Stock Returns Indices and Changing Macroeconomic Conditions: Evidence from the Johannesburg Securities Exchange

Fabian Moodley[1], Ntokozo Nzimande[2], Paul-Francois Muzindutsi[3]

Abstract: The growing support of the adaptive market hypothesis (AMH) suggests that the effect of macroeconomic variables on stock returns may be revisited to investigate whether it alternates with changing market conditions. This study examined the effect of macroeconomic variables on the Johannesburg Stock Exchange (JSE) indices returns under changing market conditions. Using the Markov regime-switching models, the authors examined the response of seven sector-based indices of the JSE to switching changes in macroeconomic conditions from February 1996 to December 2018. The study revealed that the influence of macroeconomic variables on the JSE indices returns is sector-specific and varies with market conditions. A number of the variables are found to be significant in bullish conditions but not in bearish markets. The response of the JSE All-Share Index returns to changes in money supply growth rate and real effective exchange rate in bearish market conditions is positive, but negative in a bullish market condition. Similarly, inflation growth rate has a significant effect on Industrial Metal and Mining Index returns in a bear regime but showed an insignificant effect on Industrial Metal and Mining Index returns in a bull regime. The bull market condition is most dominant among JSE selected indices. The effect of macroeconomic variables on stock market returns is explained by AMH and could be better modelled by nonlinear models.

Keywords: Macroeconomic variables; JSE; market conditions; stock returns and South Africa

JEL Classification: H54

1. Introduction

Capital markets occupy a key role in the world economy. An active or stable capital market attracts capital inflows, which, in turn, elevates economic growth. Economic role-players participate in capital markets to earn returns that are consistent with their investment decisions, which are either a risk-averse or risk-preferring strategy (Kuhnen & Knutson, 2005). The fluctuations of macroeconomic factors in emerging markets contribute either positively or negatively to investment decisions (Chen, Roll & Ross, 1986). Exchange rates, economic growth and inflation are part of the macroeconomic factors that fluctuate over time. In the South African (SA) context, these macroeconomic variables fluctuate daily and are influenced by most practical cases of macroeconomic policy adjustments and less sensitive cases such as a speech by the president of a country (Malkiel, 2003). In addition to fluctuating macroeconomic factors affecting the economy of a country, they also affect the performance of the aggregated stock market (Goodnight & Green, 2010). The crash of the dot-com bubble of 2001 and the housing bubble of 2008 demonstrate such effects. The crash of both bubbles

[1] PhD candidate, School of Accounting, Economics and Finance, University of KwaZulu-Natal, South Africa, E-mail: moodleyf@ukzn.ac.za.

[2] Senior Lecturer, Tshwane University of Technology, E-mail: Nzimandenp@tut.ac.za.

[3] Professor of Finance, School of Accounting, Economics and Finance, University of KwaZulu-Natal, South Africa, Corresponding author: Muzindutsip@ukzn.ac.za.

affected stock markets extensively as investors withdrew from the market due to fear and greed to sell overpriced shares (Doyran, 2016). It is, therefore, essential to understand the effect of macroeconomic factors on stock market returns—since these are key to investors' decision-making processes. Failing to understand this link may result in significant losses to investors, which inevitably result in investors withdrawing from capital markets and the formation of bull and bear markets (Moolman, 2004). However, the extent to which the effect is more severe in bull or bear conditions is not known.

In addition to fluctuating macroeconomic variables affecting the overall stock market, they also tend to influence the disaggregated stock market differently, where one sector of a stock exchange could benefit from a change of macroeconomic variables in a given market condition (bull or bear market condition). In contrast, the other sector may not benefit from the same fluctuating macroeconomic factor. The 2008/2009 financial crisis that started in the financial sector and ended up affecting other sectors as investors moved their funds is one example of the varying effect among sectors of a stock exchange (Reinhart & Rogoff, 2008). The financial crises started in the financial sector and moved through each sector of the US capital market. However, it also went beyond the United States of America (USA) as it infiltrated into various capital markets around the world, causing them to collapse, which inevitably affected the functioning of the world economy (Jiang, Yu & Hashmi, 2017). It is, essential to understand how these macroeconomic factors affect each sector as there is no clear explanation as to what is experienced across sectors due to the ongoing debate surrounding the linear and nonlinear relationship between macroeconomic fundamentals and stock market returns. It is evident from the academic front that there is no consensus as to how macroeconomic fundamentals impact each sector of capital markets, especially under changing market conditions. The response of stock market returns to changes in macroeconomic factors under changing/switching market conditions has not been thoroughly investigated, especially in the case of South Africa and other emerging economies with a high level of macroeconomic uncertainty.

Several international studies considered the nonlinear relationships between macroeconomic factors and stock market returns (Guidolin & Timmermann, 2005; Longin & Solnik, 2001). The switching relationships between macroeconomic factors and stock market returns have not been fully investigated. Given the growing popularities of AMH, justifies an investigation of this relationship in the context of changing market conditions. This study analysed the effect of macroeconomic variables on the returns of the JSE sectors in the presence of bull and bear market conditions. More specifically, this study compared the levels of bull and bear market conditions across the JSE sectors and evaluated how the overall JSE and its selected sectors respond to the changes in macroeconomic factors in bullish and bearish market conditions.

The current study is unique in the sense that it evaluated the predictability of the effect of macroeconomic fundamentals on stock returns under different market conditions, which brought a new dimension of validating the AMH framework in the SA context. The findings of the study are significant for investors and portfolio managers in identifying the appropriate alterations to investment portfolios when macroeconomic fluctuations occur in capital markets.

2. Literature Review

It is noted in academic literature that there exist at least two key theoretical explanations for stock market returns and macroeconomic variables. These theories include the efficient market hypothesis (EMH) and adaptive market hypothesis (APT). EMH coined by Fama (1965) suggests that capital markets are efficient in reflecting information about individual stocks/or stock market as whole. This hypothesis is related to the concept of *random walk,* which characterise subsequent price changes as random deviations from previous prices (Malkiel, 1989). The efficient market hypothesis is based on the view that new information is incorporated into security prices without a lag. As a consequence, no amount of technical or fundamental analysis will allow investors to gain greater returns than those that could be obtained by holding a randomly selected portfolio of individual stocks. This essential implies that stock returns are unpredictable from past prices. EMH dominated the literature for decades (Atanasov, Pirinksy & Wang, 2018), however, the dominance of EMH started to dissipate since Lo (2004) formulated the adaptive market hypothesis (AMH).

The basis of the AMH involves a revolutionary outlook of behavioural economics and it includes principles such as competition, reproduction, mutation and natural selection (Ghazani & Ebrahimi, 2019). The argument proposed by AMH is such that the occurrence of efficiency and inefficiency tend to alternate with bull and bear markets in what is known as changing market conditions (Obalade & Muzindutsi, 2018). AMH shows that the alternating of efficiency and inefficiency of stock markets are the key attributes to changing market conditions Lo (2004). AMH implies that macroeconomic variables should have an alternating effect that under a bullish and bearish market. The effect of macroeconomic variables on stock market returns in an upper market condition is not expected to be the same in a lower market condition, as the stock market performs differently under each market condition. AMH implies that market participants could earn excess returns as markets are not always efficient due to the behaviour of various market participants and changing market condition.

Several critics of AMH raised the question that it is rather abstract and qualitative (See, Zhou & Lee, 2013; Urquhart & McGroarty, 2016). However, these academics fail to understand that AMH contains three implications that are astonishing yet concrete concerning financial activities (Lo, 2004). The first being, that if there exists a relation between risk and reward, then it is improbable that it remains constant over time. The second implication is contrary to EMH, as it proposed that arbitrary opportunities do exist as time varies. The third implication is also seen to be contrary to EMH and implies that under AMH investment, strategies may fall for a period as the environment becomes more favourable for market participants, it returns to profitability (Lo, 2004). These implications explain the adapting relationship between stock markets and macroeconomic variables as the relationship between macroeconomic fundamentals and stock market returns must be nonlinear.

There exists a large volume of the literature examining the relationship between macroeconomic variables and stock market, both in SA and abroad. For example, Moolman (2004) used a threshold cointegration test and Markov-Switching regime to investigate the link between macroeconomic variables and the stock market. The findings revealed that exchange rates and interest rates were among the leading causes of short-run fluctuations in stock market returns. Using Markov-Switching Vector Autoregressive model (MS-VAR), Maghyereh (2006) found a negative nonlinear relationship between inflation (CPI) and the JSE All-Share Index returns. Bonga-Bonga & Makakabule (2010) found a nonlinear relationship between macroeconomic variables and stock market returns. The findings demonstrated that nonlinear models out-performs linear models in estimating this relationship. Consistent with this, Mariappan & Hari (2013) investigated the relationship between the macro-economy and stock markets in both developed and developing economies. They found an inverse and nonlinear relationship between the South African stock market returns and exchange rates, unemployment rate and bank rates. Balcilar, Gupta & Kyei (2015) investigated the link between Economic Policy Uncertainty (EPU) and the JSE All-Share Index returns. They found EPU to significantly predict the SA stock market returns. This finding is in contrast with EMH, suggesting the relationship between macroeconomic variables and stock returns can be explained by the AMH.

Cifter (2015) used the Markov switching dynamic regression (MS-DR) model to determine if stock market returns were affected by inflation (CPI). The author concluded that South African stock market returns were affected negatively during the recession regime as opposed to the expansion regime. This implied that stock market movements were regime-dependent and nonlinear. This is consistent with Phiri (2017) who found a negative nonlinear relationship and a unidirectional causality between the JSE returns and inflation (CPI). This suggests that market participants did not use equity returns to hedge against rising inflation. Hence, investing in stock market returns are not a good hedge against inflation. Nhlapho & Muzindutsi's (2019) study deviated from the general performed studies evident in the literature, as the study considered the effect of political, financial and economic risk on the JSE All-Share Index returns and the all bond Index returns and found an asymmetric relationship between country risk and the index returns. Moreover, political risk was seen to have a short-run and long-run effect on bond returns, whereas economic risk only had a short-run relationship. These findings are in line with those of Vengesai & Muzindutsi (2019; 2020) and Muzindutsi & Obalade (2020).

Consequently, there is a near consensus in the literature suggesting that markets are not efficient; and that stock market returns are contingent to a number of factors (see for example, Saman, 2015; Borjigin, Yang, Yang & Sun, 2018; Chang & Rajput, 2018; Yacouba & Altintas, 2019, among others). It is evident in literature there is no consensus as to how macroeconomic factors influence stock market returns when exposed to changing market conditions. There is a need to explore and re-examine the response of stock returns to macroeconomic factors under different market conditions as portrayed by the AMH.

3. Data and Methodology

3.1 Data Collection and Sampling

The study used a monthly time series data set covering the period 1996/02 to 2018/12. This data covers four significant episodes: the 1997 Asian financial crisis; the adoption of an inflation-targeting regime in South Africa in 2000; the 2002 currency crisis and the 2008/2009 global financial crises. These events occupied a crucial role in the choice of modelling adopted in this study, which is the Markov-Switching regime model. The variables included in the sample are the monthly closing prices for all JSE all-share index, Industrial Metals and Mining Index, Consumer Goods 3000 Index, Consumer Services 5000 Index, Telecommunications 6000 Index, Financials 8000 Index, and the Technologies 9000 Index. All these variables were obtained from McGregor BFA database. Macroeconomic variables were collected from the South African Reserve Bank (SARB) and Statistics South Africa (StatsSA). These variables consist of the inflation (CPI) rate, the industrial production rate (a proxy for economic growth), short-term interest rate, long-term interest rate, Money Supply (M2) and REER. The industrial production data is not available on a monthly basis. As a result, it is converted from quarterly to monthly data using the quadratic average interpolation approach as done by Dlamini (2017).

3.2. Empirical Model Specification

To determine the impact of macroeconomic factors on stock index returns under changing market conditions, the study relied on the regime-switching model which allows for the parameters to switching with the state of the economy. In this model, the JSE stock market index returns (I_t) are assumed to follow a process governed by an unobservable state variable C_t. The occurrence of a regime is divided into *N* states in period *t* when $C_t = N$, where $N = 1,2,3…., N$. The Markov regime-switching model of the conditional mean permits each regime with an alternate regression model. The model is specified as follows:

$$I_t = \mu_{ct} + \alpha_{0ict}\Delta CPI + \alpha_{1ict}\Delta M2 + \alpha_{2ict}\Delta ST\_INT + \alpha_{3ict}\Delta LT\_INT + \alpha_{4ict}\Delta INU\_PRO + \alpha_{5ict}\Delta REER + \varepsilon_{c_{t,}} \quad (1)$$

Where $\varepsilon_{c_{t,}}$ i.i.d $(0, \sigma^2_{c_{t,}})$, I_t referrs to the JSE stock index returns, μ_{ct} is the state-dependent intercept (mean), $\sigma^2_{c_{t,}}$ is the regime-dependent variance of the returns and $C_t = 1,2$: illustrates two regimes, namely bull (1) and bear (2) regime, where the macroeconomic variables contains state-dependent coefficients. ΔCPI is the change in SA inflation rate, $\Delta M2$ is the change in the SA money supply rate, ΔST_INT is the change in SA short-term interest rate, ΔLT_INT is the change in SA long-term interest rate, ΔINU_PRO is the change in industrial production and, $\Delta REER$ was the change in the SA REER.

Each regime is given to follow a first-order Markov process demonstrated by the transition probability matrix. Under the first-order Markov process, the possibility of being in a specific regime is dependent on the most recent state, which is demonstrated as follows:

$$Prob(C_t = j \mid C_{t-1} = i) = Prob_{ij}(t) \quad (2)$$

Where ij is the probability of switching from a regime denoted as i in a period denoted $t-1$ to a regime *j* in a specific period (*t*) where the probability is given to be constant for all periods so that $Prob(t) = Prob_{ij}$. Hence, the matric for a two-regime model is given by:

$$Prob\,[C_t = 1 | C_{t-1} = 1] = Prob_{11} \quad (3)$$

$$Prob\,[C_t = 2 | C_{t-1} = 1] = 1 - Prob_{11} \quad (4)$$

$$Prob\,[C_t = 2 | C_{t-1} = 2] = Prob_{22} \quad (5)$$

$$Prob\,[C_t = 1 | C_{t-1} = 2] = 1 - Prob_{22} \quad (6)$$

Where $Prob_{11}$ is the probability that the stock index returns is at state one (bullish state) at $t-1$ and remains there at time t, $Prob_{21}$ is the probability that the returns is at state one (bullish state) at $t-1$ and moves to state two (bearish state) at time t. $Prob_{22}$ is the probability that the returns is at state two (bearish state) at time $t-1$ and remains there at time t, $Prob_{12}$ is the probability that the returns is at state two (bearish state) at $t-1$ and moves to state one (bullish state) at time t (Brooks, 2019). The probability of staying in each regime is generated and compared across the different JSE sectors. A logit model is followed when the probability of changing from regime i to *j*. Hence, the transition matrix rows above contain a full set of conditional probabilities. A new logit model is determined for each row of the transition matric:

$$Prob_n(G_{t-1}, d_i) = \frac{\exp(G'_{t-1}, d_{ij})}{\sum_{s=1}^{N} \exp(G'_{t-1}, d_{is})} \quad (7)$$

Where j = 1, …, N and i = 1, …, N with the normalisations $d_{iN} = 0$. Markov regime-switching models are normally and generally specified with constant probabilities so that G_{t-1} contains only a constant. Therefore, the estimates from equation 3 to 6 identifies bull and bear states and provides the total number of months each JSE index stayed in bull and bear regimes. The transition probabilities and the constant expected duration of each regime is compared across the JSE sectors to identify how each sector shifts between bull and bear regimes.

3.3. Preliminary and Diagnostic Tests

The preliminary and diagnostic tests is administered in the form of correlation analyses, unit root tests with and without structural breaks, stationarity tests and residual normality tests. However, for the purposes of the study the normality test is not presented as Campbell (2002) found that the normality assumption regarding regime-switching models is inconstant. It is found when there exists a two-state regime with a high volatility state the normality assumption is violated. The study did not employ dependency tests to examine the linear or nonlinear dependency. This is done for two reasons, one being that the study examines two regimes (i.e., bull regime and bear regime). Hence, a linear model did not cater for regime switching. The second reason is that empirical studies find nonlinear dependency between stock market returns and macroeconomic variables (Abadi & Ismail, 2016: Yacouba & Altintas, 2019).

4. The Findings of the Study

4.1. Descriptive Statistics

Table 1 depicts the common sample descriptive statistics of the SA stock market indices and SA macroeconomic variables. It is evident that the Industrial Metal and Mining Index attains the highest average return for the sample period, whereas the Technologies Index demonstrates the lowest average returns. Moreover, only the Industrial Metal and Mining Index returns distribution is positively skewed. The JSE indices returns reached an all-time low in 2008/2009 as seen by the extremely negative minimum values. The JSE indices returns are leptokurtic ally distributed. Thus, the JSE indices returns does not have a normal bell curve as the returns peaks and flattens. This is confirmed by the Jarque-Bera test of normality. The money supply has the highest average growth and short-term interest rate has the lowest average growth for the sample period. The inflation growth rate attains the lowest maximum, minimum and standard deviation values whereas the growth rate of interest rates has the highest within this context. All variables except growth rate of REER and growth rate of industrial production were positively skewed. Only the money supply growth rate indicates a kurtosis less than three. The Jarque-Bera test of normality confirms this as the null hypothesis is not rejected at a 1 percent level of significance.

Table 1. Descriptive Statistics results

	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.
JSE_ALSI	0.79	0.78	14.01	-33.75	5.34	-1.08	8.89	451.25	0.00
INU_IND	0.56	0.33	72.68	-58.23	12.86	0.30	8.04	294.83	0.00
CONG_IND	1.06	1.21	19.60	-25.60	6.53	-0.61	5.08	66.52	0.00
CONS_IND	1.07	1.49	15.70	-39.52	6.48	-1.20	7.81	320.34	0.00
TELCOM_IND	0.77	0.67	32.79	-38.42	8.65	-0.14	5.58	77.02	0.00
FIN_IND	0.65	0.71	22.74	-50.06	5.96	-2.06	21.67	4189.81	0.00
TECH_IND	0.40	1.05	30.42	-53.59	10.30	-1.19	7.38	284.66	0.00
CPI	0.48	0.40	2.27	-1.22	0.48	0.57	4.25	32.68	0.00
M2	0.91	0.96	5.10	-3.22	1.44	0.08	2.72	1.21	0.55
ST_INT	-0.14	0.00	20.83	-12.73	3.95	0.26	7.02	188.33	0.00
LT_INT	-0.07	-0.15	14.08	-9.77	3.45	0.51	4.61	41.72	0.00
INU_PRO	0.62	0.63	3.73	-3.24	0.73	-0.59	7.41	238.29	0.00
REER	-0.04	0.01	9.86	-14.88	3.26	-0.54	5.52	86.34	0.00

4.2. Correlation Analysis

Table 2 showed that there exists a significant negative association between inflation growth rate and JSE All-Share Index returns, Industrial Metals and Mining Index returns, Consumable Goods Index returns and Consumable Service Index returns.

Table 2. Correlation Results

	JSE_ALSI	**INU_IND**	**CONG_IND**	**CONS_IND**	**TELCOM_IND**	**FIN_IND**	**TECH_IND**
CPI	-0.13** (0.03)	0.15** (0.01)	-0.13** (0.03)	-0.18*** (0.00)	-0.06 (0.29)	-0.06 (0.32)	-0.07 (0.23)
M2	0.01 (0.88)	-0.10 (0.12)	0.04 (0.52)	-0.05 (0.38)	0.02 (0.80)	-0.02 (0.72)	-0.01 (0.85)
ST_INT	-0.21*** (0.00)	-0.01 (0.92)	-0.12** (0.05)	-0.24*** (0.00)	-0.20*** (0.00)	-0.24*** (0.00)	-0.07 (0.29)
LT_INT	-0.21*** (0.00)	-0.04 (0.53)	-0.06 (0.32)	-0.36*** (0.00)	-0.34*** (0.00)	-0.36*** (0.00)	-0.09 (0.12)
INU_PRO	0.03 (0.65)	0.10 (0.11)	0.03 (0.58)	-0.09 (0.13)	-0.00 (0.98)	-0.04 (0.51)	-0.05 (0.41)
REER	0.054 (0.374)	0.087 (0.151)	-0.052 (0.391)	0.194*** (0.001)	0.203*** (0.000)	0.195*** (0.001)	0.027 (0.651)

*Note: The correlation coefficient test is estimated using the ordinary method with probability test statistics. The parenthesis indicates the p-values, whereas ***, ** and *indicate a 1%, 5% and 10% level of significance respectively.*

There existed a significant negative association between short-term interest growth rate and the JSE All-Share Index returns, Consumable Service Index returns, Telecommunication Index returns, Financials Index returns and Consumable Goods Index returns. The negative coefficients are evident for long-term interest growth rate. However, only the JSE All-Share Index returns, Consumable Service Index returns, Telecommunication Index returns, and Financials Index returns has a significant association with long-term interest growth rate. In addition, the Consumable Service Index returns, Telecommunication Index returns, and Financials Index returns has a significant positive association with the real effective exchange growth rate.

4.3. Unit Roots Results

It is seen in table 3 that test statistic of the ADF (with the exception of industrial production growth rate) and PP (unit root tests) test is more negative than the critical values at a 1 percent level of significance. This allows for the rejection of the null hypothesis that the JSE indices returns, and macroeconomic variables contain a unit root, in favour of the alternative hypothesis that the JSE indices returns, and macroeconomic variables are stationery. However, for industrial production growth rate, the study rejects the null hypothesis at a 5 percent level of significance. The stationery test of KPSS confirms the findings of the unit root tests for all indices and macroeconomic variables (except for money supply growth rate). The money supply growth rate demonstrates test statistics that are larger than the critical values at a 1 percent level of significance. The break point unit root test confirms the stationery of the JSE indices returns and macroeconomic variables in the presence of structural breaks. The null hypothesis of a unit root is rejected in favour of the alternative hypothesis of stationarity, as the test statistic is more negative than the critical values at a 1 percent level of significance. The study concludes that the JSE indices returns, and macroeconomic variables are stationery.

A significant requirement by the Markov regime-switching model of conditional mean with constant transition probabilities is the presence of stationarity with structural breaks in the data series. The model assumes that the transition probabilities are constant throughout time (Hamilton, 1989). This indicates that the model is biased to estimations that contain data that is non-stationery with structural breaks, as the model does not cater for the break periods in the non-stationary series. Having found the data series to be stationery in the presence of structural breaks, the study proceeds by estimating the Markov regime-switching model of conditional mean with constant transition probabilities.

	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND	CPI	M2	ST_INT	LT_INT	INU_PRO	REER
Unit Root and Stationarity Tests in Levels with an Intercept													
ADF Test	-17.03***	-9.98***	-18.03***	-14.55***	-15.62***	-16.42***	-14.61***	-12.14***	-17.72***	-10.83***	-12.88***	-3.34**	-12.71***
PP TEST	17.06***	-16.39***	-18.03***	14.43***	15.64***	-16.54***	-14.64***	-12.14***	-17.69***	-10.81***	-12.56***	-7.30***	-13.64***
KPSS TEST	0.09***	0.12***	0.14***	0.33***	0.12***	0.06***	0.13***	0.12***	1.10	0.09***	0.17***	0.25***	0.07***
Break Point Unit Root Test in Levels with an Intercept													
ADF Test	-18.27***	-16.47***	-18.74***	-15.93***	-16.16***	-16.97***	-15.740***	-12.64***	-18.98***	-11.82***	-13.32***	-7.51***	-14.07***

Note: The parenthesis indicates the p-values associated with the ADF and PP test whereas *, ** and * indicate a 1%, 5% and 10% level of significance respectively. The LM critical values of the KPPS test is: 1% = 0.739, 5% = 0.463, 10% = 0.347.*

4.4. Empirical Findings: Markov Regime-Switching Model Results

The study estimates the empirical model and the findings are inflation growth rate significantly affects the Industrial Metal and Mining Index returns and Consumable Goods Index returns in the bear market condition. The money supply growth rate has no significant effect on the JSE indices returns. The short-term interest growth rate has a significant effect on Consumable Service Index returns in a bullish market condition and JSE All-Share Index returns, Consumable Goods Index returns, and Financials Index returns in a bearish market condition. The long-term interest growth has a significant effect on the Telecommunication Index returns and Financials Index returns in upper and lower market conditions, whereas it has only a significant effect on the JSE All-Share Index returns in the upper market condition and Consumable Service Index returns in a lower market condition. The industrial production growth rate has only a significant effect on the JSE All-Share Index returns in a bear regime. The growth rate of REER significantly influences the returns of the Consumable Goods Index returns in a bullish and bearish market conditions, whereas the Telecommunication Index returns and Technologies Index returns in a bull regime. Moreover, the bull regime is found to be relevant among the JSE indices returns, the JSE All-Share Index returns remains the longest in a bullish market condition and the Consumable Service Index returns remains the longest in a bearish market condition.

Table 4. Markov Regime-Switching Model of Conditional Mean

$$I_t = \mu_{ct} + \alpha^0_{ict}\Delta CPI + \alpha^1_{ict}\Delta M2 + \alpha^2_{ict}\Delta ST\_INT + \alpha^3_{ict}\Delta LT\_INT + \alpha^4_{ict}\Delta INU\_PRO + \alpha^5_{ict}\Delta REER + \varepsilon_{c_t,}$$

Variables	JSE_ALSI	INU_IND	CONG_IND	CONS_IND	TELCOM_IND	FIN_IND	TECH_IND
Regime 1: Bull Market Condition							
μ	1.32 (0.01)	1.40 (0.22)	1.33 (0.06)	0.33 (0.93)	0.34 (0.69)	0.82 (0.07)	2.36 (0.04)
α^0	-0.46 (0.54)	-0.09 (0.95)	0.33 (0.75)	-2.50 (0.46)	0.06 (0.96)	0.42 (0.55)	-0.11 (0.95)
α^1	-0.03 (0.88)	-0.74 (0.10)	0.427 (0.19)	-0.27 (0.72)	0.50 (0.12)	0.28 (0.17)	-0.05 (0.90)
α^2	-0.00 (0.97)	-0.08 (0.70)	0.08 (0.37)	-0.56 (0.08)	-0.20 (0.20)	-0.03 (0.76)	-0.20 (0.32)
α^3	-0.32 (0.00)	0.12 (0.58)	-0.05 (0.71)	-0.96 (0.24)	-0.45 (0.01)	-0.44 (0.00)	-0.20 (0.38)
α^4	0.04 (0.91)	0.17 (0.85)	-0.00 (0.998)	-0.58 (0.71)	0.10 (0.87)	-0.01 (0.97)	-0.65 (0.28)
α^5	-0.12 (0.36)	-0.02 (0.95)	0.46 (0.00)	-0.99 (0.37)	0.33 (0.03)	0.14 (0.20)	0.40 (0.09)
σ^2	1.225 (0.00)	2.18 (0.00)	0.96 (0.00)	2.02 (0.00)	1.82 (0.00)	1.18 (0.00)	1.55 (0.00)
Transition Probabilities and Expected Duration Probabilities							
P_{11}	0.99	0.97	0.64	0.96	0.98	0.99	0.97
T_{11}	81.37	30.81	2.76	26.48	49.27	76.75	28.32
Regime 2: Bear Market Condition							
μ	-1.22 (0.389)	-15.37 (0.05)	0.73 (0.54)	2.81 (0.00)	-5.35 (0.45)	-1.70 (0.38)	-0.39 (0.88)
α^0	-1.15 (0.41)	15.30 (0.05)	-2.42 (0.08)	-1.83 (0.31)	2.51 (0.72)	0.65 (0.70)	-1.57 (0.51)
α^1	0.26 (0.62)	-1.27 (0.60)	-0.03 (0.94)	-0.14 (0.75)	-1.47 (0.52)	-0.27 (0.68)	-0.17 (0.85)
α^2	-0.40 (0.01)	0.70 (0.45)	-0.38 (0.06)	0.02 (0.86)	0.01 (0.99)	-0.32 (0.09)	-0.07 (0.81)
α^3	-0.18 (0.44)	-1.59 (0.27)	-0.14 (0.58)	-0.37 (0.06)	-2.10 (0.07)	-0.67 (0.03)	-0.25 (0.57)
α^4	2.16 (0.06)	9.87 (0.12)	1.00 (0.32)	-0.23 (0.80)	6.69 (0.29)	1.04 (0.44)	0.39 (0.84)
α^5	0.01 (0.98)	-0.02 (0.99)	-0.52 (0.03)	0.32 (0.14)	-0.85 (0.64)	-0.02 (0.96)	-0.29 (0.47)
σ^2	1.95 (0.00)	3.04 (0.00)	2.02 (0.00)	1.55 (0.00)	2.65 (0.00)	2.09 (0.00)	2.59 (0.00)
Transition Probabilities and Expected Duration Probabilities							
P_{22}	0.97	0.830	0.76	0.99	0.86	0.97	0.97
T_{22}	36.12	5.871	4.24	73.86	6.95	30.74	28.80

Note: α^0 is the change in the inflation rate (CPI), α^1 is the change in the money supply rate (M2), α^2 is the change in the short-term interest rate (ST_INT), α^3 is the change in the long-term interest rate (LT_INT), α^4 is the change in the industrial production rate (INU_PRO), and α^5 is the change in the real effective exchange rate (REER). The P-values are given in parenthesis

5. Discussion of the Results

The results of the Markov regime-switching model demonstrate that inflation growth rate has a significantly and insignificant effect on the JSE industry-based indices. The findings are supported by previous studies that has examined JSE indices returns, these include Maysami, Howe & Rahmat (2005), Jareño & Negrut (2016), Naicker (2017), Banda, Hall & Pradhan (2019). It is rather strange to find that inflation growth rate has no significant effect on certain JSE industry-based indices. However, this is consistent with the study of Paul & Mallik (2003). The finding of money supply growth rate is contrary to studies conducted by Maysami et al. (2005) and Ndlovu, Faisa & Resatoglu. (2018). The effect money supply has on stock market prices is said to be an empirical one. Thus, mix findings are foreseen.

Moreover, short-term interest growth rate and long-term interest rate has a significant effect on JSE industry-based induces in a bullish and bearish condition. The findings are consistent with the empirical literature, which finds interest rates to have a significant effect on JSE indices returns (Jefferis & Okeahalam, 2000; Alam, 2013; Eita, 2012; Naicker, 2017). The findings of industrial production growth rate show a significant effect on the JSE All-Share Index returns in a bear market condition. This is consistent with studies conducted by Sohail & Hussain (2009), Jareño & Negrut (2016) and Habib & Islam (2017). It is seen that growth rate of REER has a significant effect on certain JSE industry-based indices in a bullish and bearish regime. This is consistent with studies by Sohail & Hussain (2009) and Hsing (2013).

It is seen that macroeconomic variables have an alternating effect on each JSE index returns; where macroeconomic variable has a significant effect on JSE index returns in a bear regime, the effect is insignificant in a bull regime and vice versa. Thus, the alternating efficiency and inefficiency is present amongst the JSE index returns. Similar findings were found in studies by Bonga-Bonga & Makakabule (2010) and Abadi & Ismail (2016). The explanation is attributed to the assumption that the effect macroeconomic variables have on stock market returns is regime-dependent; the alternating efficiency effect varies according to regimes (Bong-Bonga & Makakabule, 2010). It varies as the performance of stock market returns under each regime is known, that being, in an upper market condition the stock market returns are increasing, whereas in a lower market condition the stock market returns are decreasing (Davies, 2013). Stock market returns do not follow a random walk process as the future returns of the index are known to investors is contrary to EMH (Obalade & Muzindutsi, 2018; 2019). Research has revealed that the bullish market condition prevails among the relevant JSE indices returns. This assumed that the returns are positive and increasing over time for the relevant JSE indices. Such increasing and positive returns are favourable to investors as higher returns are earned on their investments. It not only attracts investors' participation but also increases the contribution to the financial sector and, in turn, the SA economy. The finding is illuminating as studies by Guidolin (2016), and Maheu, McCurdy & Song (2012) found a higher presence of a bull market condition among stock market returns.

6. Conclusion

The study set out to investigate the regime-switching effect of macroeconomic variables on JSE indices under the AMH framework. The study found that the JSE-selected indices are affected differently by macroeconomic factors under changing market conditions. The bullish market condition is most persistent among the JSE-selected indices and the SA stock market. The findings suggested that the response of the JSE indices to changes in real exchange rate, inflation, short-term and long-term interest rates, and industrial production is subject to adaptive market behaviour. Implying that the JSE is not efficient as proposed by the EMH, instead the semi-strong form of the JSE changes with market conditions, which is consistent with the AMH. As a result, the alternating efficiency effect under changing market conditions exists in the study, suggesting that the effect of macroeconomic variables on stock market returns is explained by the AMH and could be better modelled by nonlinear models. Policymakers should consider that the effect of macroeconomic variables on JSE index returns varies with regimes and develop appropriate policies. Investors should consider the switching responses of JSE indices to changes in macroeconomic conditions in their investment decisions. This implies that hedging of macroeconomic exposure should be aligned with changing conditions.

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