Response of Stock Market Development to Monetary Policy: A Tanzanian Stock Market Perspective

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This paper examines the response of stock market development to monetary policy in Tanzania using monthly time-series data for the period spanning from 2011 to 2020. The paper employs the autoregressive distributed lag (ARDL) to determine the response of stock market to monetary variables namely; money supply, inflation, exchange rate and interest rate. All the variables in the model are statistically different from zero. Based on these results, the paper shows that there is a negative response of stock market development to interest rate and inflation suggesting that an increase in interest rate or inflation will result in a decrease in domestic market development. Conversely, empirical results show that there is a positive response of domestic market development to changes in money supply or real exchange rate suggesting that an increase in money supply or the exchange rate will lead to an increase in domestic market capitalization. The implication of this paper is that investors and policymakers should take into account the changes of monetary variables before making stock investment or policy to stabilize the stock market performance, which implicitly has an impact on the overall economy.

Keywords: Monetary Policy; Stock Market; ARDL; Tanzania
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1. Introduction

Monetary policy attempts to achieve a set of objectives that are expressed in terms of macro-economic variables such as inflation, real output, employment, interest rate, money supply and so on. However, monetary policy actions such as changes in the central bank discount rate have at best an indirect effect on these variables and considerable lags are involved in the policy transmission mechanism. Broader financial markets, though, for example, the stock market, government and corporate bond markets, mortgage markets, foreign exchange markets, are quick to incorporate new information. Therefore, a more direct and immediate effect of changes in the monetary policy instruments may be identified using financial data.

Identifying the link between monetary policy and financial asset prices is highly important to gain a better insight into the transmission mechanism of monetary policy, monetary policy news affects the stock market. Regardless of the policy type, investors will react. The type of policy that is implemented and its size should determine the magnitude of the reaction. Macro-economic variables give important information about the present and future state of the economy, and thus, a change in some of these variables should therefore change the expectation about the future. A rational investor takes account of all relevant information when making a decision, and a change in monetary policy would thereby change the behaviour of the investor. It is important to realize that in the current economy, most individuals are directly or indirectly involved in the stock market. Each day, individual and institutional investors, such as mutual fund managers and insurance company representatives, invest funds in the stock market. Thus, to decide which stock to buy or sell, investors need to be able to estimate the expected rate of return on various stocks and the amount of risk inherent in each stock (Hojat, 2015). Likewise, business corporations that try to raise capital by offering new securities to the market need to know how to decide on the price of the new securities.

According to Anon (2012), the stock market has become a vital market; playing a vigorous role in economic affluence thus fostering capital formation and nourishing economic growth. Stock markets operate as a facilitator between savers and lenders of capital by means of pooling of funds, diversifying risk, and transferring wealth. Stock markets are essential for economic growth as they facilitate the flow of resources to the most productive investment opportunities. Chiefly, stock markets help in terms of efficient allocation of credit in the economy. This role has become much stronger with the growing complexity of the economic structure, particularly since the financial crisis of 2008 (Borys, 2011; Chiarella, et al., 2013; Dempsey, 2013; Doh & Connolly, 2013; Kolozsi, 2013). Dar-es-salaam “Stock Exchange (DSE) market in

Tanzania was "formed under the establishment of Capital Market, and Security Authority (CMSA) followed the enactment of the Capital Market" and Securities Act, 1994 was incorporated in September 1996 as a private company limited by guarantee and not having a share capital under the Companies Ordinance (Cap. 212). The DSE is, therefore, a "non-profit making body created to facilitate the government implementation of the economic reforms and in future to encourage the wider share ownership of all the companies in Tanzania and facilitate the raising of medium and long-term capital. Trading activities at the DSE commenced on 15th April 1998. Till now there are almost 27 companies that are listed in DSE. Understandably, low and predictable rates of inflation, money supply and interest rate are more likely to contribute to stock market development and economic growth.

Macroeconomic volatility worsens the problem of informational asymmetries and becomes a source of vulnerability to the financial system. Both domestic and foreign investors will be unwilling to invest in the stock market where there are expectations of high risk. By and large, the important issue in asset pricing models is to identify the factors that determine the risks involved in the purchase of a specific asset (Sharpe; Linter; Mossin; as cited in Chiarella *et al.*, 2013). The literature, nonetheless, has inadequately addressed the impact of monetary policy on the equity market (Abdymomunova & Morley, 2011; Alves, 2013; Berger, 2011; Febrian & Herwany, 2010; Levy, 2012).

Inasmuch as stock prices are highly sensitive to economic conditions and their values are volatile, this sensitivity can cause large swings in stock prices, leading to bubbles, and damage the whole economy (Borys, 2011). Accordingly, knowledge of how monetary policy affects the financial market, and more specifically the stock market, is essential for understanding how monetary policy affects the broader economy (Hojat, 2015). Thus, the general problem to be addressed in this paper is how stock markets respond to changes in monetary factors such as money supply, exchange rate, interest rate, and inflation. The impact of monetary policy factors on stock market development is important to be addressed because the effect of monetary policy on the economy and economic resource allocation via the equity market is significant (Hojat, 2015). Besides, analysis of stock market development and its determinants is of paramount significance because the financial and economic crisis of 2007-2008 was considered to indicate a deficiency of the classical and neoclassical approach to understanding financial problems in the economy (Kolozsi, 2013).

This paper is of supreme importance because the role of monetary policy in financial market development for both policymaking and regulation in the financial system is likely to affect the economy and stock prices. However, it is worth noting that financial factors such as money supply, interest rate, exchange rate, and inflation affecting stock market development and thus accounting for investors' decision to invest in the financial market in the area of monetary policy have not been fully explored (Abdymomunova & Morley, 2011; Alves, 2013; Berger, 2011; Febrian & Herwany, 2010; Levy, 2012). In this regard, we contribute to the field by examining the response of stock market capitalization to changes in monetary policy in Tanzania. Thus, the results of this paper can help investors make more informed investment decisions, leading to better allocation of economic resources. Equally important, establishing the existence of a stock market response to monetary policy changes will not only be germane to the study of stock market determinants but will also contribute to a understanding of the conduct of monetary policy and of the potential economic impact of policy actions.

2. Empirical literature review

2.1. Arbitrage Pricing Theory

Financial and monetary variables such as money supply, inflation, interest rate and exchange rate can affect stock markets development. Existing theories offer different models that make available framework for examining the relationship between stock return and macroeconomic variables. The monetary variables and stock market returns may be linked through arbitrage pricing theory (APT), which applies multiple risk factors to explain asset returns. The APT, which is an advanced theory of Capital Asset Pricing Model (CAPM), is an equilibrium theory explicated by Ross (1976). It relates the expected rate of return on a sequence of primitive securities to their factor sensitivities, suggesting that factor risk is of crucial importance in asset pricing (Gilles & Leroy, 1990). The theory highlights the factors that influence the variation of shares or portfolios returns from their normal expected returns. Being a multifactorial model, for each factor there is determined a beta coefficient that shows the measure of influence, that is, how much is the variation of portfolio return from the normal expected evolution if the factor varies. In equilibrium, according to the APT, the expected return on a security $E(r_i)$ with k factors is given by:

$$E(r_i) = r_f + (\delta_1 - r_f)\beta_{i1} + (\delta_2 - r_f)\beta_{i2} + \cdots + (\delta_k - r_f)\beta_{ik} \tag{1}$$

where

$E(r_i)$	=	Expected rate of return on security i
β_{i1}	=	Sensitivity of security i to economic factor 1
β_{i2}	=	Sensitivity of security i to economic factor 2
β_{ik}	=	Sensitivity of security i to economic factor k
δ_1	=	Expected returns from the portfolios δ_1 or Expected value of factor 1
δ_2	=	Expected value of factor 2
δ_k	=	Expected value of factor k
r_f	=	Risk free rate of return

The APT however, assumes that investors prefer more returns, and that they are risk averse. It also assumes that investors have homogeneous risk expectations. The other assumption of Arbitrary pricing framework is that the capital market does not have any transaction cost and there are no taxes. The number and nature of these factors is likely to change over time and between economies, which essentially made it to be empirical in nature. Applications APT have been carried out by researchers such as Antoniou *et al.* (1998) for the London stock market, Dhankar & Singh (2005) for the Indian stock market, Berry *et al*. (1988) for the S & P 500, Chen *et al*. (1986) for the New York stock market, Azeez & Yonezawa (2006) for the Japanese stock exchange and Anatolyev (2005) for the Russian stock exchange.

It is worth noting that early empirical studies on arbitrage pricing framework focused on individual security returns. However, the theory may also be used in an aggregate stock market framework, where a change in a given macroeconomic variable could be a proxy for changes in an underlying systematic risk factor influencing future returns. It should also be noted that most of previous studies on applications of APT are characterized by modeling a short-run relationship between macroeconomic factors and the stock price in terms of first differences, assuming a trend-stationary process.

2.2.Multifactor Capital Asset Pricing Model

Unconditional multifactor capital asset pricing model can be used to link the macroeconomic variables with expected returns, we start our analysis with the unconditional multifactor CAPM (Javid & Ahmad, 2008). According to Javid & Ahmad (2008), the multifactor asset-pricing model implies that the expected returns of assets are related to their sensitivity to change in the state of the economy. A set of economic variables is specified as proxies for economic risks and it is investigated whether or not these risk factors are rewarded in the stock market (Chen, *et al.*, 1986). Assuming that the stock returns of asset i follows a linear factor model with j macroeconomic variables. The expected returns of asset can be expressed as follows:

$$E\left(r_t\right) = E\left(\sum_{j=1}^{J} \beta_{jt}\ f_j\right) \tag{2}$$

$$r_t = \beta_0 + \sum_{j=1}^{J} \beta_{jt} f_j + u_t$$

where $E(r_i)$ = Expected rate of return on security at time t

β_0 = The constant

β_{jt} = Factor sensitivities on the macroeconomic variables

u_t = Idiosyncratic error term

The market beta and macroeconomic betas are estimated simultaneously and then risk premiums are estimated by cross-sectional regression equation (3) which is estimated by GLS per time period:

$$r_t = \gamma_0 + \sum_{j=1}^{J} \gamma_j \beta_{jt} + u_t \tag{3}$$

where γ_0 = Intercept

γ_j = the slope coefficients using economic variables,

β_{jt} = Time series estimated factor sensitivities (estimated by equation 2).

The multifactor model can be extended to allow investors to have conditional expectations and therefore the CAPM-GARCH-model which has the capacity to describe direct relationship between conditional first and second moment can be used. The multifactor CAPM-GARCH asserts that inventors revise their estimation of mean and variance of asset returns each period to reflect expansion of information set upon which expected returns are based (Javid & Ahmad, 2008).

$$r_t = \beta_0 + \sum_{j=1}^{J} \beta_{jt} f_j + \sum_{i=1}^{p} \alpha_i r_{t-i} + \sum_{s=0}^{q} \beta_j u_{t-j} + \theta_i f\left(h_t^{1/2}\right) + u_t \tag{4}$$

$$u_t = v_t \sqrt{h_t} \tag{5}$$

$$h_t = \phi_0 + \sum_{k=1}^{l} \phi_k u_{t-k}^2 + \sum_{m=1}^{s} \gamma_m h_{t-m} \tag{6}$$

where β_0 = Constant

β_{jt} = Factor sensitivities on the macroeconomic variables

u_t = Idiosyncratic error term

ϕ_k = ARCH coefficient of order k

$f\left(h_t^{1/2}\right)$ = Conditional variance which is used as an explanatory variable in addition to excess market return.

γ_m = the GARCH coefficient of order m

The random error term is decomposed into v_t , which is homoscedastic with $\sigma_{v_t}^2 = 1$ and h_t which is heteroskedastic with ARMA process given by (6). The coefficient of $f\left(h_t^{1/2}\right)$ measures the premium for variance risk, as opposed to covariance risk. The estimation technique is a refined version of the standard Fama & MacBeth (1973) approach. The following time series multifactor regression model is estimated in the first stage:

$$r_t = E_{t-1}\left[r_t | z_{t-1}\right] + u_t \tag{7}$$

$$E_{t-1}\left[r_t | z_{t-1}\right] = E_{t-1}\left[\sum_{j=1}^{J} \beta_{jt} f_j | z_{t-1}\right] \tag{8}$$

$$r_t = \beta_0 + E_{t-1}\left[\sum_{j=1}^{J} \beta_{jt} | z_{t-1}\right] + u_t \tag{9}$$

$E_{t-1}[.]$indicates the conditional expectation, given public information set z_{t-1} at time $t-1$, $\beta_{jt}s$ are conditional betas or the regression coefficients on j macroeconomic variables economic variables and u_t is idiosyncratic error. The betas are allowed for time variation depending on z_{t-1} by making them linear functions of predetermined instruments (Shanken, 1992; Ferson and Harvey, 1991, 1993, 1999; Ferson and Schadt, 1996). The information set includes lagged predetermined macroeconomic variables namely money supply, industrial production growth, inflation rate, exchange rate, and the growth rate of oil prices.

2.3.Discounted Present Value

The discounted present value (DPV) approach relates the stock price to future expected cash flows. Unlike APT, the DPV can be used to focus on the long-run relationship between the stock market and macroeconomic variables (Yoshino et al., 2014). It is worth noting, however, that the effects of macroeconomic variable on stock market can be explained based on portfolio theory, where assets are substituted for each other and every change in one asset price has a direct and indirect impact on other assets. The relationship between macroeconomic variables and stock prices can be expressed as:

$$P_s = \left[\begin{array}{l} \dfrac{[\pi(y, ex)]_t}{[1 + i\,(\Delta m,\ p) + \rho]_t} + \dfrac{[\pi(y, ex)]_{t+1}}{[1 + i\,(\Delta m, p)]_{t+1}^2} + \cdots \\ \\ + \dfrac{[\pi(y, ex) + E[P^f](E[y], E[p], E[ex])]_{t+n}}{[1 + i\,(\Delta m, E[p]) + \rho]_{t+n}^n} \end{array} \right] \tag{10}$$

where

P_s	=	Stock present prices
$\pi_t, \pi_{t+1}, \cdots, \pi_{t+n}$	=	Share dividends in each year
$y_t, y_{t+1}, \cdots, y_{t+n}$	=	Economic activities in each year
$ex_t, ex_{t+1}, \cdots, ex_{t+n}$	=	Exchange rate in each year
i	=	Real interest rate
Δm_t	=	Money supply
p	=	General price level
ρ	=	Risk premium
$E[P^f]$	=	Future price of stock
$E[y]$	=	Expected economic activities

$E[ex]$	=	Expected exchange rate
$E[p]$	=	Expected general price level

Model (10) mainly focuses on the discounted present value of future dividends and future stock price. The model states that share dividends are functions of economic activity and the exchange rate in each year. If the exchange rate fluctuates, the import prices of raw materials and natural resources will change, and changes in the exchange rate also change the export, which is why it has an impact on the dividends. Interest rates are affected by monetary policy Δm_t, and general price level, p. The future price of stock, depends on how the economy fluctuates, and therefore is a function of expected economic activity, expected exchange rate and the expected general price level. The real interest rate, which is equal to nominal interest rate minus general price level, is important to capture the interest rate.

The DPV model is able to capture both monetary and fiscal policies. For fiscal policy, DPV model includes dividends and future stock prices. If fiscal policy is aggressive and positive, it will encourage gross domestic product (GDP) growth, which will increase dividends of the stock of listed companies and also the expectation of a bright future because positive fiscal policy will impact future prices in that it will push up the present stock prices as well. Based on the DPV model (10), the model explaining the response of stock markets to monetary policy, means that stock prices are a function of economic activity or GDP, monetary variable or money supply, exchange rate, interest rate and general price level or inflation rate. The empirical model can be presented as

$$P_s = f\left(y,\ m^s,\ ex,\ i,\ cpi\right) \quad (11)$$

$$\Delta \ln P_s = \theta_0 + \theta_1 \Delta \ln P_{t-1} + \theta_2 \Delta \ln y_t + \theta_3 \Delta \ln m^s + \cdots \quad (12)$$
$$+ \theta_4 \Delta \ln ex_t + \theta_5 \Delta i_t + \theta_6 \Delta cpi_t + u_t$$

where Δ = the first difference
u_t = Error term

The present value or discounted cash flow model offers useful insights on the stock market effects of monetary policy changes. Tighter monetary policy leads to an increase in the rate at which firms' future cash flows are capitalised causing stock prices to decline. The underlying assumptions are that, first, the discount factors used by market participants are generally linked to market rates of interest. Monetary policy changes exert an indirect effect on the firms' stock value by altering expected future cash flows. Monetary policy easing is expected to increase the overall level of economic activity and the stock price responds in a positive manner.

The effect of monetary expansion or contraction on the economy is through the interest rate because interest rates as a cost to the business corporations should be curtailed to encourage them to borrow and invest more. Higher investment will turn the economic cycle because (a) more funds will be available for the private sector, (b) financially constrained firms can borrow more, and (c) resources will be moved toward the high productivity entrepreneurs (Gwilym, 2013).

2.4.Empirical Evidence

There is a number of empirical works on the relationship between monetary policy and development of stock market. Nonetheless, findings have been mixed. Some empirical testing indicates strong relationship between the variables while other research shows no relationship between the variables. For example, Chen (2007) reported that monetary policy changes have a significant effect on the equity market. However, the effect of monetary shocks on stock market was proved to be more than its effect on the real economy. Thus, the financial decisions by firms are different when monetary shocks occur during a recession or recovery, which creates volatility in the stock market returns (Gwilym, 2013). The earlier work by Jensen & Johnson (1995) shows that stock returns increase during expansive monetary periods in the United States. Similarly, Thorbecke (1997) reveals that an expansionary monetary policy exerts a large and statistically significant positive effect on monthly stock returns, while a restrictive monetary policy decreases stock prices in the United States.

In a similar study, Shahid & Kamran (2015) show that stock prices in Pakistan are affected by macroeconomic variables, including inflation rate, the price of production, the price of gold, exports, while prices of silver and imports do not affect stock prices in the stock market of Pakistan over the 2005 –2014 period. Yet, Hunjra *et al.*, (2014) reveal a significant long-term relationship between inflation rate, GDP, price difference, interest rate, and stock prices on the Karachi Stock Exchange during the 2001 – 2011 period. In another paper El-Nader & Alraimony (2012) reveal that real money supply, inflation, the real exchange rate, changes in the nominal interest rate have a negative and significant effect on the stock market returns, while an increase in real domestic output positively affected the shares of the stock exchange. Also, Kganyago & Gumba (2015) show that there is a negative correlation between interest rates and monthly stock returns in the Zimbabwe. Likewise, Jefferis & Okeahalam (1999) claim that higher interest rates tend to reduce stock prices in the Republic of South Africa, Botswana and Zimbabwe.

Mohamadpour *et al*. (2012) while examining the link between monetary policy and the performance of the stock market in Malaysia, and applying the Vector Error Correction Model (VECM) to test the correlation among monetary supply and the stock market reveal that there is a long-term relationship between M1, M2 and the stock market with highly significant. In the same line, Musawa & Mwaanga (2017) explore the effect of commodity prices, interest rate and exchange rate on the stock market. They used Autoregression Distribution lag, cointegration and VECM approach. The empirical result show that interest rate, exchange rate as well as oil prices have the long and short-term stock market impact together. Only the interest rate and the copper price have a significant effect on the stock market over the long term.

It is noteworthy that some research for example Bordo & Jeanne 2002 and Fair (2005) provide no evidence that interest rate and money supply affect stock prices. Similarly, Durham (2001) also supports this view that a weak relation is present between monetary policy and stock return. Other studies from Kandir (2008), Liao et al. (2014), Husain (1999) and Kraft and Kraft (1977) also reveal no link between money supply and stock return. Kotha & Sahu (2016) while analyzing the long-term and short-term relationship between macroeconomic indicators and stock returns in India over 2001–2015 period, show that there is a positive and significant relationship between the exchange rate, money supply, consumer prices, the interest rate on treasury bills, and the return on the financial market, but the relationship between interest rate and equity returns is insignificant. According to Khan & Khan (2018), money supply, exchange rate and interest rate have a significant effect on stock prices. In the short term, however, all these variables except exchange rate, exert no effect on stock prices. Exchange rate, tends to have a negative impact on stock prices in India. Further, several studies including Cornell (1983), Pearce & Roley (1985) and Sellin (2001) show that there is an inverse link between stock return and money supply. In addition, Almutair (2015) indicates that there is no long-term or short-term causal relationship between the supply money in the narrow or broad sense and the share price index in Saudi Arabia.

As has been reported, a review of the literature indicates the presence of some mixed empirical results. In this paper the analysis focuses more on the response of stock market capitalization on changes of monetary variables in Tanzania. The country has a relatively less-developed financial market but its stock market has been performing well over the past years. The paper uses a monthly time series data spanning from January 2011 to December 2020. We apply an autoregressive distributed lag (ARDL) methods to examine the relationship between the variables. This is important for Tanzanian economy because monetary policies are usually undertaken to restore or maintain stability within an economy and such policies can either be expansive or restrictive with the central bank using interest rates and money supply as monetary policy instruments.

3. Methodology

3.1.Model specification and data

This paper applies the Autoregressive Distributive Lag Model (ARDL) bound test approach to analyze the response of stock market development to changes in monetary variables using monthly time-series dataset for Tanzania covering the 2011-2020 periods. The choice of years is primarily motivated by the availability of data for the variables in question. Table1: gives a summary of variables' definitions and sources of data of the key variables. The variable of interest is stock market capitalisations, obtained from the Dar-es-salaam stock exchange manual reports. Among the explanatory variables, we include the broad money supply, real exchange rate, interest rate and inflation rate; the data sources are the Bank of Tanzania's Annual Reports, National Bureau of Statistics (NBS) and the World Bank's *World Development Indicators* (WDI).

Originally, Engle & Granger (1987) demonstrated that once variables (say X and Y) are cointegrated, there always exists a corresponding error correction representation. Impliedly, changes in the dependent variables are the function of disequilibrium in the co-integrating relationship captured by the error correction term and changes in explanatory variables (Erjavec & Cota, 2003). Similarly, the long run and short-run relationships among variables have been analyzed using the standard Johansen Cointegration and VECM frameworks. However, the ARDL method yields more consistent and robust results. When one cointegrating vector exists, Johansen & Juselius (1990) cointegration procedure cannot be applied. Hence, it become imperative to explore Pesaran & Shin (1995) and Pesaran *et al.* (1996b) proposed Autoregressive Distributed Lag (ARDL) approach to cointegration or bound procedure for a longrun relationship, irrespective of whether the underlying variables are I(0), I(1) or a combination of both. In such situation, the application of ARDL approach to cointegration will give realistic and efficient estimates. Unlike the Johansen & Juselius (1990) cointegration procedure, Autoregressive Distributed Lag (ARDL) approach to cointegration helps in identifying the cointegrating vector(s). That is, each of the underlying variables stands as a single long run relationship equation. If one cointegrating vector (i.e the underlying equation) is identified, the ARDL model of the cointegrating vector is reparameterized into ECM. The reparameterized result gives short-run dynamics (i.e. traditional ARDL) and long run relationship of the variables of a single model. The re-parameterization is possible because the ARDL is a dynamic single model equation and of the same form with the ECM. Distributed lag Model simply means the inclusion of unrestricted lag of the regressors in a regression function.

Table 1: Definition of Variables and Sources of Data

Sn	Variable	Abbr.	Definition	Expected sign
1	Money supply	$\ln M_t^2$	Broad money supply, percent of GDP	Positive
2	Real exchange rate	$\ln rer_t$	[Domestic price/Foreign price] Nominal exchange rate	Positive
3	Interest rate	r_t	The proportion of an amount loaned which a lender charges as interest to the borrower	Negative
4	Inflation	π_t	Inflation, consumer prices, percent	Negative
5	Domestic market development	$\ln CMD_t$	Number of stocks x stocks price	

Source: Authors' construction from literature review, 2020

A framework to examine the response of stock market developments to monetary policy can be specified as

$$\ln CMD_t = f\left(r_t, \ln rer_t, \ln M_t^2, \pi_t,\ u_t\right) \tag{13}$$

where

$\ln CMD_t$	=	Log of market capitalisation, a proxy for capital market development
r_t	=	Real interest rate
$\ln rer_t$	=	Log of real exchange rate
$\ln M_t^2$	=	Log of broad money supply-to-GDP ratio
π_t	=	Inflation, consumer prices, annual percent.
u_t	=	Error term, representing the effect of other factors.

Using equation (13), the general ARDL representation is specified as:

$$\Delta \ln CMD_t = \varphi_0 + \sum_{i=1}^{p_1} \varphi_1 i\, \Delta \ln CMD_{t-1} + \sum_{i=0}^{p_2} \varphi_2 i \Delta r_{t-i} + \sum_{i=0}^{p_3} \varphi_3 i \Delta \ln rer_{t-i} + \sum_{i=0}^{p_4} \varphi_4 i \Delta \ln M_{t-i}^2 \tag{14}$$

$$+ \sum_{i=0}^{p_5} \varphi_5 i \Delta \pi_{t-i} + \phi_1 \ln CMD_{t-1} + \phi_2 r_{t-1} + \phi_3 \ln rer_{t-1} + \phi_4 \ln M_{t-1}^2 + \phi_5 \pi_{t-1} + u_t$$

Where all variables are as previously defined, Δ is the difference operator, φ_0 is the drift component, u_t is a white noise error term, and it is assumed to be serially uncorrelated. Lastly, $p_1, p_2, \cdots, p_5$ are the lag length. The part of the equation with coefficients φ_i, where $i = 1, 2, \cdots, 5$ represents the short-run dynamics of the model whereas the second part with coefficients ϕ_i, where $i = 1, 2, \cdots, 5$ represents the long-run dynamic relationship. Based on equation 14, to trace the existence of cointegration, F-statistic is computed from the OLS regression equation (14). The null hypothesis of no cointegration (H_0) is tested by restricting the lagged level variable equal to zero, against the alternative hypothesis (H_a) i.e.

$$H_0: \quad \phi_1 = \phi_2 = \cdots = \phi_5 = 0 \tag{15}$$

$$H_a: \quad \phi_1 \neq \phi_2 \neq \cdots \neq \phi_5 \neq 0 \tag{16}$$

The bounds tests provide two asymptotic critical value bound. The lower bound assumes variables are $I(0)$ while the upper bound assumes $I(0)$ variables. The long-run relationship of the underlying variables is detected through the F-statistic (Wald test). In this approach, long run relationship of the series is said to be established when the F-statistic exceeds the critical value band. The major advantage of this approach lies in its identification of the cointegrating vectors where there are multiple cointegrating vectors. It is worth noting however, that the result is inclusive, if the computed F-statistic falls within the lower and upper bound critical values. In this case, the error correction term will be a useful way to establish cointegration (Kremers *et al.* 1992).

Once cointegration is established, the conditional ARDL long-run model for CMD can be estimated based on the following equation:

$$\ln CMD_t = \theta_0 + \theta_1 r_{t-1} + \theta_2 \ln rer_{t-1} + \theta_3 \ln M_{t-1}^2 + \theta_4 \pi_{t-1} + u_t \qquad (17)$$

All variables in equation (17) are as defined earlier. The last step is obtaining the short-run dynamic coefficients, which entails estimating an error correction model. The error correction model (ECM) is developed in order to test for the speed of adjustment and how the variables in the dataset converge towards equilibrium in the long-run. Therefore, the ARDL version of the ECM for the CMD model can be expressed, in conformity with the models (16) and" (17) as

$$\Delta \ln CMD_t = \varphi_0 + \sum_{i=1}^{p_1} \varphi_1 i \,\Delta \ln CMD_{t-1} + \sum_{i=0}^{p_2} \varphi_2 i \Delta r_{t-i} + \sum_{i=0}^{p_3} \varphi_3 i \Delta \ln rer_{t-i} + \sum_{i=0}^{p_4} \varphi_4 i \Delta \ln M_{t-i}^2 + \sum_{i=0}^{p_5} \varphi_5 i \Delta \pi_{t-i} + \gamma\, ECT + u_t \qquad (18)$$

where $\varphi_1, \ \varphi_2, \ \cdots, \ \varphi_5$ = Short-run coefficients
γ = The extent of disequilibrium correction
ECT_{t-1} = The error correction term

λ Explains the speed of adjustment and the error correction term ECT_{t-1}, which is derived from the residuals obtained in the model (14). The coefficient of the lagged error correction term, λ, is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship. The negative sign of λ implies that the dependent variable was above the equilibrium in the previous period, and that it would thus be corrected through a downward movement in the next period, that is period t.

3.2.Unit root test and lag order selection

It is of the view that before pursuing formal tests to plot the time series under consideration, to determine the likely features of the series. If the series is trending upwards, it shows that the mean of the series has been changing with time. This perhaps reveals that the series is not stationary. Though ARDL, model does not require a pretesting for the unit roots, a critical condition is that the explanatory must not be I(2). As such, the test for unit roots might still be necessary to ensure that variables are not I(2). There are various methods of testing unit roots including, *inter alia,* Durbin-Watson (DW) test, Dickey-Fuller test (1979)(DF), Augmented Dickey-Fuller (1981)(ADF) test, Philip-Perron (1988) (PP) test, among others. The most popular strategy for testing the stationarity property of a single time series involves using the Dickey Fuller or

Augmented Dickey Fuller test respectively. Nevertheless, the choice of the right tests depends on the set up of the problem which is of interest to the practitioner.

The paper uses the augmented Dickey-Fullerr (ADF) test, a test developed by Dickey & Fuller (1981). In this test, the null hypothesis is that a series has no unit root, meaning that it is integrated of order 0. By rejecting the null hypothesis, it suggests that the time series variable is integrated of order 1 or higher. Hence, the time series can be differenced to keep it stationary. The results of the ADF are reported in Tables 4 and 5. The optimal number of lags to be used in the analysis was selected based on Akaike Information Criterion (AIC).

4. Findings and Discussions

4.1.Descriptive Data Analysis and Statistical Tests

Descriptive analysis and correlation matrix are conducted to ascertain the statistical properties of the variables. Table 4.1 and Table 4.2, respectively, report the descriptive statistics and correlation matrix of the variables. Some variables are measured in natural logarithm forms (i.e. money supply, domestic market capitalisations and exchange rate). The descriptive statistics suggest that all variables are approximately normally distributed because their respective skewness above 0.5 in absolute values or the probabilities of these variables reject the null hypothesis of normal distribution, which implies that all the variables are normally distributed

The correlation matrix of the variables of the regression model, as reported in Table 4.2, suggests that the inflation rate and the interest rate has negative correlations with domestic market capitalisations, but there are positive correlations between domestic market capitalisations with money supply and exchange rate. The correlation between interest rate and inflation appears to have been negative but very weak. But also there is a strong but negative relationship between exchange rate and inflations, and on the other hand, money supply and inflations, while there is a strong and positive relationship between domestic market capitalisations and money supply .The correlation matrix also shows that the is no pair-wise correlations between explanatory variables as variables are not quite high (i.e. less than 0.8), indicating that multicollinearity is not a serious problem. A strong positive correlation between money supply and the exchange rate was expected in Tanzania, as the economy tends to move from an agricultural to an industrial economy. This multicollinearity case was taken into consideration in the regression analysis. .

Table 2. Descriptive Statistics and Correlation of Variables

Variable	r_t	π_t	$ln\, r\, er_t$	$ln\, M_t^2$	$ln\, C\, MD_t$
Mean	9.137	6.902	7.574	9.895	8.905
Median	8.655	5.500	7.657	9.986	9.146
Maximum	16.000	19.800	7.749	10.309	10.074
Minimum	5.000	3.000	7.300	9.322	6.920
Std. Dev.	2.918	4.457	0.162	0.285	0.851
Skewness	1.424	1.646	-0.315	-0.391	-0.490
Kurtosis	4.226	4.729	1.308	1.929	2.161
Jarque–Bera	48.102	69.174	16.307	8.803	8.334
Probability	0.000	0.000	0.000	0.012	0.015
Sum	1096.450	828.300	908.886	1187.400	1068.658
Sum Sq. Dev.	1013.789	2364.649	3.142	9.695	86.223
Observations	120	120	120	120	120

Source: Authors' Computations

Table 3. Correlation Coefficients' Matrix

Variable	r_t	$\boldsymbol{\pi_t}$	$\boldsymbol{ln\, r\, er_t}$	$ln\, M_t^2$	$ln\, C\, MD_t$
r_t	1				
$\boldsymbol{\pi_t}$	-0.044	1			
$\boldsymbol{ln\, r\, er_t}$	0.126	-0.659	1		
$ln\, M_t^2$	0.026	-0.788	0.935	1	
$ln\, C\, MD_t$	-0.267	-0.670	0.700	0.786	1

Source: Authors' Computation

4.2.Unit root testing

It was important to verify the stationarity properties of the variables used in this study in order to avoid the risk of spurious regression since literature has shown that most time-series variables have stochastic trends. Thus their variances and unconditional means are non-stationary. The Augmented Dickey-Fuller (ADF) method is conducted to check for a unit root for all variables in both levels and first differences. In carrying out the stationarity tests, we considered both constant and constant and trend in the series. The results of this test, which are presented in the Table 4, indicate that the hypothesis of a unit root cannot be rejected in all variables in levels when tested at the 5 percent level of significance. It is therefore concluded that all variables are non-stationary at their levels. However, the hypothesis of a unit root is rejected in first differences, indicating that all variables are integrated of degree one (Table 5). This also suggests that further estimations could be carried while in the first difference in order to avoid spurious correlation.

Table 4. ADF Unit Root Tests for Stationarity: Level Variables

No	Variable	ADF test statistic			Decision
		Intercept	Intercept & trend	None	
1	Inflation rate (π_t)	-1.5813	-2.6519	-1.2287	Accept H_0
2	Market capitalisations ($ln\, C\, MD_t$)	-2.3996	-5.7109	0.3071	Accept H_0
3	Real interest rate (r_t)	-1.4496	-1.5152	-0.6831	Accept H_0
4	Exchange rate ($ln\, r\, er_t$)	-1.3627	-1.5570	1.8209	Accept H_0
5	Money supply ($ln\, M_t^2$)	-1.9654	-1.9240	5.6972	Accept H_0
	Critical values: 5% level	-2.8860	-3.4483	-1.9435	

Hypothesis: H_0: Series is non-stationary/has a unit root.
H_1: Series has no unit root.

Table 5. ADF Unit Root Tests for Stationarity: First Difference

No	Variable	ADF test statistic			Decision
		Intercept	Intercept & trend	None	
1	Inflation rate (π_t)	-4.8901	-4.8477	-4.8911	Reject H_0
2	Market capitalisations ($ln\, C\, MD_t$)	-15.253	-15.187	-15.291	Reject H_0
3	Real interest rate (r_t)	-11.323	-11.379	-11.365	Reject H_0
4	Exchange rate ($ln\, r\, er_t$)	-11.052	-11.050	-10.810	Reject H_0
5	Money supply ($ln\, M_t^2$)	-12.365	-12.701	-4.7642	Reject H_0
	Critical values: 5% level	-2.8860	-3.4483	-1.9435	

Hypothesis: H_0: Series is non-stationary/has a unit root.
H_1: Series has no unit root.

4.3 Autoregressive Distributed Lag Cointegration Test

As the variables are integrated of order 1, the ARDL bounds testing are a valid approach for examining long-run relationships (Pesaran *at al*., 2001). However, it is should be noted that to overcome the problem of non-stationarity and prior restrictions on the lag structure of a model, econometric analysis of time series data has increasingly moved towards the issue of cointegration. The reason being that, cointegration is a powerful way of detecting the presence of steady state equilibrium between variables. Indeed, cointegration has become an over-riding requirement for any economic model using non-stationary time series data. If the variables do not cointegrate, then we have the problems of spurious regression and the results therein become almost meaningless.

Results of the ARDL bound test for cointegration, "which is based on the Wald-test (F-statistic), are reported in Table 6. In this test, as has been discussed, the lower critical bound assumes all the variables are I(0), meaning that there is no cointegration relationship between the examined variables, whereas the upper bound assumes that all the variables are I(1), meaning that there is cointegration among the variables. The Table also reports the null hypothesis of no cointegration $(H_0)$and the alternative hypothesis (H_a) of cointegration amongst the variables.

The fact that the computed F-statistic of 6.817 is certainly greater than the upper bound critical value of 4.57 , at 5 percent levels of significance; then the H_0 is rejected, meaning that the variables in the model are cointegrated. Similarly, the computed t-statistic of -5.948 is greater than the upper bound critical value at all levels of significance in absolute terms, also rejecting the H_0 of no cointegration among the variables in the model. The implication is that the bounds testing approach provides a proof that there exists a long-run relationship between the variables namely stock market capitalizations, money supply, real interest rate, inflation, and real exchange rate, in the model, and therefore the long-run cointegration model and coefficients can be estimated and specified.

Table 6. ARDL Bounds and Critical Value Bounds Test for Cointegration

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.817470	10%	3.03	4.06
k	4	5%	3.47	4.57
t-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-5.947576	10%	-3.13	-4.04
		5%	-3.41	-4.36

H_0: $\varphi_1 = \varphi_2 = \cdots = \varphi_5 = 0$ A Long-run relationship does not exist

H_a: $\varphi_1 \neq \varphi_2 \neq \cdots \neq \varphi_5 \neq 0$ A Long-run relationship exists

Source: Authors' computations

4.3. Results and Discussions

Having determined the existence of the long-run equilibrium relationship, the long run and short-run models can be estimated to determine causal relationships among the variables of the study. Table 7 repots the long-run results of the ARDL model. All the coefficients in the model are statistically significant, either at 1 percent or 5 percent. Specifically, results show that stock market development responds positively to money supply and real exchange rate. The coefficient on money supply is positive and statistically significant at 5 percent level, suggesting that a 1 percent increase in money supply will lead to an increase of about 4.12 percent in domestic market capitalisations, on average, in the long-run keeping other factors constant. These results are in line with previous studies such as Mohamadpour *et al*. (2012), Qing & Kusairi (2019), Maskay (2007) Kraft and Kraft (1997), Jonathan & Oghenebrume (2017), Patelis (1997), Bernanke & Gertler (1995) Jensen & Johnson (1995), and Thorbecke (1997), among others. Similarly the coefficient on real exchange rate is positive and different from zero at 5 percent level of significance. That is to say, a depreciation of the Tanzanian shilling leads to an increase in stock market capitalization. Implicitly, when firms gain international competitiveness, they export more and thus exchange rate affects stock prices positively. Yet, these findings receive strong empirical support from earlier studies. For examples, Rahman *et al.* (2009) and Qing & Kusairi (2019) show that both money supply and the real effective exchange rate have a positive effect on the stock market performance. Similarly, Mekherjee & Naka (1995) argue that exchange rate depreciation to have a positive effect on domestic stock markets while Menike (2006) and Garcia & Liu (1999) suggest that exchange rate appreciation has a negative effect on stock prices for export-led industries. Nevertheless, the response of stock market development to changes in real exchange rate is not straight forward, Suriani *et al.* (2015) for example, show that there is no relevant relationship between exchange rate and the stock market.

Consistent with expectations, results reported in Table 7 indicate that inflation and interest rate exert a negative effect on stock market capitalization. Coefficients on both inflation and interest rate are negative and statistically significant at 1 percent level, implying that stock market capitalization will decline by either 0.06 percent or 0.11 on average, if inflation or interest rate increase by 1 percent respectively. The results align with the results in studies by Zordan (2005), Ioannidis & Kontonikas (2007), Praphan & Subhash (2002), Asiedu *et al*. (2020), Pierluigi (1995), Suhaibu *et al*. (2017), and Coleman & Agyire-Tettey (2008). The key argument here is that higher prices for materials, inventory, and labor can impact earnings as companies adjust. As a result, stock prices can fluctuate, and this causes volatility. In the same vein, implicitly, the increase in interest rate may lead to a decrease in the investments as well as share price. Nevertheless, studies such as Ologunde (2006) show that interest rate exerts a positive influence on stock market capitalization rate.

Given that the series are cointegrated, the Error Correction Model (ECM) was estimated for assessing short-run dynamics and the speed of adjustment towards the equilibrium relationship. Using the Akaike criterion the optimal model is ARDL (4, 0, 0, 0, 0). The results of the estimated short-run dynamic model are shown in Table 8. The Error Correction Coefficient (ECM) has the expected sign, with a value of -0.738 and statistically significant at 1 percent. This suggests that about 74 percent of the deviation from the equilibrium in the previous year is corrected in the current year. As such, it appears that stock market capitalization was above the long-run equilibrium in the previous period, thus, it decreases towards the equilibrium in the current period. The size of the coefficient of 0.738, suggests that the speed of adjustment towards equilibrium is reasonably high.

By and large, the findings of this paper are of great importance because stock markets are considered as being highly sensitive to changes occurring in the economy. Monetary policies are usually undertaken to restore or maintain stability within an economy and such policies can either be expansive or restrictive with the central bank using interest rates and money supply as monetary policy instruments.

4.4.Diagnostic Tests

Table 9 summarizes the results of the various residual diagnostic model. Results indicate that residuals are normally distributed as evidenced by the non-rejection of the null hypothesis using the Jarque–Bera test. Likewise, the Breusch-Godfrey Lagrange Multiplier test for serial correlation and heteroskedasticity confirms that there is no serial correlation and that the model appears to be free from heteroskedasticity. Further, the stability of the model is evidenced by the cumulative sum of recursive residuals (CUSUM) (Figure 1).

Table 7. ARDL Long-Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$ln\, r\, er_t$	2.8555**	1.1494	2.4842	0.0292
$ln\, M_t^2$	4.1241**	1.8300	2.2535	0.0263
r_t	-0.1123***	0.0240	-4.6720	0.0000
π_t	-0.0637***	0.0261	-2.4391	0.0031

Coint. = $ln\, C\, MD_t$ - (2.8555*$ln\, r\, er_t$ + 4.1241*$ln\, M_t^2$ -0.1124*r_t -0.0637*π_t

***Denotes a 1 percent level of significance

**Denotes a 5 percent level of significance

Source: Authors' computations

Table 8. ARDL Error Correction Regression

ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-24.806***	4.1767	-5.9393	0.0000
TREND	-0.0152***	0.0027	-5.4507	0.0000
D($ln\, C\, MD_t$ (-1))	0.0879	0.1152	0.7634	0.4469
D($ln\, C\, MD_t$ (-2))	0.2034*	0.1069	1.9022	0.0599
D($ln\, C\, MD_t$ (-3))	0.2118**	0.0921	2.2995	0.0234
CointEq(-1)*	-0.7379***	0.1240	-5.9475	0.0000

R-squared	0.7433	Mean dependent var	0.0160
Adjusted R-squared	0.7134	S.D. dependent var	0.4974
S.E. of regression	0.4121	Akaike info criterion	1.1154
Sum squared resid	18.685	Schwarz criterion	1.2579
Log-likelihood	-58.696	Hannan-Quinn criter.	1.1732
F-statistic	11.501	Durbin-Watson stat	2.0309
Prob(F-statistic)	0.0000		

***Denotes a 1 percent level of significance
**Denotes a 5 percent level of significance
* Denotes a 10 percent level of significance
Source: Authors' computations

1.1. Stability Diagnostic Checks

Test	Null hypothesis	Test statistic	*P*-value	Conclusions
Jarque–Bera	Residuals are normally distributed	3.63	0.16	Do not reject Ho as PV is greater than the level of significance at 5%; therefore, the residuals of the model are normally distributed.
Breusch–Pagan–Godfrey	No serial correlation	1.04	0.36	Do not reject Ho as PV is greater than the level of significance at 5%; therefore, therefore there is no serial correlation in the model.
Breusch–Pagan–Godfrey	No heteroskedasticity	1.60	0.13	Do not reject Ho as PV is greater than the level of significance at 5%; therefore, there is no heteroskedasticity in the model.

Source: Authors' calculations.

5. Conclusions

This paper intended to examine the responses of stock market capitalisations to monetary policy. It used monthly time-series data from 2011 to 2020, with a sample size of 120 observations. There key variables of interest are stock market capitalizations, real interest rate, money supply, real exchange rate and inflations rate. The Augmented Dickey-Fuller (ADF) tests were used to test the stationarity of all series. To test the long-run relationship of the variables, Autoregressive Distributed Lag bound test was applied. The fact that the validity of the results depends on the stability of the model, residual diagnostic and stability tests such as Jarque–Bera normality test and Breusch-Godfrey Lagrange Multiplier test for serial correlation test and heteroskedasticity tests were performed. Results indicated that the residuals are normally distributed while results are free from serial correlation heteroskedasticity. Since the model exhibits all the desirable properties of OLS, we concluded that the model is reliable for economic analysis and forecasting.

The paper concluded that all monetary and financial variables included in the analysis have an impact on stock market development in Tanzania for the January 2011 to December 2020 period. The results showed that the stock market capitalizations respond positively to changes in money supply and real exchange rate whereas inflation and real interest rate exert a negative effects on stock market capitalization in Tanzania.

The evidence as reported in this paper lend significant support to the existing literature on the response of stock market development to changes in monetary variables. It also gives further insight to monetary policymakers and capital market regulators about the direction and magnitude of their interventions on the financial markets in Tanzania. Markedly, understanding the response of stock market capitalizations to changes in monetary variables such as money supply, inflation, real exchange rate and real exchange rate can help investors understand how changes may impact their investments. They can also be better prepared to make better financial decisions. Changes in these variables may provide important implications for monetary policy towards financial markets such as choosing appropriate monetary policies to help investors make the right decisions on the sale and purchase of shares in the financial market. Similarly, understanding the long-run relationship among these variables is crucial because it helps to inform scholars and policymakers on the effectiveness of the monetary policy of the country in a bid to maintain a stable economy through moderate and stable inflation and exchange rate.

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Figure A1: Stability test