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THE SENSITIVITY OF BANKS' STOCK RETURNS TO THE INTEREST RATE RISK AND EXCHANGE RATE RISK:

A CASE STUDY OF GERMANY AND SOUTH AFRICA

by

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May 2022

Master's Programme in Finance

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Abstract

The purpose of this paper is to interrogate the single and joint effect interest and exchange rate movements have on banks' stock returns. This study also aims to compare the volatility of the banks' stock returns for countries in different markets using both the short and long-term interest rate and the respective exchange rates. To conduct our tests, we use a sample of 14 German and 11 South African banks' stocks listed on the respective stock exchange markets, with daily data spanning from 3rd January 2012 to 30th December 2021. We distinguish the relationship between bank stock and the interest and exchange rate by using Ordinary Least Squares (OLS) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) estimation. Generally, we find that banks' stock returns are not significantly affected by the interest rate risk in Germany, whereas in South Africa they are significantly negatively exposed to this risk. Furthermore, variation in the banks' stock returns are mostly explained by the exchange rate risk, which has a negative impact in both countries. We conclude that South African banks' stock are more sensitive to interest rate and exchange rate risk in comparison to German banks' stock returns.

Keywords: Banks' Stock Returns, Exchange rate, Interest rate, Germany, South Africa, GARCH

Acknowledgement

We would like to thank our supervisor Nagihan Simeth, for her invaluable support in seeing our thesis to a successful completion. The dream could not have been realized without the unwavering encouragement from our families, friends and fellow colleagues. Above all, we kept faith in the highest.

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Section 1: Introduction

Over the years, the financial market has welcomed an increasing number of variables that influence the performance of stocks. Bank stocks in particular have developed from the mainstream single model of interest rate risk and now appreciate the significance of other factors like the exchange rate risk, inflation, trade and the GDP (Chen, Roll, & Ross, 1986; Fama, 1981).

The sensitivity of bank stock returns to interest and exchange rate volatilities has been explored in various countries spanning from Australia, Japan, Malaysia, Thailand, Turkey and the USA - all yielding controversial results of negative and some positive correlations (Isa, Ismail, Latif & Samsudin, 2021; Joseph & Vezos, 2006; Kasman, Vardar & Tunc, 2011; Priti, 2016; Shamsuddin, 2009; Sukcharoensin, 2013). The main attributing factors to the disparities in these findings is explained in the different definitions of what a bank is. Aluko and Ajayi (2018) describe banking as a core sector in the economy and pivotal to the nation's growth; where through robust policies and infrastructure, a bank delivers intermediary services across all other business sectors. Werner (2012) further characterizes banks beyond the traditional understanding of being intermediary institutions to also being credit factories that incite economic development. His theory is that banks do not just borrow and lend but that they also create money out of nothing. Over and above the description of a bank, several studies assign weight to the data periods where daily returns produce better results in regressions compared to monthly returns (Harris, Marr & Spivey, 1991; Nydahl, 1999).

Extensive research has been carried out for individual countries that are predominantly in developed markets. However, little to no research has been done for countries in emerging markets and even less studies compare countries from both markets. Mutarindwa, Schäfer, Stephan (2020) conceptualize this through a progressive divide in economic growth emanating from taxes, foreign direct investments, technology and entrepreneurship. They attribute this developmental divide with regards to the banking systems to the bureaucratic processes, substandard creditor rights and weak contracts paired with obscure law enforcements. According to Katsikas, Brahma and Wangeci (2016) developed countries owe their superiority to deregulated policies that allow free capital allocations and ultimately reducing the interest rate exposures and conversely increasing the bank stock returns. However, for developing

countries the deficiency in such modified practices stifles a growing value of bank stock returns given that the majority of the publicly traded banks are international but incomparable in performance between markets.

Nonetheless, Fraser, Madura and Weigand (2002) together with Joseph and Vezos (2006) attribute the exposure of banks stock returns to internal management of income and expenditure against the maturity profiles of the bank assets and liabilities. In addition, Kutty (2010) discusses the relationship between exchange rates and stock prices from the point of view of investors, the government and the community, by highlighting the cointegrated effect from interest rate movement and inflation, money supply, productivity and ultimately the GDP to be significant factors in forecasting valuation trends.

Even though previous studies have looked at the sensitivity of bank stock returns to interest and exchange rate risk either independently or with a dual effect, our study aims to investigate if the outcome is consistent for countries from different markets, that is Germany and South Africa. We observe the banks' stock sensitivity to movements in interest rates and exchange rates risk to assess the difference in performance, and to what extent the factors are interdependent and correlated. Due to limited data availability, to define banks, we select 14 German and 11 South African commercial, investment and retail banks and look at the short term (3-month) treasury bill rate, long term (10-year) government bonds and exchange rates over a 10-year period from 2012 to 2021. We find that German banks are not significantly affected by movement in the interest and exchange rates. However, South African banks are more sensitive to changes in both variables, with a higher volatility in the long-term interest rates. Our study extends on previous research by comparatively observing the results in both Germany and South Africa.

The remainder of this paper consists of six sections. Section 2 outlines the literature review, while Section 3 presents the theoretical framework and hypotheses development. Section 4 discusses the data and variables while Section 5 discusses the methodology. Section 6 presents the empirical results and finally, Section 7 concludes our study.

Section 2: Literature Review

Preceding studies on the sensitivity of banks stock returns to a host of variables including market returns, interest rates and exchange rates has been ongoing over decades now. A significant amount of research has been focused on the single model analogy and a joint effect impact analysis of the variables, on different subjects spanning from financial intermediaries such as commercial banks, insurance and brokerage firms and even to real estate. That is to show the effect of the variables across diverse sectors in the market.

Hartmann and Pierdzioch (2007) uncovered that movements in exchange rate do not entirely explain stock returns, while Jorion (1990) argues that there is a positive significant correlation in movement of exchange rates and the stock returns by looking at the exposure on US multinationals. However, subsequent studies carried out by Adjasi, Harvey and Agyapong (2008), AtindeÂhou and Gueyie (2001) and Choi, Elyasiani, and Kopecky (1992) argue against these results by suggesting a negative impact on the bank stock returns. The former two authors use multifactor models for the US and Canada, while latter research employs the Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) model in the Ghana stock market to conclusively agree on this inverse relationship.

Despite the limited research done on exchange rate sensitivity, more extensive empirical studies have been applied to the interest rate sensitivity of bank stock returns. Shamsuddin (2009) and Sukcharoensin (2013) look at the Thai and Australian financial sectors and both apply the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) approach to banks by order of size. However, their findings conflict between small banks and medium–large sized banks. The small banks are almost unaffected or they have significant negative effects. And the larger banks are either highly affected or not significantly affected. These opposing conclusions are also maintained in the works of Akella and Chen (1990) and by Di Iorio, Faff and Sander (2013) as they look at the long term and short-term periods. These authors applied various models and approaches, including Autoregressive Integrated Moving Average (ARIMA), augmented market and the multivariate ordinary least squares (OLS) and GARCH models to prove a similar and sensitive time varying effect to the bank stock returns. In addition, research by Benink and Wolff (2000) and lyasiani and Mansur (2004) supports the ideology of bank stock returns being significantly affected and sensitive to the interest rate risk.

While works by Di Iorio, Faff and Sander (2007) and Isa et al. (2021) stand to conclude otherwise.

Furthermore, different methodologies have been used to investigate the sensitivities of interest rate risk and or exchange rate risk on bank stock returns, and in turn bringing different empirical results. Prior studies include the works of Flannery and James (1984), Koch and Saporoschenko (2000) and Sukcharoensin (2013) with AR and ARCH models.

While most of the studies have centred around a single model analogy on how bank stocks are affected either by interest rate risk or exchange rate risk, some research has demonstrated the joint effect of these variables. Among these are Joseph and Vezos (2006), Kasman, Vardar and Tunc (2011), Koch and Saporoschenko (2000) and Priti (2016). They all agree on a positive relationship between interest and exchange rates and consistently inconclusive significance to the bank stock returns.

In spite of the widespread literature on the banks' stock returns and their sensitivity to both interest and exchange rate risk in various countries, barely any comparative research has been done for countries in different continents. Di Iorio, Faff and Sander (2007) investigate how the financial sector (Banking, Financial Services and Insurance) stock returns are affected by short term and long-term interest rates as well as exchange rate risk. They focus on euro zone countries and non-euro zone countries with similar conclusions to the preceding research. They find that banks are more sensitive to interest rates with lengthened time horizons but exchange rate exposure is not as strong.

Germany (GER) is a leading economy in Europe, with relatively low interest rates and a sizable consumer spending base. It is driven by a robust manufacturing sector and following Brexit it is steadily gaining competitive financial recognition to the London market. With growing interest rates and declining inflation, the economy should see growing investments as the Euro also strengthens against the US dollar. Alam and Uddin (2009) identify these characteristics as consistent measures of a developed market and consequently reflected in high GDP levels. In spite of Germany being a more mature economy, the same economic principles are evidenced in the emerging South African market. Shammsudin (2009) describes this mirror effect by qualifying different countries with varying factors and this is evidenced by the growing ZAR performance, promising foreign direct investment opportunities and downward sloping interest

rates. Notably, the economic divide between the two countries is being bridged by increased trade in machinery and vehicles from Europe against energy products from Africa. Therefore, it is valuable to interrogate the interest and exchange rates and assess their influence on the bank stock returns.

Section 3: Theoretical Framework and Hypotheses Development

The Arbitrage Pricing Theory (APT) is credited to Ross (1976) who established the linear relationship between stock returns and the economic variables. This ideology asserts that markets are inefficient, with assets being mispriced and are therefore either overvalued or undervalued. APT is modelled such that the economic variables as the independent factors, affect the risk level of the asset, which are our banks' stock. This academic overview given by Ross (1976) is revised in Roll and Ross (1980) as they suggest plausible macroeconomic variables that are key in explaining the stock returns. Prior studies by Chen, Roll, and Ross (1986) and Fama (1981) show the evolution in independent variables from industrial production, inflation, interest rates and risk premiums to including other factors such as exchange rates, trade and GDP.

Notably, APT is a time varying theory that argues on the quantity of macroeconomic variables to be more than just the market risk. However, the Efficient Market Hypothesis (EMH) interrogates another angle of information availability in the stock price and performance (Fama, 1970). EMH debunks the findings of APT in that stock prices are always fairly priced and a true reflection of all economic factors. That is to say, banks' stock returns are a sound representation of the financial markets' performance.

Subsequently, Fama (1970) disintegrates the EMH theory into three segments: the weak, semi-strong and strong form. The weak form is backward looking and dependent on historical pricing and performance. However, this is inappropriate in predicting future bank stock price performance, as stocks follow the random walk theory of independent movement. The semi-strong form follows to imply that stock returns are sensitive to public information but without conclusive evidence on the response time. And lastly, the strong form argues for all private and

public information such that no one can capitalize on the bank stock returns. If a merger or acquisition is taking place then all stakeholders would be assumed aware of this venture with access to firm valuations and all necessary data. We can therefore deduce that policy makers in the central banks, international activity in trade and amongst employees, together with the traders and stakeholders cannot outperform the market.

3.1 Interest Rate Risk and Bank Stock Returns

Interest rates are a core variable in explaining the price changes in the bank stock returns. Banks use them to determine their net interest income from the difference in revenue through loans and charges on deposits (Kasman, Vardar & Tunc, 2011). Since net interest income is a measure of financial performance, Williams (2014) ascertains that the profitability should to some degree be reflected in the stock price. Therefore, any movement in interest rates should affect the notional value of banks and their share pricing.

In addition to affecting the net interest income, interest rates are also associated with operational efficiency where rising interest rates incite higher cost of capital. Consequently, during steep interest rate periods, banks require higher returns to subsidize the expenses and ultimately sustain a fair priced stock value (Williams, 2014).

Flannery and James (1984) however look at the effect of interest rates on bank stock returns through the maturity profiling of assets and liabilities. This approach proposes that longer asset over liability duration will inversely affect the balance sheet as interest rates rise and subsequently value down the banks' fair value (Saunders & Cornett, 2015). Moreover, Hamrita and Abdelkade (2011) and Rashid (2007) argue that a continued rise in interest rates increases the sensitivity of bank stock returns and although a decline in the bank assets results in less capital requirements, it also indicates reduced cash flows for borrowers which translate to high credit risk and an overall distress in the investment ecosystem. With this principle, we propose the hypothesis that bank stock returns are negatively affected by interest rate risk.

Hypothesis 1: Bank stock returns are negatively affected by interest rate risk.

3.2 Exchange Rate Risk and Bank Stock Returns

Exchange rates are a fundamental variable in explaining the price changes in the bank stock returns. Banks fragment this risk to either transaction or translation risk to operating sensitivities (Nydahl, 1999). Firstly, banks are exposed to the transaction risk through instruments like forwards and swaps, where there is a time-lag between the trade agreement and settlement. Due to the market volatility, the liquid assets in the trading book would result in either gains or losses and translate to lower profits for the latter outcome (Bodnar, Hayt & Marston, 1996). Hence, measuring the banks' stock returns against profitability would have a negative effect in the presence of transaction risk.

Secondly is the translation risk that banks are susceptible to if they are international and their financials are revalued in a different currency to their operative one. That is to say, international banks possibly lose value against the local banks due to this risk. Harris, Marr, and Spivey (1991) explain this concept of value dilution by observing the effect on the banks' offshore assets and liabilities which in turn speak to the capital adequacy in an inefficient market.

Thirdly are the operating sensitivities that together with the translation risk form the economic exposure, where factors like location and current affairs are accentuated. With this risk Nydahl (1999) equates the value of the firm to the present value of the expected future cash flows and asserts the complexity in managing it despite it being the most common of the three risk classifications. Ultimately banks are exposed to the exchange rate risk in all foreign transactions, so we additionally argue that bank stock returns are negatively affected by exchange rate risk.

Hypothesis 2: Bank stock returns are negatively affected by exchange rate risk.

3.3 Dual Effect

Interest and exchange rates can have a bi-variate effect in influencing the performance of bank stock returns. The impact can either be on a firm level for valuation on loans and deposits or on a market level to adhere to a comparable standard for investors. While interest rates affect the income and expenditure through pricing of the assets and liabilities on the balance sheet,

the exchange rate impacts the income statement when converting into the reporting currency (Choi, Elyasiani & Kopecky, 1992).

Similarly, the individual and market level effect of interest and exchange rates on the bank stock returns can be combined to give a more rounded interpretation of the market. Shamsuddin (2009) conceptualized this through a twofold model that breaks down the function of banks. He articulates banks to either have a brokerage function or operate traditionally with asset transformation. In both cases the returns are valued in direct association to profits, where the asset maturities, cashflows and conversion risks have been accounted for. Nonetheless, higher interest rates influence higher value of a local currency and eventually the real return on investor portfolios. Hence, we propose a third hypothesis, that bank stocks are jointly affected by interest rate and exchange rate risk.

Hypothesis 3: Bank stock returns are jointly affected by exchange rate risk and interest rate risk.

Section 4: Data and Variables

Data for stock prices of banks, interest rates and stock market indexes are acquired from FactSet and Yahoo finance, while data for daily exchange rates is acquired from Bloomberg. The 10-year analysis period from 2nd January 2012 to 30th December 2021 is specified and this choice is to allow us to focus on the most recent period due to limited research undertaken covering this period. All data are in daily frequencies since research proves that daily returns have the likelihood to produce better results (Hahm, 2004; Kasman, Vardar & Tunc, 2011). The sample comprises stock prices of 14 banks listed on the Frankfurt Stock Exchange as well as the 11 banks listed on the Johannesburg Stock Exchange. These banks are mainly commercial and retail banks and are selected purely based on the consistency and availability of data for the sample period in consideration. Two categories of interest rates are used to measure short and long-term sensitivity of bank stock returns to interest rates. These include the 3-month treasury bill (TBR) and the 10-year government bond yield (LGB) for each country for the sample period respectively. The stock market index (GDAX) consisting of the 40 major German blue-chip companies traded on the Frankfurt Stock Exchange is employed for the sample period, while for South Africa, we use the FTSE/JSE Top 40 index made up of the largest 40 companies. Finally, the exchange rates of the home currencies (Euro and Rand) against the US dollar are also incorporated into the study.

4.1 Dependent Variable

To measure how reactive bank stock returns are to changes in interest and exchange rates, we define our dependent variable as bank stock returns. We calculate the log returns of the bank stocks using the formula below:

$$R_t = \text{Ln}\,(P_t / P_{t-1}) * 100$$

where, R_t is stock return at period t; P_t is stock price at period t; P_{t-1} is the stock price at period t-1 and Ln is natural log.

Log returns are preferred because they capture the compounding effect and are effective for time series data. Also, it is suitable for stock prices as it assumes returns that follow a normal distribution (Danthine & Donaldson, 2014).

4.2 Independent Variables

The explanatory variables consist of return on short term interest rates (TBR), long term interest rates (LGB) and exchange rates for Germany (EUR) and that of South Africa (ZAR).

4.3 Descriptive Statistics

Table 1 and *Table 2* below present the descriptive statistics, normality and stationarity tests of bank stock returns, market returns, interest and exchange rates in both countries. During the sample period 2012 to 2021, German banks, on an average have higher stock returns compared to South African banks even though the maximum daily stock return is higher in South Africa. Interestingly, stock market returns in South Africa recorded a greater mean than Germany, with similar volatility suggesting of a more matured market for the latter.

Also, the mean return on long term bond yields and short-term interest rates is higher in South Africa than in Germany. Moreover, we observe that both countries have the highest volatility in short-term interest rates, which supports that markets are eventually self-correcting in the long term. Additionally, through the standard deviation, we conclude the ZAR to be more volatile than the EUR.

Furthermore, we perform normality tests using the Jarque-Bera (JB) test which has similar skewness and kurtosis as that of normally distributed data. All variables used for Germany and South Africa lack normality, since the p-values are not significantly different from zero.

Subsequently, we test for stationarity in the time series by employing the Augmented Dickey Fuller (ADF) test, which is mostly appropriate and applied across several studies. We find all variables to be stationary in both countries.

Table 1 Descriptive Statistics for Germany Data

	Stock return	MKT	TBR	LGB	EUR
Obs - 2532					
Mean	0.05%	-0.04%	-0.0552	-0.0162	0.0000
Maximum	5.64%	13.05%	74.000	13.000	0.0308
Minimum	-6.78%	-10.41%	-172.00	-48.50	-0.0237
Standard.Dev	0.0082	0.0121	4.1536	1.0660	0.0049
Skewness	-0.2852	0.6778	-25.099	-36.874	0.1047
Kurtosis	6.2678	3.8739	106.60	1.5076	-0.6454
JB test	0.000***	0.000***	0.000***	0.000***	0.000***
ADF test	-12.3***	-17.94***	-9.72***	-11.06***	-51.62***

*These are computations based on the data for the research which consists of 3 month Treasury Bill Rate (TBR),10-year Government Bond Yield(LGD),Exchange rate of EUR/USD and stock returns of 14 banks in Germany. Obs - total number of observations for all variables.Note: ***,**,*indicates 1%, 5% and 10% level of significance respectively*

Table 2 Descriptive Statistics for South Africa Data

	Stock Returns	MKT	TBR	LGB	ZAR
Obs- 2560					
Mean	0.03%	0.03%	0.0036	0.0001	0.0003
Maximum	8.55%	9.06%	0.8889	0.1200	0.0510
Minimum	-11.62%	-10.45%	-0.5455	-0.1003	-0.0495
St.Dev	0.0137	0.0112	0.0890	0.0106	0.0097
Skewness	-0.4753	-0.4580	2.1887	1.5652	0.2994
Kurtosis	7.5920	8.9835	21.363	29.191	1.3436
JB test	0.000***	0.000***	0.000***	0.000***	0.000***
ADF Test	-9.903***	-18.26***	-6.93***	-11.65***	-50.40***

*These are computations based on the data for the research which consists of market index of banks (MKT),3 month Treasury Bill Rate(TBR),10-year Government Bond Yield(LGB),Exchange rate of USD/ZAR and stock returns of 11 banks in South Africa. Obs - total number of observations for all variables. Note: ***,**,*indicates 1%, 5% and 10% level of significance respectively*

4.4 Correlation Matrix

Multicollinearity is the interdependence of independent variables in a regression. Generally, it tends to reduce the precision in estimated coefficients of explanatory variables, while also weakening the statistical power of the model. *Table 3* and *Table 4* below display the correlation matrix between the independent variables for both Germany and South Africa, where in accordance with Kennedy (2008) we conclude there is no multicollinearity since the explanatory variables are significantly below 0.70.

Table 3 Correlation between independent variables for Germany

	MKT	**TBR**	**LGB**	**EUR**
MKT	1			
TBR	-0.00966913	1		
LGB	-0.00120342	-0.000915284	1	
EUR	0.01759209	0.011876213	0.016996	1

Table 4 Correlation between independent variables for South Africa

	MKT	**TBR**	**LGB**	**ZAR**
MKT	1			
TBR	0.01779067	1		
LGB	-0.15821327	-0.001347817	1	
ZAR	-0.11831315	-0.004157308	0.228182	1

Section 5: Methodology

5.1 Multivariate Factor Model

As employed by Choi, Elyasiani & Kopecky (1992); Hahm (2004); Kasman, Vardar & Tunc (2011), we study the sensitivity of bank stock returns to interest rate and exchange rate risk using a multivariate factor model; considering 4 factors. This model is an augmented form of the one factor market model where market return is included in the estimation equation as a first factor. Moreover, it is an extension of Sharpe's single index model which has the view that the interaction between two securities are explained by their exposure to the market index (Joseph & Vezos, 2006).

Our study is in two-folds. First, we consider a single effect of interest or exchange rates on banks' stock returns after which we look at the joint effect of both interest and exchange rates on banks' stock returns. Similar to previous studies, we commence estimating these effects using the OLS regression model.

We start off by determining the relationship between banks' stock returns and interest rates using the two-factor model stated below:

$$R_t = \alpha + \beta_1 MKT_t + \beta_2 TBR_t + \varepsilon_t \qquad (1)$$

$$R_t = \alpha + \beta_1 MKT_t + \beta_2 LGB_t + \varepsilon_t \qquad (2)$$

Due to the differences in the volatilities between short and long-term interest rates, we employ both rates in the study for a combined effect, even though we initially investigate an independent effect of time horizons on the banks' stock returns.

Additionally, we focus on our second hypothesis, where we analyse the single effect of exchange rates on banks' stock returns by using the regression model below:

$$R_t = \alpha + \beta_1 MKT_t + \beta_2 XR_t + \varepsilon_t \qquad (3)$$

which is followed by our final observation of the joint effect in the below equations:

$$R_t = \alpha + \beta_1 MKT_t + \beta_2 TBR_t + \beta_3 XR_t + \varepsilon_t \qquad (4)$$

$$R_t = \alpha + \beta_1 MKT_t + \beta_2 LGB_t + \beta_3 XR_t + \varepsilon_t \qquad (5)$$

where (R_t) represents the return on banks' stock in time t. Alpha (α) is the intercept, which tells us the value of R_t given that all x-variables are zero and MKT_t is the return of the market index at time t, taking into consideration economy-wide factors. TBR_t denotes the short-term interest rate (3-month Treasury bill rate) at time t and LGB_t represents long-term interest rate (10-year Government Bond Yield) at time t, while XR_t is the return of the foreign exchange rate at time t. The sensitivity of the bank's stock returns to the market is represented by β_1, with β_2 and β_3 representing changes in short and long-term interest rate and exchange rates. Epsilon (ε_t), is the error term.

5.2 GARCH (1,1) Model

GARCH model is a statistical model that is appropriate for analysing various macroeconomic data, which includes interest and exchange rates and is a more preferred model when the variance of the error term of an OLS model is not constant. Consequently, to avoid biased, unreliable and false results, we begin by interrogating the suitability of our model by testing for all OLS assumptions including a test for ARCH effects by using the Lagrange Multiplier (LM) of order 1 (Di Iorio, Faff & Sander, 2007).

With the GARCH model, heteroskedasticity is treated as a variance to be modelled, therefore, as a result of the inefficiency of the OLS estimates, we implement the GARCH process (Isa et al. 2021; Kasman, Vardar & Tunc, 2011; Sukcharoensin, 2013). Moreover, the presence of volatility clustering in our time series reaffirms the appropriateness of the GARCH (1,1) model which we state as follows:

Hypothesis 1: interest rates and banks' stock returns

$$R_t = \gamma_0 + \gamma_1 MKT_t + \gamma_2 TBR_t + \varepsilon_t \qquad (6)$$

$$R_t = \gamma_0 + \gamma_1 MKT_t + \gamma_2 LGB_t + \varepsilon_t \qquad (7)$$

Hypothesis 2: exchange rates and banks' stock returns

$$R_t = \gamma_0 + \gamma_1 MKT_t + \gamma_2 XR_t + \varepsilon_t \quad (8)$$

Hypothesis 3: interest and exchange rates on banks' stock returns

$$R_t = \gamma_0 + \gamma_1 MKT_t + \gamma_2 TBR_t + \gamma_3 XR_t + \varepsilon_t \quad (9)$$

$$R_t = \gamma_0 + \gamma_1 MKT_t + \gamma_2 LGB_t + \gamma_3 XR_t + \varepsilon_t \quad (10)$$

where Rt represents the conditional bank returns. γ_0 is the constant term and γ_1, γ_2 and γ_3 represent the coefficients of explanatory variables, while other explanatory variables maintain their definition from the previous multivariate factor model.

The conditional variance is estimated as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \beta \sigma^2_{t-1} \quad (11)$$

where α_0 represents the average volatility in the long term, ε^2_{t-1} is the news about volatility from the prior period described as an ARCH term with its coefficient being α_1 and σ^2_{t-1} is the GARCH term showing the previous period's forecast variance with coefficient as β.

The GARCH(1,1) specification demands that the parameters α_0, α_1 and β should be positive for a non-negativity condition, where simultaneously the addition of α_1 and β should be less than one for the covariance stationarity of the conditional variance to hold.

Section 6: Empirical Results

This section addresses the empirical results derived from testing all hypotheses making use of the two previously stated methodologies, OLS and GARCH model. The estimates are presented, all necessary tests are made and our findings are discussed below.

6.1 OLS Estimations

As stated earlier in the methodology, our research focuses on the OLS regression which is only effective and reliable if the standard error estimates do not violate the OLS assumptions. Hence all three models are tested for autocorrelation and heteroscedasticity using Ljung Box and White Test respectively.

6.1.1 Short term interest rate exposure

Table 5 below displays the results of how short-term interest rates affect bank stock returns using Equation 1. Our findings show that, though statistically insignificant, banks in South Africa exhibit negative exposure to short term interest rates compared to German banks with no effect at all. Also, market returns have the greatest effect on banks' stock returns in both countries.

Table 5 OLS - Bank Stock Returns to Short Term Interest Rates

	α	β_1	β_2	Adjusted R^2	ARCH(1)
Germany	0.0005***	0.0114	0.0000	-0.0001	15.32***
	(0.0002)	(0.0134)	(0.0000)		
South Africa	0.0001	0.5308***	-0.0036	0.1863	156.43***
	(0.0002)	(0.0219)	(0.0027)		

*This table presents results from OLS regression of Equation 1. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.1.2 Long term interest rate exposure

The results of the long-term interest rate variable analysis are presented in *Table 6* below. It is observed that there is a weak evidence of long-term interest rate sensitivity on bank stock returns for Germany. However, consistent with the results of Kasman, Vardar and Tunc (2011), we observe that in South Africa there is a negative relation between long term interest rates

and bank stock returns which is statistically significant at 1% level. Market returns positively influence stock returns of banks in both countries though statistically significant at 1% level in South Africa.

Table 6 OLS - Bank Stock Returns to Long Term Interest Rates

	α	β_1	β_2	Adjusted R^2	ARCH(1)
Germany	0.0005***	0.0115	0.0002	0.0000	15.443***
	(0.0002)	(0.0134)	(0.0002)		
South Africa	0.0001	0.5098***	-0.1358***	0.1966	140.8***
	(0.0002)	(0.0220)	(0.0231)		

*This table presents results from OLS regression of Equation 2. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.1.3 Exchange Rate Exposure

Table 7 below shows the results of Equation 3, where market returns positively affect banks' stock returns in both countries. Nonetheless, Germany exhibits a weaker relationship in comparison to South Africa. Our results are akin to that of Tripathi and Ghosh (2012) where the banks' stock returns are negatively affected by the exchange rate, notably with more significance for South Africa than Germany.

Table 7 OLS - Bank Stock Returns to Exchange Rates

	α	β_1	β_2	Adjusted R^2	ARCH(1)
Germany	0.0004***	0.0117	-0.0325	-0.0001	16.3644***
	(0.0001)	(0.0134)	(0.0331)		
South Africa	0.0001	0.5084***	-0.2112***	0.2080	138.118***
	(0.0002)	(0.0217)	(0.0249)		

*This table presents results from OLS regression of Equation 3. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.1.4 Short term Interest rate and Exchange rate Exposure

Table 8 below reports the results of the joint effect of short-term interest and exchange rates on banks' stock returns in Germany and South Africa. We notice that the negative relationship between movements in exchange rates and banks' stock returns still holds for both countries. Moreover, there is no evidence of short-term interest rate sensitivity on the stock returns of

banks in Germany unlike in South Africa where short-term interest rates affect bank stock returns in a negative way.

Table 8 OLS - Bank Stock Returns to Short Term Interest and Exchange Rates

	α	β_1	β_2	β_3	Adjusted R^2	ARCH(1)
Germany	0.0005***	0.0116	0.0000	-0.0321	-0.0002	16.27***
	(0.0002)	(0.0134)	(0.0000)	(0.0331)		
South Africa	0.0002	0.5090***	-0.0037	-0.2112***	0.2082	137.97***
	(0.0002)	(0.0217)	(0.0027)	(0.0249)		

*This table presents results from OLS regression of Equation 4. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.1.5 Long term Interest rate and Exchange rate Exposure

The results for the exposure of long-term interest rates and exchange rates exposure on bank stock returns as estimated in Equation 5, are presented in *Table 9* below. Similar to *Table 6,* there is barely any evidence of an interaction between long term interest rates and stock returns of banks in Germany. Nevertheless, South African banks are negatively exposed to long term interest rates at a 1% statistically significant level. Finally, we observe stronger evidence of a negative impact of exchange rates on South African banks compared to that of German banks.

Table 9 OLS - Bank Stock Returns to Long Term Interest and Exchange Rates

	α	β_1	β_2	β_3	Adjusted R^2	ARCH(1)
Germany	0.0005	0.0117	0.0002	-0.0331	0.0000	16.42***
	(0.0002)	(0.0134)	(0.0002)	(0.0332)		
South Africa	0.0002	0.4959***	-0.0987***	-0.1882***	0.2132	129.19***
	(0.0002)	(0.0218)	(0.0234)	(0.0254)		

*This table presents results from OLS regression of Equation 5. Standard errors are in parenthesis whereas coefficient estimates are not.*** indicates significance at 1%, ** significance at 5% and * significance at 10%*

Next, we examine the results from these OLS models and observe the presence of ARCH effects in the squared residuals being heteroskedastic and autocorrelated for all the regression equations. Additionally, the adjusted R square values of these OLS models are very low signifying that the model exhibits a lack of fit and therefore should not be relied upon.

Subsequently, we move to estimate a new model with GARCH (1,1) since it is a more appropriate method when the error variance is not constant and there is volatility clustering in the sample.

6.2 GARCH (1,1) Model

6.2.1 Short term interest rate exposure

Table 10 below presents the coefficient estimates of the GARCH (1,1) model estimated using the variables of the conditional return shown in Equation 6. γ_1 as the coefficient of the market risk, is positive in both countries but statistically insignificant for Germany. Notably, it is still the case that changes in short term interest rates with coefficient γ_2 do not have any impact on bank stock returns in Germany, whereas in South Africa there is an insignificant but negative effect.

Table 10 GARCH (1,1) - Bank Stock Returns to Short Term Interest Rates

	γ_0	γ_1	γ_2	α_0	α_1	β_1
Germany	0.0004	0.0076	0.0000	0.0000***	0.0558***	0.9211***
	(0.0001)	(0.0110)	(0.0000)	(0.0000)	(0.0090)	(0.0129)
South Africa	0.0003	0.4942***	−0.0016	0.0000***	0.1134***	0.8126
	(0.0002)	(0.0206)	(0.0025)	(0.0000)	(0.0177)	(0.0303)

*This table presents results from GARCH (1,1) for Equation 6. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.2.2 Long term interest rate exposure

Table 11 below shows the results of the GARCH (1,1) model estimated from Equation 7. Similar to the findings of Mansur (2004) who employed the multivariate GARCH model, we explicitly find that banks in South Africa are more sensitive to long term interest rates than short term interest rates. Moreover, although the effect is negligible, we learn that the stock returns of German banks show a positive exposure to long term interest rates.

Table 11 GARCH (1,1) - Bank Stock Returns to Long Term Interest Rates

	γ_0	γ_1	γ_2	α_0	α_1	β_1
Germany	0.0004	0.0077	0.0002	0.0000***	0.0564***	0.9204***
	(0.0001)	(0.0110)	(0.0001)	(0.0000)	(0.009)	(0.013)
South Africa	0.0003*	0.4883***	−0.0728***	0.0000***	0.1124***	0.8123***
	(0.0002)	(0.0206)	(0.0207)	(0.0000)	(0.0179)	(0.0311)

*This table presents results from GARCH (1,1) for Equation 7. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.2.3 Exchange Rate Exposure

Table 12 below shows the results of the GARCH (1,1) model for Equation 8 where the exchange rate volatility on banks' stock returns is represented by γ_2. Similar to the findings of Isa et al. (2021), we observe that exchange rates have an insignificant negative exposure on German banks' stock returns and a 1% statistically significant negative effect on South Africa

Table 12 GARCH (1,1) - Bank Stock Returns to Exchange Rates

	γ_0	γ_1	γ_2	α_0	α_1	β_1
Germany	0.0004***	0.0814	-0.0473	0,000***	0,0557***	0,9214***
	(0.0001)	(0.0090)	(0.0294)	(0.000)	(0.009)	(0.0128)
South Africa	0.0003	0.4849***	-0.1657***	0.0000***	0.1204***	0.7972***
	(0.0002)	(0.0203)	(0.0222)	(0.0000)	(0.01848)	(0.0312)

*This table presents results from GARCH (1,1) for Equation 8. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

6.2.4 Interest rate and Exchange rate Exposure

Table 13 and *Table 14* below display the parameter estimates of the GARCH (1,1) model for Equation 9 and Equation 10 respectively. We maintain that movements in short term interest rates do not affect bank stock returns in Germany while exchange rates hold a negative effect. Subsequently consistent with the work of Kasman (2011), we note that simultaneous changes in long term interest and exchange rates have a negative and significant impact on the conditional banks' stock returns in South Africa. Generally, we observe that in both countries, the movements in exchange rates are more significant on the banks' stock returns compared to the impact of interest rates returns, at a 1% significance level.

Table 13 GARCH (1,1) - Bank Stock Returns to Short Term Interest and Exchange Rates

	γ_0	γ_1	γ_2	γ_3	α_0	α_1	β_1
Germany	0.0004***	0.0080	0.0000	−0.0472	0.0000***	0.0555***	0.9217***
	(0.0001)	(0.0110)	(0.0000)	(0.0293)	(0.0000)	(0.0089)	(0.0129)
South Africa	0.0003*	0.4854***	−0.0018	−0.1660***	0.0000***	0.1202***	0.7973***
	(0.0002)	(0.0202)	(0.0024)	(0.0222)	(0.0000)	(0.0185)	(0.0313)

*This table presents results from GARCH (1,1) for Equation 9. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

Table 14 GARCH (1,1) - Bank Stock Returns to Long Term Interest and Exchange Rates

	γ_0	γ_1	γ_2	γ_3	α_0	α_1	β_1
Germany	0.0004***	0.0081	0.0002	−0.0483	0.0000***	0.0561***	0.9211***
	(0.0001)	(0.0110)	(0.0001)	(0.0293)	(0.0000)	(0.0090)	(0.0129)
South Africa	0.0003*	0.4818***	−0.0450**	−0.1565***	0.0000***	0.1187***	0.7988***
	(0.0002)	(0.0203)	(0.0200)	(0.0226)	(0.0000)	(0.0185)	(0.0316)

*This table presents results from GARCH (1,1) for Equation 10. Standard errors are in parenthesis whereas coefficient estimates are not. *** indicates significance at 1%, ** significance at 5% and * significance at 10%*

Generally, we notice from all models that bank stock returns are most responsive to the market with a positive effect even though South African banks show a greater influence than German banks. Also, long-term interest rates are more sensitive to bank stock returns than short-term interest rates in both countries.

Furthermore, from all five *Tables 10,11,12,13 and 14,* we notice that the intercept (α_0), the ARCH parameter (α_1) and the GARCH parameter (β_1) in the conditional variance equation are all statistically significant at a 1% level. This shows that generally, the volatility of banks' stock returns is sensitive to the residual variance and previous period's forecast variance. Moreover, the GARCH parameter is greater than the ARCH parameter in all cases, maintaining that the volatility of each banks' stock returns is more sensitive to previous period's forecast variance rather than the residual variance. In addition, we observe that the coefficients of $\alpha 1$ and β when summed up result in a large positive number less than 1.0 which meets the condition of non-negativity, statistically significant at 1% level. With this reasoning, it implies that our GARCH (1,1) model is a good one and can be relied on for statistical inference.

6.3 Discussion

The analysis of this study is based on 3 hypotheses. We first look at the effect of short-term interest rates on bank stock returns, then we look at the outcome with long term interest rates. Next, we observe the effect of exchange rates on the banks' stock returns and then conclude with the joint analysis of the exchange rates with either short term or long-term interest rates.

In our hypotheses we anticipate a negative relationship between the banks' stock returns and the interest rate risk. Subsequently, we find that short term interest rates have a negative effect on banks' stock returns in South Africa, while in Germany they have no effect. This may be due to the asset sensitivity nature of banks in Germany.Nonetheless, similar results are maintained when we use the long-term interest rates, where South Africa has an even more negative effect. Previous studies found that a negative correlation is mainly associated with liability sensitive banks, where the loans do not re-price as fast as the deposits. Hence, banks are exposed to a rise in interest rates and for South Africa this is emphasized with longer horizons, where ultimately the bank has longer duration assets than their liabilities. We refer to this compromise in the profit margins using the APT in our theoretical framework, where temporarily the banks' stock could be viewed as mispriced (Flannery & James, 1984; Fraser, Madura & Weigand, 2002; Joseph & Vezos, 2006; Kasman Vardar & Tunc, 2011; Saunders & Cornett, 2015; Williams, 2014).

However, the opposite is concluded for German banks' stock returns, as they emerge with a positive relationship to long-term interest rates. In general, banks stand to benefit from rising interest rates, with asset sensitivity in repricing loans faster than the deposits. Investors can interpret this to be an efficient market and therefore, infer that Germany is a less risky market for banks' stocks to the exposure of interest rate risk. Also, with more prevalent hedges against movements in the long-term (Akella & Chen, 1990; Di Iorio, Faff & Sander, 2013).

Additionally, both German and South African banks' stock returns are negatively correlated to the exchange rate risk factor. In general, banks are exposed to this risk in two parts. First with core trading activities like forwards and swaps, which serve as hedging instruments and second when measuring profitability in uniform currency (Bodnar, Hayt & Marston, 1996). Therefore, an appreciation in the home currency against increasing valuation of banks' stock returns is a

positive reflection of the banks' performance and desirable to the investor (Nydahl, 1999). Notably, the difference in the levels of significance speaks to the market disparities highlighted by Mutarindwa, Schäfer and Stephan (2020). That is to say, location and current affairs are paramount in influencing the exchange rate performance, where ZAR is more reactive to changes in the USD in comparison to the EUR.

Furthermore, we observe that the results in the single model analogy of interest rate risk to banks' stock returns is exactly mirrored in the bi-variate model. In other words, the effect of exchange rate risk is diluted by the domineering effect of the interest rate risk (Jarnér & Nguyen, 2011). Generally, the exchange rates translate the bank performance, whereas the interest rates influence the bank performance. Hence, higher interest rates influence higher value of a local currency and in turn increase the real return on investor portfolios (Shamsuddin, 2009).

Interestingly, our results show that with both OLS and GARCH models, South African banks' stock returns appear more responsive to the changes in interest and exchange rates when compared to German banks' stock returns. Germany is a developed nation with deregulated governance yet also accountable to the European Union's Central Bank monetary policies. Despite the double-breasted governance, we note the robust infrastructure and operational efficiency in controlling the interest and exchange rate risks. However, the contrary performance of South African banks' stock returns shows the efforts in managing these risks and as with emerging markets, there is more arbitrary opportunity to beat the market, although it is at a higher risk (Ross, 1976).

Section 7: Conclusion

This study investigated the sensitivity of bank stock returns to interest and exchange rate risk for Germany and South Africa. We looked at the OLS and GARCH estimation methods on daily returns for single and joint effects to determine consistency in our models for both countries. As noted earlier, extensive studies have interrogated the two-fold effect of interest and exchange rate risk, however limited research has compared countries from different markets.

The influential factors affecting the banks' stock returns have increasingly been redefined over the years, with both the interest and exchange rates being of paramount importance given the impact they have on core banking activities. These variables determine the operational efficiency of banks and in turn speak to the profitability which serves as a performance indicator for investors. Notably, this helps to inform economic development of a nation through foreign direct investments, import and export trade and a stable and strong currency.

The multifaceted dimension of banking makes it pivotal in establishing monetary policies, controlling for inflation and navigating other macroeconomic factors, like politics. Needless to say, their stocks levels of exposure to interest rate risk are varied and highly dependent on the banking system at a national level. Notwithstanding, on a global scale banks are however united by credit lines and international business operations, which expose them to the foreign currency risk. Therefore, since banks mainly exist to transform deposits and loans and handle international transactions, we find that the effect on banks' stock returns are at risk to both variables, since they are informed by the interest rates and translated by the exchange rates.

The conclusions of this study are fundamental in investor analysis of the informative elements to banks' stock in the financial market. Bank managers and shareholders could improve the competitive advantage of the stocks to go beyond national barriers and price comparatively on an international level. However, the results of this study are limited by the source of data employed, the sample period and the methodology used. Further research can be done to investigate the miscellaneous factors represented by the market in our study.

References

Adjasi, C., Harvey, S.K. and Agyapong, D.A. (2008). Effect of exchange rate volatility on the Ghana stock exchange. *African Journal of Accounting, Economics, Finance and Banking Research*, 3(3)

Akella, S.R. and Chen, S.J. (1990). Interest rate sensitivity of bank stock returns: Specification effects and structural changes. *Journal of Financial Research,* 13(2), pp.147-154

Alam, M.D. and Uddin, G. (2009). Relationship between interest rate and stock price: empirical evidence from developed and developing countries. *International Journal of Business and Management (ISSN 1833-3850),* 4(3), pp.43-51

Aluko, O.A. and Ajayi, M.A. (2018). Determinants of Banking Sector Development: Evidence from Sub-Saharan African countries. *Borsa Istanbul Review,* 18(2), pp.122-139

AtindeÂhou, R.B., Gueyie, J.P. (2001). Canadian chartered banks' stock returns and exchange rate risk. *Management Decision*. 39 (4), pp.285–294

Bae, S. C. (1990). Interest rate changes and common stock returns of financial institutions: Revisited. *Journal of Financial Research*, 13, pp.71-79

Bengtsson, F. and Persson, A., 2018. Bank stock return sensitivity to changes in interest rate level and volatility. Bachelor Thesis, Department of Management Accounting and Logistics, Linnaeus University, Available online: https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1217167&dswid=3493 [Accessed 26 May 2022]

Benink, H.A. and Wolff, C.C. (2000). Survey data and the interest rate sensitivity of US bank stock returns. *Economic Notes, 29(2*), pp.201-213

Bodnar, G.M., Hayt, G.S. and Marston, R.C., 1996. 1995 Wharton survey of derivatives usage by US non-financial firms. *Financial Management*, pp.113-133

Booth, J. and D. T. Officer. (1985). Expectations, interest rates, and commercial bank stocks. *Journal of Financial Research*, 8, pp.51-58

Chance, D. M. and W. R. Lane. (1980). A re-examination of interest rate sensitivity in the common stocks of financial institutions. *Journal of Financial Research,* 3, pp.49-55

Chen, N.F., Roll, R. and Ross, S.A., 1986. Economic forces and the stock market. *Journal of Business*, pp.383-403

Choi, J.J., Elyasiani, E. and Kopecky, K.J. (1992). The sensitivity of bank stock returns to market, interest and exchange rate risks. *Journal of Banking & Finance*, 16(5), pp.983-1004

Danthine, J. P. & Donaldson, J. B. (2014). *Intermediate Financial Theory*, 3th edn, academic press

Di Iorio, A., Faff, R. and Sander, H. (2013). An investigation of the interest rate risk and exchange rate risk of the European financial sector: Euro zone versus non-Euro zone countries. *Journal of Accounting and Management Information Systems*, *12*, pp.319-344

El-Masry, A., & Abdel-Salam, O. (2007). Exchange rate exposure: Do size and foreign operations matter? *Managerial Finance*, 33(9), pp.741–765

Elyasiani, E., & Mansur, I. (2004). Bank stock return sensitivities to the long term and short-term interest rates: A multivariate GARCH approach. Managerial Finance, 30 (9), pp.32-55. https://doi.org/10.1108/03074350410769263

Fama, E.F., 1970. Efficient capital markets: A review of theory and empirical work. *The Journal of Finance*, *25*(2), pp.383-417

Fama, E. (1981). "Stock Returns, Real Activity, Inflation and Money", *The American Economic Review*, vol. 71, pp. 545-565

Flannery, M. J. and C. M. James. (1984). The effect of interest rate changes on the common stock returns of financial institutions. *The Journal of Finance*, 39, pp.1141-1153

Fraser, D. R., Madura, J., & Weigand, R. A. (2002). Sources of bank interest rate risk. *The Financial Review*, 37, pp.351-368. https://doi.org/10.1111/0732- 8516.00002

Hamrita, M.E. and Trifi, A., 2011. The relationship between interest rate, exchange rate and stock price: A wavelet analysis. *International Journal of Economics and Financial Issues*, *1*(4), pp.220-228

Hartmann, D. and Pierdzioch, C. (2007). Exchange rates, interventions, and the predictability of stock returns in Japan. *Journal of Multinational Financial Management*, *17*(2), pp.155-172

Harris, J.M., Marr, M.W. and Spivey, M.F., 1991. Exchange rate movements and the stock returns of US commercial banks. *Journal of Business Research*, *22*(3), pp.233-242

Hooy, C. W., Tan, H. B., & Nassir, A. M. (2004). Risk sensitivity of bank stocks in Malaysia: Empirical evidence across the Asian financial crisis. *Asian Economic Journal*, 18 (3), pp.261-276. https://doi.org/10.1111/j.1467-8381.2004.00192.x

Isa, M. A. M., Ismail, N., Latif, R. A., & Samsudin, S. (2021). Sensitivity of Banks' Stock Returns to the Changes in The Market, Interest and Exchange Rates: Evidence from Malaysia. *International Journal of Academic Research in Accounting Finance and Management Sciences*, 11(1), pp.256-270

Jarnér, M. and Nguyen, T., 2011. Determinants of interest rate exposure–A study of Eurozone banks. Master's Thesis, Department of Economics, Lund University, Available online: https://lup.lub.lu.se/student-papers/search/publication/1978030 [Accessed 26 May 2022]

Jorion, P. (1990). The exchange-rate exposure of US multinationals. *Journal of Business*, pp.331-345

Joseph, N. L., & Vezos, P. (2006). The sensitivity of US banks' stock returns to interest rate and exchange rate changes. *Managerial Finance*, 32 (2), pp.182 – 199. https:// doi.org/10.1108/0307435061064193

Joseph, N. (2002). Modeling the impacts of interest rate and exchange rate changes on UK stock returns. *Journal of Derivatives Use, Trading and Regulation* 2002, Volume 7, Number 4; pp. 306 - 323

Kasman, S., Vardar, G., & Tunc, G. (2011). The impact of interest rate and exchange rate volatility on banks' stock returns and volatility: Evidence from Turkey. *Economic Modelling*, 28, pp.1328-1334. https://doi.org/10.1016/j.econmod.2011.01.015

Katsikas, E., Brahma, S. and Wangeci, S.M. (2016). Effects of Interest Rates and Exchange Rates on Bank Stock Returns. *In Handbook of Frontier Markets*, pp. 71-92. Academic Press

Kennedy, P. (2008). A guide to econometrics (6th ed.). Oxford, UK: Blackwell Publishing. Kenourgios, D., & Padhi, P. (2012). Emerging markets and financial crises: Regional, global orisolated shocks?". *Journal of Multinational Financial Management*, pp.24–38

Khoo, A. (1994), Estimation of foreign Exchange exposure: an application to mining companies in Australia, *Journal of International Money and Finance*, June, 13 (3), pp.342-363

Koch, T.W. and Saporoschenko, A. (2001). The effect of market returns, interest rates, and exchange rates on the stock returns of Japanese horizontal keiretsu financial firms. *Journal of Multinational Financial Management*, 11(2), pp.165-182

Kutty, G. (2010). The relationship between exchange rates and stock prices: The case of Mexico. *North American Journal of Finance & Banking Research*, *4*(4)

Lynge, M. J. and J. K. Zumwalt. (1980). An empirical study of the interest rate sensitivity of commercial bank returns: A multi-index approach. *Journal of Financial and Quantitative Analysis*, 15, pp.731-742

Mansur, I. and E. Elyasiani. (1995). Sensitivity of Bank Equity Returns to the Level and Volatility of Interest Rates. *Managerial Finance*, 21, pp.58-77

Mao, C. K. G., and W. Kao. (1990), On Exchange Rate Changes and Stock Price Reactions, *Journal of Business Finance and Accounting*, 17 (3), pp.441- 449. 11

Mouna, A. and Anis, J. (2016). Market, interest rate, and exchange rate risk effects on financial stock returns during the financial crisis: AGARCH-M approach. *Cogent Economics & Finance*, 4(1), pp.1125332

Muktadir-al-Mukit, D. (2012). Effects of interest rate and exchange rate on volatility of market index at Dhaka stock exchange. *Journal of Business and Technology (Dhaka)*, 7(2), pp.1-18

Mutarindwa, S., Schäfer, D., Stephan, A. (2020). Legal History, Institutions and Banking System Development in Africa, DIW Discussion Papers, No. 1844, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin. http://hdl.handle.net/10419/213315

Nilsson, O. and Jónsson, A., (2021). Stock price reactions to analysts' recommendations. Master's Thesis, Department of Economics, Lund University, Available online: https://lup.lub.lu.se/student-papers/search/publication/9052143 [Accessed 26 May 2022]

Nydahl, S., 1999. Exchange rate exposure, foreign involvement and currency hedging of firms: some Swedish evidence. *European Financial Management*, *5*(2), pp.241-257

Priti, V. (2016). The Impact of Exchange Rates and Interest Rates on Bank Stock Returns: Evidence from US Banks. *Studies in Business & Economics*, *11*(1)

Rashid, A. (2007). Exchange rates or stock prices, what causes what: A firm level empirical investigation. MRPA working paper No.27209, University Library of Munich

Roll, R., and Ross, S. (1980). "An Empirical Investigation of the Arbitrage Pricing Theory", *The Journal of Finance*, vol. 35, pp. 1073-1103

Ross, S. (1976). "The Arbitrage Theory of Capital Asset Pricing", *Journal of Economic Theory*, vol. 13, pp. 341-360

Saporoschenko, A. (2002). The sensitivity of Japanese bank stock returns to economic factors: an examination of asset/liability differences and main bank status. *Global Finance Journal*, 13(2), pp.253-270

Saunders, A. and Cornett, Marcia Millon. 2015. Financial Markets and Institutions. 6th Eition. McGraw- Hill Education

Sukcharoensin, P. (2013). Time-varying market, interest rate and exchange rate risks of Thai commercial banks. *Asian Academy of Management Journal of Accounting and Finance*, 9(1), pp.25-45

Shamsuddin, A.F. (2009). Interest rate and foreign exchange risk exposures of Australian banks: A note. *International Journal of Banking and Finance*, 6(2), pp.129-138

Tripathi, V. and Ghosh, R. (2012). Interest rate sensitivity of banking stock returns in India. I*nternational Journal of Financial Management (ISSN: 2229-5690)* Vol, 2, pp.10-20

Uddin, M.G.S. and Alam, M.M. (2007). The impacts of interest rate on stock market: empirical evidence from Dhaka Stock Exchange. *South Asian Journal of Management and Sciences*, 1(2), pp.123-132

Werner, R.A., 2012. Towards a new research programme on 'Banking and the Economy'—Implications of the quantity theory of credit for the prevention and resolution of banking and debt crises. *International Review of Financial Analysis*, *25*, pp.1-17

Williams, S.T., 2014. *The causal relationship between stock price and interest rates* (Doctoral dissertation, University of Nairobi)