90015-1](http://doi.org/10.1016/S1044-0283(98)90015-1)
- Ohlin, B., Robertson, D., & Hawtrey, R. (1937). Alternative theories of the rate of interest: three rejoinders. *The Economic Journal*, 423-443. <https://doi.org/10.2307/2225356>
- Okech, O. F. (2013). *The effect of lending interest rates on financial performance of commercial banks in Kenya*. (Masters of Business Administration). University of Nairobi, Nairobi.
- Olweny, T. (2011). The reliability of dividend discount model in valuation of common stock at the Nairobi Stock Exchange. *International Journal of Business and social science*, 2(6), 121-141.
- Randa, J., & Gubbins, P. (2013). *Time to shift gears: accelerating growth and poverty reduction in the new Kenya*. Retrieved from <http://documents.worldbank.org/curated/en/2013/06/17886043/time-shift-gears-accelerating-growth-poverty-reduction-new-kenya>
- Randa, J., Smita, W., Apurva, S., Umutesi, A., Kennedy Mukuna, O., Nyamumbo, M., . . . Sophie, R. (2013). Reinvigorating growth with a dynamic banking sector. *World Bank Working Paper, 1*, 1-82.
- Ricci, O. (2015). The impact of monetary policy announcements on the stock price of large European banks during the financial crisis. *Journal of Banking & Finance*, 52(0), 245-255. <http://doi.org/10.1016/j.jbankfin.2014.07.001>

- Rindfleisch, A., Malter, A. J., Ganesan, S., & Moorman, C. (2008). Cross-sectional versus longitudinal survey research: concepts, findings, and guidelines. *Journal of Marketing Research*, 45(3), 261-279. <https://doi.org/10.1509/jmkr.45.3.261>
- Rochon, L.-P. (2006). Endogenous money, central banks and the banking system: Basil Moore and the supply of credit. *Complexity, Endogenous Money and Macroeconomic Theory: Essays in Honour of Basil J. Moore, Cheltenham, UK and Northampton, MA, USA: Edward Elgar*, 170-186. <https://doi.org/10.4337/9781847203113.00020>
- Tai, C.-S. (2000). Time-varying market, interest rate, and exchange rate risk premia in the US commercial bank stock returns. *Journal of Multinational Financial Management*, 10(3-4), 397-420. [http://doi.org/10.1016/S1042-444X\(00\)00031-1](http://doi.org/10.1016/S1042-444X(00)00031-1)
- Tarazi, R. E., & Gallato, C. (2012). Determinants of Expected Stock Returns: Evidence from the Malaysian and Thai Markets. *Available at SSRN 2167679*.
- Tarus, D. K., Chekol, Y. B., & Mutwol, M. (2012). Determinants of Net Interest Margins of Commercial Banks in Kenya: A Panel Study. *Procedia Economics and Finance*, 2(0), 199-208. [http://doi.org/10.1016/S2212-5671\(12\)00080-9](http://doi.org/10.1016/S2212-5671(12)00080-9)
- Thorbecke, W., & Alami, T. (1994). The effect of changes in the federal funds rate target on stock prices in the 1970s. *Journal of Economics and Business*, 46(1), 13-19. [https://doi.org/10.1016/0148-6195\(94\)90018-3](https://doi.org/10.1016/0148-6195(94)90018-3)
- Were, M., & Wambua, J. (2014). What factors drive interest rate spread of commercial banks? Empirical evidence from Kenya. *Review of Development Finance*, 4(2), 73-82. <http://doi.org/10.1016/j.rdf.2014.05.005>
- Wray, L. R. (1992). Alternative theories of the rate of interest. *Cambridge Journal of Economics*, 69-89.
- Yin, H., & Yang, J. (2013). Bank characteristics and stock reactions to federal funds rate target changes. *Applied Financial Economics*, 23(23), 1755-1764. <https://doi.org/10.1080/09603107.2013.851770>
- Yin, H., Yang, J., & Handorf, W. C. (2010). State Dependency Of Bank Stock Reaction To Federal Funds Rate Target Changes. *Journal of Financial Research*, 33(3), 289-315. <http://doi.org/10.1111/j.1475-6803.2010.01272.x>
- Zare, R., Azali, M., & Habibullah, M. S. (2013). Monetary Policy and Stock Market Volatility in the ASEAN5: Asymmetries Over Bull and Bear Markets. *Procedia Economics and Finance*, 7(0), 18-27. [http://doi.org/10.1016/S2212-5671\(13\)00213-X](http://doi.org/10.1016/S2212-5671(13)00213-X)
- Zhang, D., Wang, L., Lv, F., Su, W., Liu, Y., Shen, R., & Bi, P. (2007). Advantages and challenges of using census and multiplier methods to estimate the number of female sex workers in a Chinese city. *AIDS care*, 19(1), 17-19.