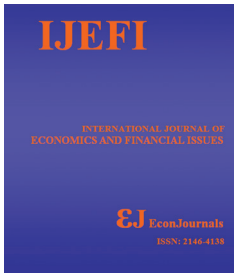

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Threshold Analysis of the Stock Market Capitalization and Monetary Policy in South Africa: The Role of Investment in Artificial Intelligence

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ABSTRACT

This study investigates how repo rates and the nominal effective exchange rates affect stock market capitalization between 2016M1 and 2022M1, with a focus on the threshold level of investment in artificial intelligence. To analyze the data, econometrics techniques were employed. The Augmented Dickey-Fuller test confirmed that while market capitalization and repo rates became stationary after the first difference that of investments in artificial intelligence and the nominal effective exchange rates were stationary at level. A threshold model identified the threshold level of investment in artificial intelligence. The findings indicate that repo rates and the nominal effective exchange rates positively influence stock market capitalization when the threshold level of investment in artificial intelligence is below 7.7647. However, above the threshold, repo rates and the nominal effective exchange rates negatively affect stock market capitalization. This study concludes that the negative impact of the repo rates and the nominal effective exchange rates on stock market capitalization at higher levels of investment in artificial intelligence should be internalized through government subsidies that reduce the production cost of firms. However, the SARB should consistently manage the exchange rates from growing out of proportion.

Keywords: Stock Market Capitalization, Repo Rates, Exchange Rates, Investments in Artificial Intelligence, Threshold
JEL Classifications: E4, E52, E6, O3, O5

1. INTRODUCTION

The stock market and its corresponding performances, either in terms of stock market capitalization or stock returns, are inextricably linked to technological revolutions that firms are adopting, which influence the mode of their business operations, sales, and profitability. In recent times, there has been the emergence of the fourth industrial revolution (4IR), of which this study concentrates on the threshold level of investments in artificial intelligence, a measure for 4IR towards ascertaining the corresponding impact of monetary policy on the stock market capitalization of listed companies in South Africa. The use of artificial intelligence techniques in forecasting the stock market has been extensively considered in previous times by practitioners such as Lunga and Marwala (2006), Leke and Marwala (2005) as well as Khoza and Marwala (2011).

In the context of technological advancement, such that a new technology having applications across several companies, referred to as a general-purpose technology, comes into existence. Such advancement in a historical perspective could be in terms of electricity or computers. The early adoption by companies of new technology typically generates excitement in stock markets due to the need to enjoy massive gains of early movers (Poloz, 2021). The fourth industrial revolution implies the digitalization of the world economy, characterized by machine learning, artificial intelligence, and big data, having the prospect of enhancing every area of economic activity (Poloz, 2021). The use of digital

technologies enables companies to wield a greater competitive benefit in differentiation, efficiency, and innovation support (Yu et al., 2021). Various scholars with early study have examined the outcomes of 4IR in the examination of its efficiency and cost advantages (Anand et al., 2013; Weill, 1992). However, studies in recent times take into cognizance strategic and operational outcomes such as innovation performance (Díaz-Chao et al., 2021), effectiveness of supply chain management (Erkmen et al., 2021) as well as financial performance (Del Gaudio et al., 2021; Zhu and Yang, 2021) as cited in Oduro and De Nisco (2023). Artificial intelligence has been observed as a crucial technique that guides the fourth scientific and technological revolution (Dwivedi et al., 2021). For instance, based on the report of Capgemini's Research (2020), as cited in Wang et al. (2023), more than half of the leading manufacturing firms in Europe are adopting AI, such that Japan's 30% while of the United States's 28%. Considering the emergence and the adoption of AI technologies by firms, policy makers like the monetary authority need to factor this development in the process of formulating monetary policy as the prevailing circumstances in the economy will tend to impact on its relative effectiveness.

Monetary policy stance and deployed measures play a significant role in influencing macro-economy and, by implication, the performance of stock markets which is one of the macroeconomic signals of an economy. According to Kashyap and Stein (2023), variations in monetary policy rates have the tendency to have an impact on the desire of investors and intermediaries to take risks, hence, the risk premium on an array of financial assets, via several avenues. Based on the transmission mechanism via the stock market, monetary policy measures influence stock prices, which themselves have connection with the real economy via their effect on consumption spending and investment spending (Ioannidis & Kontonikas, 2006). The stock market is viewed by some observers as an independent cause of macroeconomic volatility such that policy makers may need to instigate necessary responses (Bernanke and Kuttner, 2005).

Monetary policy could be operated either by quantitative easing or monetary tightening, with each approach exerting varying effects on the macro-economy and, by implication, the stock market. Benford et al. (2009) are of the view that expansionary monetary policy is targeted at stimulating the economy, it is, however, passed via asset prices and portfolio effects. Such a quantitative easing has been observed to exhibit certain consequences despite its economic prospects (Pastpipatkul et al., 2016). The foregoing is premised on the ground that the financial liquidity availed by the outstanding rise in the unit of assets sold can result in asset price bubbles arising from explosive rises in asset prices (Huston and Spencer, 2018). Evidence abounds of the interplay between monetary policy and the stock market, for instance, Val et al. (2018) view that the monetary policy implementation of the Bank of Brazil has a relationship with the stock market and that though monetary policy significantly influences the stock market, it only exerts a negligible proportion of market variation.

The foregoing information provides evidence that monetary policy influences the stock market, nevertheless, it becomes crucial to emphasize that the macroeconomic environment on which the policy is programmed to operate continuously goes through a technological revolution. This study puts this into cognizance by examining the effectiveness of the repo rates of the South African Reserve Bank on stock market capitalization in South Africa. While we admit that there exist avalanche of studies analyzing monetary policy effect on stock market capitalization, however, no study has been found to determine the effectiveness of monetary policy rate on stock market capitalization by considering investment in artificial intelligence as a threshold variable. The question is, how effective is the monetary policy rate in influencing stock market capitalization considering the wave in the fourth industrial revolution as measured by investment in artificial intelligence? Secondly, what are the levels of thresholds of investments in artificial intelligence that will correspondingly result in the optimal outcomes of stock market capitalization in South Africa?

While the listed companies on the Johannesburg stock exchange have been performing in various degrees over the years, it needs to be emphasized that the operational environment has been passing through various industrial revolutions, which invariably have implications on the scale of industrial activities, profitability, and dividend declaration. In order to remain on the front line, industrial companies have been adopting modernized technology in their productive activities. In order to evaluate this current scenario, an effort was made to obtain data on repo rates from the South African Reserve Bank on a monthly frequency while that of investments in artificial intelligence were obtained from OECD.

The data set on investment in artificial intelligence for the South African economy has limited coverage (2016-2022). This study therefore provides a monthly transformation of it which subsequently resulted in 73 observations. We set investments in artificial intelligence as the threshold variable to evaluate the corresponding impact of monetary policy as measured by the repo rates and the nominal effective exchange rates on stock market capitalization.

Several studies exist on the impact of monetary policy on stock market behavior. However, this study makes a novel contribution, stretching the existing knowledge by setting investment in artificial intelligence as a threshold variable in order to examine the corresponding effect of monetary policy on stock market capitalization.

The study is divided into various sections, with section 2 comprising the literature review. Methodology, empirical analysis, and interpretation of results as well as the discussion of the empirical results, occupy sections 3, 4, and 5, respectively, while conclusion and policy recommendations occupy section 6.

2. LITERATURE REVIEW

2.1. Theoretical Review

The Gordon Growth Model (GGM)

The Gordon growth model, as described in the study of May and Ngandu (2023), is on the basis of certain mathematical features of an infinite series, formulated by (Gordon, 1963):

$$P_0 = D_1 / k - g$$

Such that the current price of a share of stock is P_0 while the expected yearly nominal dividend for each share in respect of the following year is D_1. The dividend has an expected growth rate of g while the discount rate is k. Monetary policy is expected to influence stock prices via two channels comprising of money market rates and, by implication, the risk-adjusted discount factor. Secondly, anticipated future dividends. An unexpected contractionary monetary policy of increasing the repo rate causes commercial banks to increase their prime lending rates. This results in higher debt costs for firms, which undermines profits and, by implication, the amount that can be paid out as dividends which results in a decrease in stock prices (May and Ngandu, 2023). As expressed in the work of Resende (2020), Gordon's model regards dividends as the only factor that constitutes a stream of cash flow from an organization to its equity holders. This sounds reasonable in 1962, which was the inception of the model, given that companies were not depending on alternative avenues to return cash to shareholders (Fama and French, 2001; Skinner, 2008).

Bujang and Nassir (2007) evaluated the preciseness of Gordon's growth model over some selected stocks with respect to the Bursa Malaysia Stock Exchange. They are of the view that the model is appropriate as a valuation device for the Malaysian stock market, that could count on the economy's economic cycle towards achieving more precise forecasts.

The study attempts to analyze the effect of repo rates on stock market valuation in respect of South Africa by considering investment in artificial intelligence as the threshold variable. The concept of stock market valuation is inseparable from the prices of stocks and thus theoretically links to Gordon's model as the Gordons model specifies the current price of a share stock as a function of nominal dividend, growth rate of dividend, and the discount rate.

2.2. Efficient Market Hypothesis

The hypothesis portrays that the previous history of the price of a stock is reflected in current prices. Moreover, the market is expected to respond promptly to any recent information about the stock. It, therefore, implies that variations in the stock price follow a Markov process. The modeling of the stock price has to do with the modeling of the occurrence of new information, which influences the price. Therefore, probability distribution and information play a crucial role in the modeling of future stock prices (Dmouj, 2006). The EMH relies on three critical arguments: It is assumed that investors are rational and value securities based on maximum expected utility. Secondly, in the case of irrationality of investors, their trades are assumed to exhibit randomness, thus offsetting any impact on prices. Finally, it is assumed that rational arbitragers get rid of any influence irrational investors have on security prices (Naseer and Bin Tariq, 2015).

The efficient market hypothesis finds relevance in the current study which is majorly driven on the need to access the effect of repo rates on stock market capitalization given investment in artificial intelligence. Information on repo rates by SARB tends to filter into financial assets such as market securities. Moreover, the adoption of superior technology by firms which reflects on stock market prices and consequently on market capitalization tends to influence profits and dividend declaration which provide information on the attractiveness of such securities and the subsequent future preference for such assets which invariably influences stock market capitalization.

2.3. Empirical Review

The analysis of monetary policy and its corresponding impact on the macro-economy and, by focus, the stock market is an ongoing debate. This section appraises studies that have examined the behavior of the stock market to monetary policy as well as analyzes the relevance of artificial intelligence. For instance, Laine (2023), analyzed how monetary policy influences the term structure of stock market risk premia. The authors used analyst's dividend forecasts alongside dividend future prices as implied stock market risk premia. Local projections and VAR models were employed to evaluate the impact of monetary policy on risk premia. It was found from the study that quantitative easing stimulates the average risk premium such that the impact is influenced by an increase in long-horizon risk premia.

Hsing (2013) evaluated the effects of fiscal and monetary policies regarding the performance of the stock market in Poland. The technique of the GARCH model and a sample comprising 1999q2 to 2012q4 were used for the study. It was observed that, while the money market rate negatively influenced Poland's stock market index, it is, however, not influenced by the ratio of government deficits or debt to GDP. The author found that the ratio of M3 to GDP and the stock index exhibits a quadratic relationship having a critical value of 46.03% which indicates that a direct relationship exists provided M3/GDP is lower than 46.03% while it turns into a negative relationship provided M3/GDP ratio exceeds 46.03%. Moreover, Poland's stock index is directly related to industrial production and the performance of the stock market in Germany and the United States but negatively influenced by the price level and the nominal effective exchange rate.

Horobet and Dumitrescu (2009) observed that the real stock index in respect of Poland shows a direct relationship with real GDP, the real interest rate, and the CPI but an inverse relationship with M1 money supply as well as the real effective exchange rate.

Sekandary and Bask (2023) and Ioannidis and Kontonikas (2006) examined the impacts of surprises in monetary policy with respect to stock returns in the context of low and high monetary policy uncertainty in the United States by utilizing the Panel Smooth Transition Regression model to ascertain the uncertainty regimes. The author used a data span of 1994-2008 and established an inverse relationship between surprises in monetary policy and stock returns in the context of both uncertainty regimes, while a minimal pronounced affinity regarding surprises and returns provided uncertainty is minimal. It was concluded that it is more relevant to hedge against unexpected volatility in the stock market in the era of high uncertainty in monetary policy relative to the era of low uncertainty.

Laopodis (2013) studied the dynamic linkages with respect to monetary policy and the stock market in the era of the three separate monetary periods of Volcker, Burns, and Greenspan right from the 1970s. The author found that a disconnection seems to characterize Federal Reserve actions (through the federal funds rate) and the stock market responses. Moreover, in the later parts of the 1980s and the 1990s, the effect of inflation on the stock market did not manifest significantly. Also, there was the characterizing of a significant asymmetric impact of monetary policy on the stock markets, which was noticed in the entire respective monetary regime but appeared more considerable in the era of the bear markets relative to the bull markets. The author concluded that there is the absence of a consistent dynamic relationship regarding monetary policy and the stock market, as well as the fact that the state of the dynamics are not the same in the respective regimes.

Mroua and Trabelsi (2020) examined the causal and dynamic relationship between exchange rates and stock market indices towards evaluating the short and long-term impact of the US dollar on key stock market indices of the BRICS nations. They employed the panel generalized method of moments as well as the panel auto-regressive distributed lag model to ascertain the possibility of short or long-run causation and dynamic dependence with respect to all stock market returns and changes in exchange rates of the BRICS economies. The authors found that changes in exchange rate exert a significant impact on the previous and the current volatility of the stock indices in the region. Also, the technique of ARDL shows that movements in exchange rates generate a significant impact on short and long term stock indices of all BRICS economies.

Kyereboah-Coleman and Agyire-Tettey (2008) investigated the effect of macroeconomic variables with respect to the Ghana Stock Exchange and found that inflation and lending rates adversely influence the stock market.

Banda et al. (2019) examined the effect of economy-wide variables on listed industrial shares on the Johannesburg Stock Exchange. They analyzed the industrial index on the JSE by utilizing data covering 1995-2017. The authors found that a significant direct relationship exists between inflation and stock prices, while interest rates and stock prices were negatively related. Over the study period, while exchange rates exert a positive impact on industrial shares, industrial shares, and gross domestic product were found to be non-related.

According to Sitorus et al (2020), profitability exhibits a direct and significant impact on market capitalization. Also, Al-Nimer & Alslihat (2015) observed that return on equity, return on investment, and return on asset exert a direct and significant impact on market capitalization.

Hojat (2015) analyzed the "impact of monetary policy on stock market returns." it was observed that the Federal funds rate generates a significant negative effect on the prices of equities while an indirect impact on the market rate of return as well as the firm's rate of return on equity.

A panel study on the Southern African Customs Union, by Aromolaran and Daw (2021) was examined over the span of 1990-2019, the threshold of central bank policy rate differential with respect of foreign portfolio investments and foreign direct investment. The technique of the fixed effect panel threshold was utilized for the empirical analysis. The authors found that a linear relationship characterizes central bank policy rate differential and foreign portfolio investment as well as foreign direct investments. The threshold level stood at 2.5000 for foreign portfolio investment but 10.1600 for foreign direct investment. The policy rate differential of <2.5000 reduces foreign portfolio investments but stimulates foreign direct investment, provided it is below the threshold of 10.1600. The findings of Aromolaran and Daw (2021) show the significance of monetary policy in influencing investment activities.

Phuong et al. (2023), analyzed the effect of macro factors on the market capitalization of economies across the globe. Macroeconomic variables on inflation, exchange rates, foreign direct investment, interest rates, and GDP growth were obtained over the span of 2008-2019. Based on the technique of the generalized method of moments, it was found that interest rates, inflation, and foreign direct investment significantly influence the stock market capitalization.

The stock market is perceived to be another avenue for the transmission of monetary policy action due to its multifaceted function in influencing various companies of an economy (Suhaibu et al., 2017). The stock market could be described as a complex, and continuously evolving framework that is characterized by a constant subjection to unanticipated and anticipated events, like political, economic, and social factors that could result in persistent, volatile, and dynamic market reactions (Tang et al., 2019).

2.4. Gap in the Literature

The review of literature provides evidence of a gap as no study was established to examine the effect of monetary policy rate on stock market capitalization, given investment in artificial intelligence as the threshold variable. This study, therefore, provides a novel contribution to the existing studies in this regard.

3. METHODOLOGY

3.1. Model Specification

This study proposes a threshold analysis to examine the effect of repo rates and nominal effective exchange rates on the market capitalization of listed companies in South Africa by using investment in artificial intelligence, a proxy for the fourth industrial revolution as the threshold variable. Following StataCorp (2023), the equations below model the relationship between the variables on the basis of a threshold or two regions.

$$lmcl_t = \beta_{10} + \beta_{11}\, repo_t + \beta_{12}\, neer_t + \epsilon_t \; if - \infty < lgai < \gamma \quad (1)$$

$$lmcl_t = \beta_{20} + \beta_{21}\, repo_t + \beta_{22}\, neer_t + \epsilon_t \; if - \gamma < lgai < \infty \quad (2)$$

Where lmcl is the log of Stock Market capitalization of listed companies, repo (repurchase rate), neer represents the nominal effective exchange rates and lgai is the log of investment in artificial intelligence. The data on stock market capitalization were obtained from the World Development Indicators and investment in artificial intelligence from OECD over the period 2016-2022 based on data availability on the investments in artificial intelligence from OECD. Consequently, the limited stream of data on artificial intelligence resulted in the monthly transformation of the data set which resulted in 73 observations. Also, the missing data points on stock market capitalization for 2021 and 2022 were interpolated. Repo rates and the nominal effective exchange rates were obtained on a monthly frequency from the SARB and Bruegel data respectively.

4. EMPIRICAL ANALYSIS AND INTERPRETATION OF RESULTS

This section provides information on the descriptive and econometric analysis of the behaviour of stock market capitalization with respect to the repo rates and nominal effective exchange rate considering investments in artificial intelligence as the threshold variable.

4.1. Descriptive Statistics

The description of the variables that constitute the study is expressed in Table 1.

The variables maintain internal consistency because they respectively lie within their minimum and maximum values. Moreover, the measure of skewness shows that all the variables are negatively skewed, and the variables are relatively normally distributed as they are in the neighbourhood of zero.

Table 2 contains the time stationarity of the variables on the basis of the Augmented Dickey-Fuller (ADF) test statistic, and all are examined on the basis of the constant option with the assumption of lag 0. This becomes expedient in order to avoid the incidence of spuriousity. The log of stock market capitalization and repo rates are I (1) variables because of their stationarity after the first difference while the log of investments in artificial intelligence and nominal effective exchange rate are I(0).

4.2. Matrix of Correlations

The correlations among the variables were examined in order to examine any possibility of linear dependence among the variables as displayed on Table 3. Our findings show that repo rates and stock market capitalization are negatively correlated, as well as investment in artificial intelligence and repo rates. Moreover, investment in artificial intelligence is negatively correlated with stock market capitalization, repo rates, and nominal effective exchange rates (neer) while nominal effective exchange rates are negatively correlated with stock market capitalization (lmcl).

4.3. Normality of the Model

Table 4 provides information on the normality of the distribution based on the tests for skewness and Kurtosis. The probability of the joint test is 0.956, which exceeds 5%, signifying that the null hypothesis that the residuals are normally distributed cannot be rejected. The normality of the residual is further corroborated by the Shapiro-Wilk test having a probability of 0.425 which implies that the null hypothesis of a normal distribution cannot be rejected.

4.4. Threshold Regression

This section evaluates the effect of repo rates and nominal effective exchange rates on stock market capitalization by setting the log of investment in artificial intelligence as the threshold variable. We estimated a threshold as shown in Table 5. The threshold is 7.765, which consequently splits the sample into two regions. Investment in artificial intelligence in the first region is ≤7.765. However, in this instance, the repo rate has a positive effect (0.078) on stock market capitalization and is significantly different from zero at the 1% level. By implication, a unit increase in the repo rates in region one stimulates stock market capitalization. Similarly, the nominal effective exchange rate was found to directly affect stock market capitalization at the level of 1% significance. A 1% rise in the exchange rates promotes market capitalization by 0.004%. However, the dynamics changed completely over the second region at which investments in artificial intelligence surpassed the threshold of 7.765 with both variables negatively and significantly influencing stock market capitalization. Over this region, a 1% rise in the repo rates and the nominal effective exchange rates respectively results in a 0.007 and 0.002 decline in the stock market capitalization in South Africa.

5. DISCUSSION OF THE EMPIRICAL RESULTS

The empirical findings provide information on the significance of the nominal effective exchange rate and, particularly, the repo rates on the stock market capitalization in South Africa. The significance of the two variables signals the indispensability of the effective management of the monetary policy by the South African Reserve Bank in ensuring optimal performance of the stock market, which is one of its macroeconomic objectives. The findings show that the monetary policy device of the repo rates has an alternative impact on stock market capitalization depending on the level of investments in artificial intelligence. The repo rates were observed to promote market capitalization below the artificial

Table 1: Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
lmcl	73	12.016	0.03	11.937	12.09	11.937	12.09	-0.246	3.899
repo	73	5.774	1.462	3.5	7	3.5	7	-0.8	1.747
neer	73	59.935	4.569	49.093	68.709	49.093	68.709	-0.228	2.67
lgai	73	7.718	0.426	6.146	8.332	6.146	8.332	-0.999	4.55

Source: Authors' computation

Table 2: Unit root test

Series	Model	Levels	First difference
lmcl	ADF		−2.439***(0.009)
Repo			−4.522***(0.000)
Lgai		−6.495***(0.000)	
Neer		−2.045**(0.022)	

NB: ADF represents Augmented Dickey-Fuller Test Statistic. ***, and **connote the rejection of H0 at 1%, and 5% significant levels, respectively

Table 3: Matrix of correlations

Variables	(1)	(2)	(3)	(4)
(1) lmcl	1.000			
(2) repo	−0.015			
(3) neer	−0.069	0.598	1.000	
(4) lgai	−0.077	−0.736	−0.122	1.000

Source: Authors' computation

Table 4: Normality test

(a) Skewness and kurtosis tests for normality					
Variable	Obs	Pr (Skwness)	Pr (Kurtosis)	Adj. Chi (2)	Prob >Chi2
Residual	73	0.813	0.856	0.090	0.956
(b) Shapiro-Wilk test for normal data					
Variable	Obs	W	V	Z	Prob>z
Residual	73	0.983	1.091	0.190	0.425

Source: Authors' computation

Table 5: Threshold regression

Threshold variable		lgai		
Number of obs		73		
AIC		−587.702		
BIC		−573.959		
HQIC		−582.225		
Order		1		
Threshold		7.765		
SSR		0.019		
Lmcl	**Coefficient**	**Std. err**	**Z**	**P>z**
Region1				
Repo	0.078	0.014	5.600	0.000
Neer	0.004	0.001	4.740	0.000
Cons	11.254	0.099	113.460	0.000
Region2				
Repo	−0.007	0.003	−2.590	0.010
Neer	−0.002	0.001	−3.090	0.002
_cons	12.183	0.038	319.490	0.000

Source: Authors' computation

investments threshold of 7.7647 but decreased above the threshold. The implication of the foregoing is that at the earlier periods of investments in artificial intelligence, a hike of the repo rates stimulated business activities in the stock market. Theoretically, repo rates which is the rates at which SARB advances fund to commercial banks is expected to squeeze fund out of the economy due to a rise in the rates. During such periods, ceteris paribus, production costs of firms are expected to rise. However, with the incorporation of advanced technologies in the form of investments in artificial intelligence, such a rise in the cost of production would be internalized. This invariably gives credence to the capacity of such firms to enjoy the benefits of technological economies and consequently increased performance in profit and dividend declarations. The preceding information will thus tend to promote the stock market capitalization of such firms. A corroborative study to this observed result is the study of Alenezy et al. (2023) who established that, a unit increase in repo stimulates stock market price by 0.198. A Share price is expected to impact market capitalization. For instance, Kuvshinov and Zimmermann (2022) assert that the magnitude of stock issuance or price influences the growth of market capitalization.

The South African economy being one of the major economies in Africa thus has the potential to leverage on the effective management of its monetary policy through repo rates to drive development aspirations through the intensification of the level of stock market capitalization, which invariably has the prospects of stimulating output and employment. However, on the flip side of the empirical finding, it was observed that repo rates negatively affect market capitalization at the level of investments that surpassed the threshold level. The implication of this is that while the advancement in artificial intelligence is expected to result in the internalization of the rise in cost, arising from the rise in the repo rates, other factors could have risen in the domestic economy which undermines the cost-saving potential of the technologies. Some previous studies utilizing interest rate as a measure of monetary policy have established a negative relationship between interest rates and the prices of stocks (Hojat, 2015; Ioannidis and Kontonikas, 2006; Smirlock and Yawitz, 1985). Furthermore, the impact of the nominal effective exchange rates on stock market capitalization alternated in sign depending on the threshold of the investments in artificial intelligence. Exchange rates generally can be influenced by transactions across international boundaries such as the procurements of resources from abroad by firms, investments in the domestic stock market by foreign portfolio investors, etc. A rise in the nominal exchange rate has the possible effect of increasing the cost of production of domestic listed companies. However, the use of advanced technology that minimizes the cost of production and enhances productivity which stimulates profits and dividend declaration for shareholders has the prospects to promote and intensify market capitalization. However, beyond the threshold level of investments in artificial intelligence, the scenario changes as it negatively influences the market indicating that while increased investments in artificial intelligence should not be compromised, the government through the South African Reserve Bank should not allow the exchange rates completely to the whims and caprices of the forces of demand and supply. The negative impact could have risen due to the excessiveness of investments in artificial intelligence above the threshold which drives it up among other factors. Some previous studies have also accessed the effect of exchange rates on stock markets. The study by Mechri et al. (2018) on Tunisian and Turkish markets observed a highly significant and direct effect of exchange rates on stock market returns in both markets. Also, the authors established the evidence of volatility clustering for Tunisia but nil for Turkey. The authors concluded that in Tunisia, exchange rate volatility exerts a significant impact on the variations of stock market prices. Another study by Hsing (2011) showed that a depreciation in the Bulgarian currency resulted in a negative effect on the stock market while an appreciation resulted in a

direct effect. These studies thus imply that exchange rates may influence the stock markets in varied proportions.

6. CONCLUSION AND POLICY RECOMMENDATION

This study evaluated the impact of repo rates and nominal effective exchange rates on the stock market capitalization of listed domestic companies in South Africa by setting investment in artificial intelligence as the threshold variable. It becomes necessary to analyze such a study considering the recent developments of the fourth industrial revolution, which is expected to influence the investment and productive activities of organizations and, by implication, the performances of their stocks in the stock market. This study established the evidence of a threshold that split the study period into two regions. It was concluded from the study that in the early era of investment in artificial intelligence found below 7.7647, repo rates and the nominal effective exchange rates significantly stimulated stock market capitalization. However, we conclude from the study that at higher levels of investments in artificial intelligence, repo rates, and the nominal effective exchange rates significantly depress stock market capitalization. Increased stock market capitalization is a reflection of the state of productivity in an economy. We, therefore, conclude that the South African Reserve Bank should take into consideration the magnitude of investments in artificial intelligence of firms in the economy when deciding its repo rates and the management of the exchange rates in order to achieve a desirable impact on stock market capitalization and, by implication, the macro-economy.

Moreover, the level of the stock market capitalization of the economy is one of the indications of the performance of the macro-economy and therefore reflects the state of productivity and employment which have implications on economic development. As a policy devise, we therefore recommend that while increased investments in artificial intelligence should not be discouraged given the technological drive of the twenty-first century, however, the SARB should continually put measures in place regarding the nominal effective exchange rates from growing out of proportion. Also, the rise in the cost of production by firms arising from the rise in the repo rates and the nominal effective exchange rates can be minimized by the intervention of subsidy programs by the government on deserving firms. A major constraint to the study is the unavailability of sufficient data, considering the recent emergence of investments in artificial intelligence. With time and more streams of data available in the future, more studies can be considered in this area.

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