



Department of Finance and Tax

THE IMPACT OF MACROECONOMIC VARIABLES ON THE PERFORMANCE OF SELECTED AFRICAN STOCK MARKETS

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Abstract

This dissertation investigates the impact of macroeconomic variables on the performance of African stock markets, focusing on Egypt, Mauritius, and South Africa during the period 2009–2019. This dissertation employed the multiple linear regression model and the Granger causality test to ascertain the impact of these factors. For each country, the stock market index was used as a dependant variable while interest rates, inflation rate, money supply, exchange rate, gold price, and oil price were used as independent variables. The results from the country-specific models varied widely from country to country. The heterogeneity of the results may be explained by differences in economic fundamentals between the countries, for example, market depth, market size, and liquidity. The model showed that interest rate, which is inversely related to stock prices, is the only significant variable in explaining stock prices in Egypt. In Mauritius, it was found that only three factors significantly affect stock prices, namely, exchange rate, gold price, and inflation. A depreciation of the Mauritius Rupee to the USD and an increase of the gold prices decrease stock prices in Mauritius, whilst the effect of inflation was found to be positive. In South Africa, results showed that inflation, money supply, and oil prices significantly affect stock prices in the Johannesburg Stock Exchange (JSE). However, unlike for Mauritius (where inflation has a positive impact), in South Africa, its effect is negative. By contrast, money supply and oil prices were found to impact the JSE stock prices positively. Against the backdrop of these findings, this dissertation encourages the governments and policy makers in emerging markets to consider stabilising the macroeconomy to create a conducive environment for stock market development. The Granger causality test reveals that stock prices can be used to predict oil prices in Egypt. In contrast, the South African data suggests no causal relationship between macroeconomic factors and stock prices. Finally, the same test in Mauritius shows that money supply can be used to predict stock prices, and stock prices can be used to forecast gold prices and exchange rates.

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List of Abbreviations

ADF	Augmented Dickey-Fuller Test
ALSI	All Share Index
APT	Arbitrage pricing theory
ARDL	Autoregressive distributed lag
BLUE	Best linear unbiased estimators
CAPM	Capital asset pricing model
CLRM	Classical linear regression model
CPI	Consumer Price Index
EGP	Egyptian pound
EGX	Egyptian Stock Exchange
EGX30	Egyptian Stock Exchange index representing Top30 companies
EMH	Efficient market hypothesis
ETF	Exchange traded fund
FDI	Foreign direct investment
GARCH	Generalized Auto Regressive Conditional Heteroskedasticity
MUR	Mauritius Rupee
OLS	Ordinary least squares
USD	United States Dollar
SEM	Stock Exchange of Mauritius
SEMDEX	Stock Exchange of Mauritius index
VAR	Vector Auto regressive model
VECM	Vector error correction model
ZAR	South African Rand

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Chapter 1 – Introduction

1.1 Introduction

The importance of financial markets to both advanced economies and emerging markets is impossible to ignore. Financial markets are markets in which funds are transferred from people with an excess to those who have a shortage (Mishkin and Eakins, 2012). They are broadly classified into bond markets, equity markets, and foreign exchange markets. These markets help to distribute idle funds from people who are not actively using their money to those with productive projects who are in need of extra capital, thereby promoting economic efficiency. The evolution of financial markets as a pillar of economic growth has been well studied in previous research. Boubakari and Jin (2010) studied the role of stock market development on economic growth for Euronext countries. Their research found that there is a positive and significant causal effect running from stock market development to economic growth, and therefore showed how an improvement in the performance of the stock market increases economic growth. With that being said, if economic growth can be increased by increasing the performance of the stock market, it follows that an agenda must be set aside to ascertain how economic variables such as interest rates, unemployment, inflation, and government debt affect stock market performance. Once that is ascertained, policy makers can then incorporate that knowledge into their economic policy mix. This will provide the much needed answers to the economic growth question, especially in the emerging markets where the economic growth levels are still oscillating at subpar levels.

On another front, investors are rational; that is, they prefer higher returns to lower returns at the same level of risk. Thus, analysts, fund managers, and portfolio managers have a mammoth task in ensuring that the returns maximisation goal of investors is achieved. One of the tools used to further that agenda is termed 'fundamental analysis', which Bodie, Kane, and Marcus (2011) define as comprehensive research into the determinants of the value of financial assets. Taking this insight one step further, this study seeks to contribute to the existing knowledge base on fundamental analysis by adding perspective on how fund managers, portfolio managers, and

other analysts may use macroeconomic variables to predict stock market returns in emerging markets.

Due to many factors, the predictability of financial asset returns has not been made easy. Factors such as behavioural finance (financial sentiments, risk aversion, and financial impulses), financial innovation (leading, for example, to the emergence of cryptocurrencies), and new emergent forms of asset class, have made it harder to predict the market. However, by understanding the impact of economic variables on stock market returns, investment managers will be able to adjust their portfolios accordingly during economic headwinds.

Stock market and macroeconomic conditions are known to have a relationship. When economic conditions change, they can either produce a positive or negative effect on stock prices. For instance, the discount rate used to value a company is affected when macroeconomic conditions change, and earnings are influenced by economic conditions and future dividends, thus affecting the growth of a firm. Stock markets are usually on an upward trend when economic conditions are good. Stock markets are also important for developing countries because they allow foreign investors to invest in local markets. This capital is usually important to develop and strengthen local economies—however, foreign investors only have appetite if macroeconomic conditions are favourable.

The pioneering studies of Ross (1976), and Chen, Roll, and Ross (1986) investigated this relationship between macroeconomic factors and their impact on stock prices. Ross (1976) introduced the Arbitrage pricing theory (APT), which is a model that determines that asset returns can be calculated from selected macroeconomic variables. The APT is an alternative to the Capital Asset Pricing Model (CAPM), where the only factor used in calculating returns is the market risk (beta). The macroeconomic variables on the APT are not predefined, however. Chen, Roll, and Ross (1986), found that some variables are significant in explaining movement in stock prices; namely, the spread between long and short interest rates, expected and unexpected inflation, industrial production, and the spread between high and low grade bonds. A number of

studies, such as those conducted by Assagaf et al. (2019), Jareño and Negrut (2016), Chittedi (2015), and Humpe and Macmillan (2009), have also investigated the relationship between macroeconomic variables and stock returns across the world.

This study builds on previous studies that have examined the effect of economic variables on stock returns. South Africa was chosen because it is the largest and most liquid African stock exchange. Egypt and Mauritius were chosen due to the limited number of studies available covering them. Additionally, Mauritius has the second highest market capitalisation to GDP ratio in Africa (SEM, 2019), making it an interesting case for investigation.

This dissertation aims to investigate the relationship between macroeconomic variables and stock returns in three countries. Furthermore, this dissertation seeks to determine whether those variables that influence stock returns are country-specific, and to investigate lead-lag relationships between explanatory variables and stock returns.

This study will aim to answer the following questions:

1. Do macroeconomic variables influence stock returns in Egypt, Mauritius and South Africa? If so, which variables?
2. Are the results similar across countries?
3. Do causal relationships exist between macroeconomic variables and stock returns?

The investigation makes use of monthly data for a period of approximately ten years. This data is comprised of monthly stock index returns from Egypt, Mauritius and South Africa, and the macroeconomic variables of inflation, interest rates, foreign exchange rate, gold price, money supply, and oil price. This study will apply an ordinary least squares (OLS) time-series regression approach that is consistent with previous studies to estimate the relationship between stock returns and macroeconomic variables. Prior to this, the regression data will be tested for stationarity using the Augmented Dickey-Fuller Test (ADF). Lead-lag relationships between stock returns and macroeconomic forces will be tested using the Granger causality tests.

This dissertation aims to test the following hypotheses:

H₀: Changes in inflation have no impact on stock prices in Egypt, Mauritius, and South Africa.

H₀: Changes in interest rates have no impact on stock prices in Egypt, Mauritius, and South Africa.

H₀: Changes in money supply have no impact on stock prices in Egypt, Mauritius, and South Africa.

H₀: Changes in exchange rate have no impact on stock prices in Egypt, Mauritius, and South Africa.

H₀: Changes in gold price have no impact on stock prices in Egypt, Mauritius, and South Africa.

H₀: Changes in oil price have no impact on stock prices in Egypt, Mauritius, and South Africa.

1.2 Overview of African stock exchanges

To provide some context to the study, this subsection provides an overview of the respective stock exchanges for Egypt, Mauritius, and South Africa.

1.2.1 Egypt – Egyptian Stock Exchange (EGX)

Similar to the JSE, the Egyptian Stock Exchange has a long history that dates back more than 100 years. It started with the establishment of the Alexandria Stock Exchange in 1902 and then the Cairo Stock Exchange in 1904. Both exchanges became a single entity in 1992 to form the current Egyptian Stock Exchange. The EGX tries to cater to diverse investor and institutional needs by offering various products, such as stocks, bonds, closed-ended funds, ETFs, and Egyptian Depository Receipts. Additional trading facilities include omnibus accounts, margin trading, intra-day trading, and short selling. The EGX has over 200 companies listed and a total market capitalisation of USD 80 billion. (CFA Institute, 2019).

The EGX aims to implement a trading platform based on the concept of automatic acceptance of order (continuous action system). This is to help brokerage firms connect the trading system to their back office systems, allowing investors to trade on the internet using smartphone software, within the flexible timing of the trading sessions (EGX, 2019).

The EGX's main index is the EGX TOP 30, which represents the 30 most liquid and active companies on the EGX. This index is weighted by market capitalisation and free float adjusted. The requirements for inclusion in the index specify that companies must have at least 15% free float. Free float is compatible with listing rules and adjusted market capitalisation must not be less than median of adjusted market capitalisation of all companies trading on the exchange (EGX, 2019).

1.2.2 Mauritius – Stock Exchange of Mauritius (SEM)

The Stock Exchange of Mauritius Ltd. (SEM) was incorporated in Mauritius in March 1989, first as a private company and later as a public company with the objective to operate and promote an efficient and regulated securities market in Mauritius (SEM, 2019). The exchange has undergone transformations over the past years that have positioned SEM as one of the most attractive markets in Africa, despite the limitations of an island economy with a limited universe of products to offer investors (SEM, 2019).

The exchange makes use of a modern operating system, has a market capitalisation of over 12 billion US dollars (USD) (giving it the second largest market capitalisation to GDP ratio in Africa), and is becoming increasingly international over time. Some of the features of the SEM include a multi-currency listing, trading, and capital raising platform that has been used to support the Mauritius economy and has helped companies raise more than USD 6.5 billion. The SEM has over 200 companies listed (including both local and international firms), and offers equity products such as shares and a variety of bonds. Other products include ETFs and structured products (SEM, 2019).

The main index in the SEM is the SEMDEX, which began in 1989, with the objective of tracking the progression of ordinary shares listed on the exchange, subject to meeting the free-float requirement established by the exchange.

1.2.3 South Africa – Johannesburg Stock Exchange (JSE)

At over one hundred years old, the Johannesburg Stock Exchange (JSE) is the oldest exchange in Africa. Over the years, the exchange has evolved and, in the 1990s, it upgraded to an electronic trading system. The JSE is comprised of different asset classes and has even acquired the Futures Exchange (SAFEX) and the Bond Exchange (BESA) to provide more products for investors (JSE, 2019). It also offers an efficient primary and secondary capital market that is subject to strict regulation (JSE, 2019).

The JSE continues its technological advancement by upgrading its trading, clearing, and settlement services. Another major change was moving the trading system from London to Johannesburg, which allowed trades to be executed up to 400 times faster than was possible in the old system (JSE, 2019) as well as improving the JSE's liquidity and overall market efficiency.

The JSE attracts both local and foreign investors looking for opportunities in South Africa, as there are more than 300 companies listed on the exchange, in addition to other products such as derivatives, fixed income securities, and exchange traded funds (ETFs). The JSE has a total market capitalisation of USD 1.1 trillion (CFA Institute, 2019). It is the 19th largest stock exchange in the world by market capitalisation and the largest exchange in Africa (JSE, 2019).

The main index is the JSE All Share Index (ALSI), which corresponds to 99% of the full market capitalisation of all eligible equities listed on the main board of the JSE (a free float market capitalisation weighted). The other main index is the JSE Top 40 index, which includes the top 40 companies listed on the exchange by market capitalisation (JSE, 2019).

1.3 Organisation of the dissertation

The remainder of this dissertation is organised as follows: Chapter Two consists of an introduction to the theoretical background of asset pricing theory, which is the foundation for this study; Chapter Three then reviews the literature related to the relationship between

macroeconomic variables and stock returns (both intercontinentally and Africa specific); Chapter Four describes the data that will be used in this study; Chapter Five explains the study methodology; Chapter Six discusses and analyses the results; and finally, Chapter Seven concludes the study and suggests other avenues for research on this topic.

Chapter 2 – Theoretical Background

This chapter introduces the theoretical framework, in which different theories and models that support the asset pricing literature and tests are discussed. These theories are: (i) the efficient market hypothesis (EMH); (ii) the CAPM; and (iii) the APT. A brief discussion of the dividend discount model used for equity valuation is also provided in this section, which explains the possible relationship between stock returns and macroeconomic variables.

2.1 The efficient market hypothesis

The EMH is the brain child of Harry Roberts (1967) and Eugene Fama (1970). The theory postulates that stock prices contain all the historic data and all publicly available information. Central to this theory is the notion that no one can profit by forecasting or speculating on future price movements of stocks because such movements exhibit a random walk movement. The theory can be expressed with various degrees of confidence, from the weak-form, and the semi-strong form, to the strong-form market hypothesis.

The weak-form hypothesis entails, deductively, that no one can profit by using historical data of a firm to predict future price movements. Under this hypothesis, historic data such as the price of a stock over the past five years, for instance, will not help in predicting the future movement of a stock price. If this is true, it then repudiates technical analysis, which is the study of the behaviour of stock prices of a firm using historic prices, rates of return, and trading volume data (Mankiw and Taylor, 2008).

The semi-strong form hypothesis of the EMH builds on the weak form and states that share prices already reflect available public information (including historical prices), as well as the fundamentals of companies that can be observed in financial metrics such as price-to-earnings ratio, earnings yield, dividend yields, and other news related to companies, such as earnings announcements, merger and acquisitions, or stock splits. Changes in macroeconomic variables such as interest rates, money supply, inflation, and others are also considered in the semi-strong

form of the EMH. The semi-strong form of the EMH implies that it is not possible for investors to obtain abnormal returns by acting on recent news (Fama, 1970).

The strong form of the EMH is based on the weak and semi-strong forms and has the premise that all the information relevant to companies, including inside information, is already reflected in their prices. This hypothesis assumes that prices adjust quickly whenever new information is available to the general public, and therefore not even the privileged investor with private or inside information will achieve higher than average returns (Fama, 1970).

The implications of the EMH are that the current price of stocks reflects all the past and the present information regarding a particular stock. If the current price of stocks reflects their historic and present information, then the price of the stocks can be used to analyse the state of the firm, and more broadly, the economy (Bodie, Kane, and Marcus, 2011).

2.2 Capital asset pricing model

The CAPM was pioneered by the work of Sharpe (1964) and furthered by Lintner (1965) and Mossin (1966). The theory is based on the theoretical equilibrium determination of asset prices. Central to the CAPM, is the view that there are two forms of risk that investors face. These are systematic risks (i.e. risks that cannot be reduced or eliminated via diversification), and unsystematic risks (i.e., those that can be eliminated or reduced through diversification) (Forcadi and Fabozzi, 2004). The CAPM further maintains that there is only one risk factor at play in the market, and this is the market risk itself. This is the risk that emanates from overall stock movement. Under the CAPM, the expected return of an asset is equal to the risk-free rate plus the risk premium. Thus it is given by the following identity:

$$E(r) = R_f + \beta(R_m - R_f)$$

Where:

$E[r]$ = the expected return of the security

R_f = the risk-free rate on government bonds

β = Beta of the security

R_m = return on the market

The β measures the responsiveness of asset i to the overall market portfolio. If β is equal to 1 it means that the asset in question has the same risk with the market portfolio. A β that is more than 1 means that an asset is highly risky as compared to the market portfolio, whereas a β less than 1 means that the asset is less risky than the market portfolio. Beta is the covariance of returns of the individual stock and return on the market, divided by the variance of the returns of the market.

In order for the CAPM to hold, a set of assumptions needs to be considered: 1) Investors are assumed to be rational and mean-variance optimisers, that is, investors plan for a single period only and have homogeneous expectations; 2) All assets are publicly held and trade on public exchanges, short positions are allowed, and all information is publicly available; and 3) Investors can borrow and lend at the same risk-free rate and there are no taxes and no transaction costs.

The contribution of the CAPM to the financial theory cannot be debated; however, empirical tests of the CAPM suggest that stocks with lower Betas have higher expected returns, contrary to the predictions of the CAPM (Fabozzi and Drake, 2009). Other critiques of the CAPM emanate from its fundamental assumptions that the market resembles the characteristics of perfectly competitive markets, which, in reality is not true. Critics of the CAPM also focus on the fact that, in reality, market risks cannot be limited to only one factor; there are many risks that may affect the prices and the expected return of assets, such as unemployment rates, inflation, money supply, and interest rates (to name but a few).

2.3 Arbitrage pricing theory

The APT is an alternative model to the CAPM. This model was developed by Ross (1976). Whereas the CAPM consists of a single factor, the APT is a multifactor model. It is based on the premise

that many factors other than the market can explain stock returns; however, the APT does not predefine these factors nor quantify them. The APT has less restrictions than the CAPM.

The main assumptions proposed by Ross (1976) are:

- Systematic factors can explain asset returns;
- Diversification can eliminate specific risk when investors construct a portfolio of assets;
- Markets are perfectly competitive and, therefore, well-diversified portfolios are not subject to arbitrage opportunities.

The APT model assumes that the stochastic process underlying the generation of security returns over time can be expressed in the form of the following linear k-factor model sourced from van Rensburg (1997):

$$R_{it} = E(R_{it}) + \sum_{k=1}^K b_{ik}f_{kt} + \varepsilon_{it}$$

Where:

R_{it} = realised returns earned by asset i in time period t , where $i = 1, 2 \dots n$ and $t = 1, 2 \dots T$

$E(R_{it})$ = the expected rate of return of asset i for period t at the beginning of period t

f_{kt} = the k th risk factor that impacts on asset i 's returns, where $k = 1, 2 \dots K$. All risk factors represent unexpected movements in pervasive economic forces and have an expected value of zero i.e. $E(f_{kt}) = 0$

b_{ik} = a coefficient that measures the sensitivity of R_{it} to movements in f_{kt}

ε_{it} = a normally distributed random error term t which measures the unexplained residual return of asset i in period t , where $E(\varepsilon_{it}) = 0$; $E(\varepsilon_{it}\varepsilon_{jt}) = 0$ for all $i \neq j$ and $E(\varepsilon_{it}f_{kt}) = 0$

The different macroeconomic factors are represented by f in the equation above. These could be inflation, GDP growth, political events, interest rate changes, exchange rates, and other economic variables. The b in the equation quantifies how return on the asset will change when there are movements in the underlying factors. The error term represents factors that have not been considered in the model but could also explain returns.

Large portfolios diversify away the effects of the error term, which are assumed to be independent on the APT model. When these effects are fully diversified, the model specifies that in equilibrium, the return on a risk-free and costless investment should be zero. That is the case, because the APT derives from the law of one price, where similar assets should be sold at the same price. If that is not the case, investors will take advantage by buying the mispriced asset at lower price and then selling the same asset at a higher price, leading to a demand and supply problem. Other investors will follow the same approach and eventually the market corrects the price.

The above assumption implies that the expected return on any asset i (E_i) can be represented by the following equation:

$$E(R_{it}) = r_f + \sum_{k=1}^K b_{ik} \lambda_k$$

Where:

$E(R_{it})$ = the expected rate of return of asset i

r_f = return on a risk-free asset

b_{ik} = beta or factor loading, measures the sensitivity of the asset return relative to changes in the risk factor

λ_k = the risk premium related to the k th common risk factor

2.4 Dividend discount model and macroeconomic variables

The dividend discount model (DDM) is commonly used for equity valuation and allows one to obtain insight into the relationship between macroeconomic variables and stock prices. The DDM is given by the following equation:

$$P_{it} = \sum_{N=1}^{\infty} \frac{E(D_{it+n})}{(1 + k_i)^n}$$

Where:

P_{it} = the price of stock i in period t

$E(D_{it+n})$ = the expected dividend receipt in period t+n

k_i = the required rate of return of stock i

Considering Miller and Modigliani's (1961) argument that firm value is derived from earnings rather than dividends, and the fact that future dividends are financed by earnings, it implies that the numerator on the right-hand side of the above equation suggests that equity prices are positively correlated with a company's expected earnings, as well as economic growth; while it is highly probable that the denominator on the right-hand side is influenced by changes to interest rates (van Rensburg, 1999). Theoretically, a growing economy with increased money supply (which lowers interest rates), lower inflation, and more production, is likely to influence the earnings growth of companies, hence positively affecting the numerator.

This chapter provided the theoretical background required to carry out this dissertation. It started with the EMH, which asserts that stock prices reflect information available in an efficient market and each form of the EMH was explained. Following the EMH, asset prices theories such as the CAPM and the APT were discussed. The CAPM is a single factor model that attempts to predict stock returns using the market risk as the only source of risk, while APT can be seen as an extended version of the CAPM with multiple factors and, in most cases, macroeconomic variables that might explain stock returns. Finally, the DDM was discussed to show the link between macroeconomic variables and stock prices.

Chapter 3 – Literature Review

This chapter reviews the literature related to the impact of macroeconomic variables on stock returns. The section begins with a review of international studies before focusing on those studies that are pertinent to the particular African countries of concern in this dissertation. Finally, the literature relating to studies conducted in other African markets is also reviewed.

3.1 Macroeconomic variables and stock returns in international markets

There is evidence that short-term interest can explain return in stocks. This is shown by Choi and Jen (1991) in a paper where the authors investigate the relationship between stock returns and short-term interest in the US by applying the Fama-MacBeth regression for the period 1963–1985. The results of the study suggest that short-term interest rates have significant explanatory power over stock market returns, especially for the small stocks, as well as indicating a negative relationship with them. Similarly, Alam and Uddin (2009) used regression analysis to investigate the relationship of interest rates and stock returns in 15 developing and developed countries and found that in all cases there was a negative relationship between the two variables during the period 1988–2003. These results were consistent across different countries.

Contrary to the results of the above studies, Lee (1997), using three-year rolling regression models to investigate the relationship of stock market and short-term interest rates, obtained surprising results. Lee found that the relationship was not consistent across the whole period (1957–1994), changing from a negative relationship to a non-existing relationship to even a positive insignificant relationship between the two variables.

Humpe and Macmillan (2009) compare the US and Japanese markets by using cointegration analysis to examine the long-term relationship between macroeconomic variables and stock returns. This study covers a relatively large sample period (1965–2005). Results for the US indicated that there is a negative relationship between stock prices, and both long-term interest and inflation. However, industrial production was found to have a significant positive impact on stock prices. The money supply proxy was found to be having an insignificant impact on stock

prices for the US. For Japan, money supply was found to be having an insignificant impact on stock prices, while the industrial production proxy was found to be having a positive and significant impact on stock prices.

Karagoz, Ergun, and Karagoz (2009) undertook a study to assess the impact of macroeconomic factors on stock markets using evidence from the Istanbul stock exchange in Turkey. The study covered the period from January 1998 to December 2008. They used the Johansen co-integration, vector autoregressive methods for analysis. Inflation, interest rates, money supply, real exchange rate, gross domestic product, and the industrial index were used as explanatory variables, while the dependent variable was the Istanbul stock exchange index. The study established that there is long run equilibrium between macroeconomic factors and the Istanbul index. Inflation showed a positive relationship with the index, while both interest rates and money supply were found to exhibit a negative relationship on the index.

Ali et al (2010) studied the causal relationship between macroeconomic indicators and stock exchange prices in Pakistan. They used monthly data from January 1990 to December 2008. Their explanatory variables were inflation, exchange rates, and balance of trade while using the industrial production index of the Karachi stock exchange as a dependant variable. They employed the Granger causality test technique to test the relationship. Their results indicated that macroeconomic indicators had no impact on stock exchange prices. These results disagree with Abbas, Tahir, and Raza (2014) and Pervaiz, Masih, and Jian-Zhou (2018). The latter studies found a statistically significant relationship between macroeconomic variables such as inflation, exchange rate and interest rates and stock returns in Pakistan. The different results can be justified by the use of the different sample periods and different variables.

Pal and Mittal (2011) explored the impact of macroeconomic indicators on Indian capital markets. They used interest rates, inflation, gross domestic savings, and exchange rates as independent variables, while taking market index as a dependant variable. The study used quarterly data from 1995 to 2008. The error correction model was used for data analysis. The

findings indicated that there existed long run equilibrium between the macroeconomic indicators and the stock market index.

Gonçalves (2012) studied the effect of inflation, exchange rates, money supply, interest rates, and the industrial production index on the Portuguese stock market (both PSI20 index and the companies representing it) using multiple regression analysis during the period 1999–2011. In this study it was found that exchange rate and inflation have a positive relationship with stock returns, however, only exchange rate was statistically significant. The other variables had negative coefficients but were not significant.

Masduzzaman (2012) studied the UK and German stock markets and their relationship with inflation, interest rates, exchange rates, money supply, and the industrial production index during the period 1999–2011. The investigator used a number of techniques, such as the Johansen co-integration test, error correction model, variance decomposition, and impulse response functions to examine the long- and short-term relationships between stock returns and variables. The results showed that stock returns were co-integrated with the selected macroeconomic variables in both markets. The causality tests for Germany revealed short-term causality from money supply and industrial production on the index, but the results also showed a long-term causality from inflation and exchange rate. In the UK, there are short-term causal relationships between the index and all the macroeconomic variables, as well as between the exchange rate and the index. There is also long-term causality between inflation and the index. This study implies that macroeconomic variables can be a predicting factor for stock returns in both the UK and Germany (Masduzzaman, 2012).

A study carried out by Hsing (2014) evaluated the impact of macroeconomic factors on the Estonian stock market for the period 2000–2013, using a Generalized Auto Regressive Conditional Heteroskedasticity (GARCH) approach. Findings of this study suggested that debt/GDP ratio, exchange rate, real GDP, domestic interest rate, expected inflation rate, the German stock market index and Euro area government bond yield are all significant at the 1% level.

Furthermore, it seems that the model fits quite well the data as the r-squared is relatively high (0.93).

Chittedi (2015) investigated the relationship of macroeconomic fundamentals and stock returns in the BRICS countries, excluding South Africa, using monthly data from 1994–2010. The technique used was the Autoregressive Distributed Lag model (ARDL) to test the causal relationship between stock prices and economic fundamentals. The variables included: money supply, real effective exchange rate, industrial production index, foreign institutional investment (FII), interest rates, wholesale price index, and gold prices. Findings of this study suggest that FII, money supply, inflation, and gold prices have a long run relationship with the Indian stock market. Interest rates are the only variable that has influence on Brazilian stocks. It was also found that none of the variables influence the Chinese stock market, whilst the Russian market is only affected by the production index. This study shows that the influence of macroeconomic variables on stock returns varies from country to country, even though the BRICS have some similarities.

Jareño and Negrut (2016) examined the US stock market and its linkages to the following macroeconomic variables: GDP (real and GDP growth), inflation, interest rates, unemployment rate, and the industrial production index. Quarterly data for the period 2008–2014 was used. The results showed that all the selected variables except inflation are statistically significant. Furthermore, a strong positive correlation is obtained for GDP, the industrial production index, and inflation. However, a negative correlation was detected for interest rates and the unemployment rate.

Chauque and Rayappan (2018) investigated the Malaysian stock market and its relationship with exchange rate and inflation for the period 2007–2016 using multiple regression analysis and Granger causality tests. The results show that inflation and exchange rates have a significant and negative impact on the Kuala Lumpur stock exchange. However, the model has a low R-Squared (22%), which implies that some important variables have been omitted. Granger causality tests

reveal that there is no causal relationship between inflation and exchange rate with the returns in Malaysia.

Assagaf et al. (2019) analysed the Indonesian stock market during the period November 2016 to June 2018. They used multiple regression to examine the impact of inflation rates, interest rates, money supply, and exchange rate on stock prices. The results indicate that all four variables have a significant impact on stock returns in Indonesia. The authors also noted that inflation and money supply have a positive relationship with the stock market, while interest rates and exchange rates have a negative relationship with stock returns. A limitation of this study is the relatively small sample, leading to a few observations that could possibly have had different results if the period of study had been longer.

3.2 Macroeconomics variables and stock returns in Africa

3.2.1 Egypt

Barakat, Elgazzar, and Hanafy (2016) examined the relationship between stock returns and macroeconomic variables in northern Africa, focusing specifically on Egypt and Tunisia during the period 1998–2014. The following variables were examined: interest rate, inflation, money supply, and exchange rate, using vector autoregression (VAR), cointegration analysis, and Granger causality tests. Granger causality tests in Egypt show a bidirectional causal relationship between exchange rate, money supply, and the EGX 30 (an index representing the top 30 companies in the Egyptian Stock Exchange). Further, the results reveal that there is a causal relationship between interest rate and the EGX 30, running only the direction from interest rate to the index. As for the consumer price index (CPI), results indicate that there is a causal relationship between CPI and the EGX 30 that runs only from the direction of the EGX 30 to CPI. The results for Tunisia indicate a bidirectional causal relationship between interest rates and the Tunisian stock market index (Tunindex); surprisingly, no relation between inflation and the index was found.

Additionally, the same study found that money supply and exchange rate have a unidirectional causal relation to the Tunindex.

The link between interest rates and stock returns in Egypt has been further investigated by Kamal (2018) using monthly data from November 2004 to November 2017. Kamal used a set of different interest rates such as the three-month T-Bill rate, the three-month deposit rate, and the lending rate, and the cointegration analysis to determine whether these variables have a relationship with stock returns in Egypt, represented by the EGX 30 index. The findings of this study found a significant inverse relationship between the EGX 30 and the different interest rates used in this study.

3.2.2 Mauritius

The only study available relating to Mauritius was done by Seetanah et al. (2012), who investigated the relationship between stock returns in the SEM and macroeconomic factors such as exchange rate, interest rate, GDP, money supply, and trade balance. This paper made use of the ARDL technique and covered the period 1998–2011, on a quarterly basis. Findings from this study showed that in the long-run money supply and trade balance are significant and positively related to stock returns, while interest rates are significant and inversely related to stock returns in Mauritius.

3.2.3 South Africa

There has been some research about this topic in South Africa. Van Rensburg has pioneered the study of macroeconomic variables and stock returns in South Africa, conducting extensive research on the issue in the 1990s. The first study to be reviewed in this subsection is the one conducted in 1999, in which van Rensburg reinvestigated the issue of the macroeconomic identity of candidate Arbitrage Pricing Theory (APT) factors on the JSE, following the end of apartheid in South Africa and the country's transition to democratic rule at the 1994 elections. Based on a time-series analysis of the data from 1965 to 1995, the following variables: the rand

gold price, the three month Banker's Acceptance rate, the 10-year long bond rate, the Dow-Jones Industrial Index, the balance on the current account, and the money market shortage had a strong influence on the time series of equity returns on the JSE.

Jefferis and Okeahalam (2000) studied the linkage between both local and international macroeconomic variables and stock market performance in the Southern Africa region, specifically South Africa, Botswana, and Zimbabwe. The period under consideration was 1985–1995 and cointegration and error correction methods were applied. For South Africa, this research shows that there was a positive influence of real GDP and real exchange rate on real stock prices and a negative relationship between real stock prices and long-term interest rates. This study also found that real exchange rate was the main transmitter of international influences. Furthermore, US GDP and real exchange rate did not show a long-term relationship with stock returns in South Africa.

MacFarlane (2011) investigated whether macroeconomic factors can explain future stock price movement on the JSE, using quarterly data for the period 1965–2010 using money supply, interest rates, GDP, exchange rate, and inflation as variables. Through techniques such as Granger causality tests, cointegration, and variance decomposition, it was found that economic variables are not useful to predict future stock market performance in South Africa. This study also found a negative relationship between the JSE All Share Index and interest rates, exchange rate, and GDP. Inflation and money supply, furthermore, were found to have a positive relationship in the long run.

Hsing (2011) examined the South African market and its relationship with both local and international macro variables, using quarterly data for the period 1980–2010 and the Exponential generalized autoregressive conditional heteroscedastic (EGARCH) model. Empirical results suggested that there is positive relation between the South African stock market index and real GDP growth, M3/GDP ratio, and the US stock market index. The following variables have a negative influence on the South African stock market index: government deficit/GDP ratio, the

domestic real interest rate, the nominal effective exchange rate, the inflation rate, and the U.S. government bond yield.

The South African stock market is highly concentrated, and industrial shares have a large weight on the entire market. This observation led to a study conducted by Banda (2017) to investigate the relationship between macroeconomic variables and returns of industrial stocks on the JSE, represented by the INDI 25 index (representing the top 25 industrial stocks), for the period 1995–2015 on a quarterly basis. The techniques used were as follows: correlation analysis, cointegration, Granger causality tests, and the vector error correction model. The results indicated that inflation has a weak positive but insignificant relationship with industrial stocks, whereas GDP has a weak negative relationship. Furthermore, exchange rates are found to be significant and positively correlated with industrial stocks, while interest rates are negatively related and only significant at the 1% level. Granger causality tests revealed that there is a unidirectional causality from the INDI 25 to prime rates. Cointegration results showed no long-run relationship between industrial stocks and GDP, but did reveal a positive correlation between industrial stocks and inflation. The results also revealed that interest rates are inversely related to industrial stocks, whereas exchange rates have a positive but insignificant relation.

Olivier (2018) also attempted to test the influence of local and international macroeconomic variables on the JSE; namely, US and South African GDP, US and South African interest rates, exchange rate, money supply, and the FTSE index, using time-series regression for the period 1995–2016 with both quarterly and monthly data. The results indicated that there is a negative and statistically significant relationship between South African stock returns and South African interest rates and the exchange rate. Findings of this study also report a positive and statistically significant effect of the FTSE index on the JSE. It is worth noting in this study that the effect of money supply on South African stock returns changes as the data frequency changes from monthly to quarterly. With monthly data, money supply reveals a negative influence on South African stock returns, while with quarterly data it shows a positive influence. Another interesting

point is that inflation becomes statistically significant and inversely related to stock returns once tested using quarterly (as opposed to monthly) data.

3.3 Other African studies

This subsection will discuss studies related to the impact of macroeconomic factors on stock returns in other parts of Africa, excluding the selected countries in this study. Research conducted on Nigeria, Kenya, Botswana, Ghana, Tanzania, Namibia, Uganda, and Rwanda is highlighted below.

John and Duke (2013) undertook a study to assess macroeconomic factors that influence stock market development in Nigeria. They focused on the period between 1970 and 2011. Their study took national savings rate, GDP, financial sector development, stock market liquidity, inflation, domestic savings rate, and gross fixed capital formation as exogenous factors while taking market capitalisation to GDP ratio as a dependant variable. They then employed cointegration and the error correction model. Their study came to the conclusion that national savings rate, GDP, and inflation have a significant impact on stock market development.

Worlu and Omodero (2017) conducted a comparative analysis of macroeconomic variables and stock returns for Nigeria, South Africa, Ghana, and Kenya. The selected variables were inflation, GDP, and real exchange rate, and they used time series regression analysis for the period 2000–2015. However, the model was not a good fit as the economic factors were statistically insignificant in all four markets. Moreover, the results suggested a weak relationship between economics fundamentals and stock prices. Lastly, this study also showed that all the selected variables had a negative influence on stock returns in Nigeria.

In a recent study, English (2018) used Granger causality tests to investigate causality between macroeconomic variables and stock returns in Nigeria for the period 2000–2016. The results in this study indicated that there is no causality between inflation and stock returns. Money supply and stock returns, however, demonstrate a causal relationship from the money supply direction,

and there is a bidirectional causal relationship between exchange rate and stock returns, suggesting that exchange rate fluctuations will affect stock returns.

Omodero and Mlangi (2019) investigated the relationship between exchange rates, interest rates, inflation, and GDP with stock returns in Nigeria using annual data for the period 2009–2018. The multiple regression was used in this analysis and the results show that the exchange rate and interest rate have a positive influence on stock market performance. This is, however, statistically insignificant. Inflation has a positive impact on the index and is also statistically significant. Lastly, GDP was shown to be a positive and significant variable for explaining variation in Nigerian returns.

Adam and Tweneboah (2008) investigated the relationship between macroeconomic factors and stock market movement using evidence from Ghana. The study assimilated the Databank stock index as an endogenous variable while taking the treasury bill rate, inflation, foreign direct investment (FDI), and exchange rates as exogenous factors. In addition to this, the study assimilated the vector error correction model (VECM) and impulse response functions to analyse data. Quarterly time series data from 1991 to 2006 was also used. The results from the VECM indicated that interest rates and FDI are positive and significantly impacting stock market prices in Ghana. Another interesting discovery is that a long run relationship was observed between economic variables and stock market prices. Inflation was found to be negative, but insignificantly impacting stock prices. This research finding on inflation confirms the findings by Ali et al (2010), who also noticed the insignificant impact of inflation on the Pakistan stock exchange prices.

Eita (2012) applies a VAR model to test the impact of macroeconomic variables in the Namibian Stock Market, using quarterly data for the period 1998–2009. Money supply, inflation, real GDP, interest rates, and exchange rate were the variables included in the model. This study revealed that money supply and real GDP have a positive effect on stock prices, while interest rates and inflation have a negative relationship with stock prices in the Namibian market.

Laichena and Obwogi (2015) used a correlation analysis and panel regression approach to investigate the linkage between economic factors with stock returns in the East African countries of Kenya, Uganda, and Tanzania. The sample period was between 2004–2013 and the independent variables included: interest rate, inflation, exchange rate, and GDP on a monthly basis. The correlation showed that the four variables have a negative relationship with East African Stock Markets. The panel regression revealed that all the variables are statistically significant. Furthermore, it also indicated a positive influence of GDP and inflation on stock returns and a negative impact of interest rates and exchange rates on the East African stock markets.

Regression analysis and ARDL were utilised by Rapaeye (2017) to test the relationship between macroeconomic variables and stock returns on the Botswana Stock Exchange over the period 1994–2014. The variables included: inflation, interest rates, exchange rates, and money supply. Regression results for the study showed that only exchange rate and money supply are significant at the 10%, with the former having a negative relationship with stock returns and the latter having a positive relationship. This study also revealed that there is no long run relationship between economic indicators and stock returns in Botswana.

Worlu and Omodero (2017) studied the influence of GDP, inflation rate, and real exchange rate in Ghana and Kenya. The results indicated that there is no influence of inflation and real exchange rate on stock prices and a negative relationship between stock prices and GDP. For Kenya, there is no influence of GDP and inflation on stock performance, but real exchange rate contributes negatively to stock prices.

The Rwandan market was examined by Innocent et al. (2018), who employed a set of tools including: regression, cointegration, VAR, and causality tests to model both short and long run relationships between stock prices and inflation, interest rates, GDP, and exchange rate on a monthly basis for the period 2010–2016. Regression analysis showed that exchange rate,

inflation and GDP have a significant and negative influence on the Rwandan stock Exchange, while interest rate has a negative effect (but this relationship is not significant). Cointegration analysis revealed that there is a long run relationship between the four economic indicators and stock returns in Rwanda.

Epaphra and Salema (2018) conducted research in order to ascertain the impact of macroeconomic forces and stock returns in Tanzania, using monthly time-series data for the period 2012–2016 and choosing cointegration analysis and VECM as the research methods. Findings of this study revealed that inflation has a negative and insignificant relationship with the overall Dar Es Salam Stock Exchange; exchange rate and money supply impact positively and significantly on the market; and lastly, interest rate has a significant and negative influence. Cointegration results also suggest that a long run relationship between the economic factors and stock returns exists.

Gacunha and Kuso (2019) evaluated the determinants of stock returns in the Nairobi Stock Exchange by selecting some macroeconomic variables. The study covered the period 1998–2015, and the selected variables included stock index, inflation, interest rates, exchange rates, and money supply. It was found that money supply has a negative relationship with stock returns and inflation, whereas exchange rates and interest rates have a positive relationship with Kenyan stock returns in the long run. These results are surprising because interest rates usually have an inverse relation with stock prices. It was suggested that the anomaly could be due to the tight monetary policy approach, whose objective it is to keep inflation to one digit and limit high lending rates. This study also made use of Granger causality tests, which revealed a lagged relationship between money supply and interest rates with stock prices, and a contemporaneous bidirectional relationship between stock prices and exchange rates in the long-run. Similar results are obtained in the short-run, except for exchange rates.

A summary of selected papers from the literature review is presented below in Table 1 and it highlights that the influence of macroeconomic variables on stock prices can vary due to the method used, the sample period, frequency of the data, and choice of variables.

Table 1: Summary of selected papers from the literature

Authors	Country and period	Variables	Method	Significant relationship
Assagaf et al. (2019)	Pakistan 2016–2018	Inflation, interest rates, money supply, and exchange rate	Regression	Inflation and money supply (positive); interest rates and exchange rates (negative)
Chauque and Rayappan (2018)	Malaysia 2007–2016	Exchange rate and inflation	Regression	Exchange rate and inflation (negative)
Olivier (2018)	South Africa 1995–2016	US and SA GDP, US and SA interest rates, exchange rate, money supply, and the FTSE index	Regression	SA interest rates, inflation and exchange rate (negative); FTSE index (positive)
Omodero and Mlanga (2019)	Nigeria 2009–2018	Exchange rate, interest rates, inflation, and GDP	Regression	GDP (positive)
Kamal (2018)	Egypt 2004–2017	Interest rates	Cointegration analysis	Interest rate (negative)
Innocent et al. (2018)	Rwanda 2010–2016	Inflation, interest rates, GDP, and exchange rate	Regression, cointegration, VAR	Inflation and GDP (negative)
Epaphra and Salema (2018)	Tanzania 2012–2016	Inflation, exchange rate, interest rate	Cointegration, VECM	Exchange rate and money supply (positive); interest rates (negative)
Rapaeye (2017)	Botswana 1994–2014	Inflation, interest rates, exchange rates, and money supply	ARDL	Exchange rate (negative); money supply (positive)
Jareño and Negrut (2016)	United States 2008–2014	GDP, inflation, interest rates,	Correlation	GDP and industrial

		unemployment rate, and industrial production index		production index (positive); interest rates and unemployment rate (negative)
Laichena and Obwogi (2015)	Kenya, Uganda, Tanzania 2004–2013	Interest rate, inflation, exchange rate, and GDP	Panel regression	GDP and inflation (positive); interest rates and exchange rates (negative)
Gonçalves (2012)	Portugal 1999–2011	Inflation, exchange rates, money supply, interest rates, and industrial production index	Regression	Exchange rate (positive)
Seetanah et al. (2012)	Mauritius 1998–2011	Exchange rate, interest rate, GDP, money supply, and trade balance	ARDL	Money supply and trade balance (positive); interest rate (negative); exchange rate (negative in the short-run)
Humpe and Macmillan (2009)	US and Japan 1965-2005	Interest rates, inflation, industrial production, money supply	Cointegration	US: inflation and long-term interest rate (negative); industrial production (positive) Japan: industrial production (positive)
Jefferis and Okeahalam (2000)	South Africa 1985-1995	Real GDP, Real exchange rate, and long-term exchange rate	Cointegration	Real GDP, real exchange rate (positive), long-term interest rates (negative)

Chapter 4 – Data

This chapter describes the data that was used in this study and justifies the inclusion of the different macroeconomic variables in the model. The sources of the data will also be mentioned.

The data consists of the monthly total return index of the main stock market indices in Egypt, Mauritius and South Africa used as a proxy for stock prices. The total return index includes not only share prices, but also dividends declared by dividends-paying companies. The inclusion of dividends in the data provides a more accurate reflection of the performance of the market.

The macroeconomic variables used in this study are: inflation, money supply, oil prices, gold prices, exchange rates, and interest rates. The inclusion and the theoretical impact of each variable on stock prices is explained below.

Inflation in this study is proxied by the CPI and refers to a general increase in commodity prices over a given period. A high rate of inflation reduces consumers' ability to buy products, thereby leading to a reduction in demand for stocks and eventually leading to a decrease in stock prices. The influence of inflation on stock returns has been documented in the literature by Fama and Schwert (1977), who found a negative relationship between inflation and stock returns. This finding was supported by other studies, such as those by Innocent et al. (2018) and Olivier (2018). However, Fisher (1930) hypothesised that expected inflation and stock returns have a negative relationship. In the present study, inflation is expected to be either positively or negatively related to stock exchanges.

Money supply can be divided into three broad categories; namely, M1, M2, and M3. M1 refers to so-called 'narrow' money, which includes the currency in circulation plus cheque deposits; M2 refers to 'broad' money, which includes M1 and short and medium term deposit accounts; and M3 is money that includes M1, M2, and long-term deposits (Parkin et al, 2010). This study makes use of M2 for South Africa and Egypt, and M3 for Mauritius (as no M2 data could be sourced from the Mauritius Central Bank). As people hold more funds, they will tend to invest more in the stock

markets, increasing demand in stocks and driving a price increase. The relationship between stock returns and money supply has been analysed in a number of previous studies with mixed results, hence the inclusion of this variable in the present study to further understand its influence on stock returns. Assagaf et al. (2019) and Epaphra and Salema (2018) found a positive relationship between money supply and stock prices. This study hypothesises a positive relationship between money supply and stock prices.

Oil is one of the most important commodities in the world, often driving the economies of major oil producing nations that rely on oil revenues to cover their government budget. Therefore, the price of oil could be relevant to explain stock price movements. For oil importers, a decrease in price is hypothesised to have a positive impact on stock prices, as it leads to expansion in the economy. In contrast, for oil exporters such as Egypt, a price fall is expected to have a negative impact on stock prices, as it leads to a contraction in the economy. This is the justification for using the international oil price as one of the macroeconomic variables in this study. This study hypothesises a positive relationship between oil prices and stock returns.

Similar to oil, gold is also a relevant and valuable commodity, the price of which is often monitored in international markets. Gold is usually kept as a reserve by central banks, as part of the international reserves. It is also expected that gold can influence stock prices in some countries (especially in South Africa), as it significantly contributes to income from total exports. In addition, mining companies have a significant weight on the JSE All Share index. For this reason, the international gold price is another significant variable used in this study. It should, however, be noted that the influence of gold prices on stock returns has been tested in previous studies (such as by Gay, 2016), but has not been found to be significant in the BRIC countries. This study hypothesises a positive relationship between stock returns and gold prices.

Exchange rate is the rate used to convert the price of one good in local currency to a foreign currency. A depreciation of the exchange rate implies that it is more expensive for locals to buy foreign goods, and cheaper for foreigners to buy local goods. It can be hypothesised that a

weaker exchange rate may cause an increase in demand for local stocks, therefore causing an increase in local stock prices. The exchange rate used in this study is local currency against the USD, as the USD is the most transactional foreign currency. Exchange rate is also critical for commodity exporters, as a weaker local currency reduces local revenue and allows buyers to get more of that commodity. Evidence of a relationship between exchange rate and stock returns has been documented in the literature, and results have varied from negative to positive. Assagaf et al. (2019), Olivier (2018), and others found an inverse relationship, while Jefferis and Okeahalam (2000) found a positive relationship. This study hypothesises an inverse relationship between stock returns and exchange rate, as this is the most common outcome in the literature.

Finally, interest rates do affect companies' cost of capital. A high interest rate would increase the cost of servicing debt, and therefore the overall cost of capital. This leads to a higher interest expense, and thus a reduction in earnings. In the literature, there is evidence of a negative relationship between stock returns and interest rates, as evidenced by Chen and Joi (1991) and Allan and Uddin (2009). Interest rates are, therefore, a sensible variable to consider for the current research. The government three-month T-Bill rate will be used as proxy for interest rates in this study. An inverse relationship between interest rates and stock prices is hypothesized in this study.

The sample period is from November 2009 to October 2019 on a monthly basis. This period was chosen because it was the earliest period for which total return index data was simultaneously available for three of the indices that are used in this study; namely, the JSE ALSI total return index; the EGX 30 index; and the SEM index.

With regard to the data, it must also be noted that an adjustment was made to the Egyptian monthly stock index data. Due to the Egyptian political revolution in 2011, the stock market did not trade from 28 January to 22 March and, therefore, there was no monthly data for February. To overcome that, the average of January and March index prices was used as a proxy for February, to make sure there were no missing points in the data.

Data was collected from the central banks of the countries in question and reputable financial data providers such as Bloomberg and Reuters/DataStream. The appendix at the end of this dissertation provides the exact source of each variable. A summary of the variables to be used is provided in Table 2 below.

Table 2: Variables description

Variable	Description	Code
Stock index	Local total return index prices	LEGX30/SEMDEX/ALSI_SA
Oil price	International oil price in USD	LOIL
Gold price	International gold price in USD	LGOLD
Inflation rate	Inflation rate (12 month)	INF
Money supply	Either M2 or M3 in local currency	LMS
Exchange rate	Local currency in terms of USD	LEGP/USD; MUR/USD; ZAR/USD
Interest rates	Three-month T-Bill rate	LIR

Note: With the exception of inflation, all the variables have been logged, hence the L before each variable name. Inflation was not logged because it can be negative. For instance, Mauritius recorded a negative inflation in 2019 and, for consistency, it was not logged across the three countries that are being evaluated in this study.

Chapter 5 – Methodology

This section describes and explains the methodology that was used to conduct the data analysis and to obtain the results that will be analysed in the next section. This study employs OLS time series regression to examine the relationship between macroeconomic variables and stock returns in the selected countries. A correlation analysis is also conducted, along with a Granger causality test. Furthermore, the data is pre-tested for stationarity using the ADF test. Each of these methodologies is explained in more detail below.

5.1 Correlation analysis

In order to examine the relationship between macroeconomic variables and stock returns, this study starts with a correlation analysis between the selected variables. Correlation measures the linear association between two variables or the extent to which they move together (Brooks, 2014). Pearson's correlation was selected for use in this study. Correlation coefficients range from -1 to 1, with the extremes implying perfect negative and perfect positive relationships between the variables, respectively. Correlation coefficients are obtained by dividing the covariance of the two variables by the product of the two standard deviations (Brooks, 2014). As useful as correlation analysis is, it is necessary to exercise some caution when interpreting these results. This is because only linear relationships are tested, without controlling for the influence of others. Due to the large number of relationships to be analysed, it is possible that some might be spurious, even though they pass traditional tests of statistical significance (van Rensburg, 1999).

5.2 Augmented Dickey-Fuller test (ADF)

The ADF test is a procedure for unit root testing, which is an extension of the original test by Dickey and Fuller. Time series data is often non-stationary, meaning that the data do not have a constant mean across the time. Regressing non-stationary series results in a spurious regression, which is characterised by high R-squared, inaccurate t-stats, and low Durbin-Watson statistics. When constructing the ADF test, one wants to confirm that its specification accurately represents

the true data generation process. By including a constant term α_0 , it allows for a representation of a random walk with drift and this is useful in all cases where the mean of the series is non-zero (van Rensburg, 1999). To test the null hypothesis that the time series has a unit root, versus the null hypothesis that the time series is stationary, a time trend t needs to be included for the stationarity test (Harris, 1995: 29). Therefore, under normal circumstances the most restricted form of the Dickey-Fuller test (meaning the least likely to reject the null hypothesis of non-stationarity) will be conducted on each series $\{Y_{it}\}$ and is calculated using the following equation:

$$\Delta y_{it} = \alpha_{i0} + \alpha_{i1}t + b_{i0}y_{it-1} + \sum_{p=1}^p b_{ip} \Delta y_{it-p} + \varepsilon_{it}$$

Where: $\varepsilon_{it} \sim \text{IID}(0, \sigma^2)$

We reject the null hypothesis of the Dickey-Fuller test if the t-statistic lies to the left of the Dickey-Fuller critical values. The ADF test is performed so that the lagged difference terms are included until the residual of this equation is white noise (van Rensburg, 1999). This test initially considers 10 lags as the maximum. Should a series be considered stationary, it is first differenced and subsequently retested.

5.3 Regression analysis

Brooks (2014) considers regression analysis as the most important statistical method, as it is widely used in empirical studies. Regression analysis is a tool that is useful for explaining the relationship between a certain variable (dependent) and one or more variables (independent), or to explain variation in one variable as a result of variation in one or more variables (Brooks, 2014). The OLS method is the most used method for conducting a regression analysis. The OLS method is applied by squaring each vertical distance from the point to the line and then minimising the total sum of the areas of the squares (Brooks, 2014). This regression analysis has been widely used in the literature for this area of research, with van Rensburg (1999), Assagaf et al. (2019), Omodero and Mlangi (2019), and Innocent et al. (2018) serving as some prominent examples.

The regression model can be represented by the following equation:

$$Y_t = \beta_0 + \sum_{n=1}^n \beta_n x_{nt} + \varepsilon_t$$

Applying the selected variables, the equation becomes:

$$LStockIndex_t = \beta_0 + \beta_1 INF_t + \beta_2 LIR_t + \beta_3 LLocalcurrency/USD_t + \beta_4 LGOLD_t + \beta_5 LOIL_t + \beta_6 LMS_t + \varepsilon_t$$

Where:

LStockIndex = Log local total return index

INF = Inflation rate

LIR = Log Interest rate, three-month T-Bill

LEGP/MUR/ZAR/USD = Log exchange rate (local currency in terms of USD)

LGOLD = Log international gold price in USD

LOIL = Log international oil price in USD

LMS = Log money supply (local currency)

The above equation is the *a priori* equation, before taking into account stationarity of the variables.

5.3.1 Model diagnostics

Multicollinearity

A classical linear regression must not have any perfect linear relationship among two or more of its independent variables (Gujarati, 2012). If this is the case, then the problem of multicollinearity emerges (Gujarati, 2012). Regression that involves the problem of multicollinearity has serious consequences. Under multicollinearity, ordinary least squares estimators will still be best linear unbiased estimators (BLUE) but their covariances and variances will likely be larger than their true values (Gujarati, 2012). This creates difficulties in estimating precisely (Gujarati, 2012). Due to large covariances and variances, the resultant confidence intervals will also be wider, leading to the failure of rejecting the null hypothesis in the model (Gujarati, 2012).

This study uses the variance inflation factor (VIF) to detect multicollinearity. The VIF test is obtained. The rule of thumb is that multicollinearity is problematic should the VIF be bigger than 10.

Autocorrelation

Time series studies and regression models involving time series data are subject to autocorrelation or serial correlation (Gujarati, 2012). The CLRM assumptions include the assumption that the error terms are not correlated with each other. In other words, a given error term at time t is not correlated with a given error term at time $(t-1)$ (Gujarati, 2012). If these errors happen to be correlated, then autocorrelation, another serious problem, emerges. Although the OLS estimates will be consistent, unbiased, and still normally distributed—as is always desirable—they will lack efficiency (Gujarati, 2012). This means that the Gauss Markov assumption of BLUE estimators would have been violated. Estimators, according to the Gauss Markov theorem, must be BLUE. Thus, since the estimators will be inefficient, they will deviate from the requirement of minimum variance, as required by the BLUE criteria. This means that the standard errors will now be understated and, as such, the resulting t statistics will be overestimated, to the extent that a given coefficient may appear significant when in reality it is not (Gujarati, 2012). Consequently, the inferences, hypothesis, and the conclusions drawn from such regression results are likely to be far from reality and thus biased. This study will use the Breusch-Godfrey test, sometimes called the Lagrange multiplier test, to detect autocorrelation.

Heteroscedasticity

The CLRM assumptions include the assumption that the error term has the same variance across observations (homoscedasticity). However, should this fail to occur, the model will have the problem of heteroscedasticity (Gujarati, 2012). The OLS estimators will remain unbiased and consistent in the presence of heteroscedasticity, but they will not be efficient. The consequences of this assumption violation include unreliable t and F -tests, which leads to incorrect inferences about the statistical significance of the obtained regression coefficients (Gujarati, 2012). This study will use the Breusch-Pagan test to detect heteroscedasticity.

Normality

The CLRM assumptions include the assumption that the error term must be normally distributed, and this is critical when sample sizes are small (Gujarati, 2012). In the presence of non-normal errors, OLS estimators are still BLUE; the problem lies, however, in the hypothesis testing of t and F-tests, which assume normal distribution. (Gujarati, 2012). This study will use the Jarque-Bera test to investigate the normality of the residuals.

5.4 Granger causality tests

Causality tests are also performed to evaluate the relationship between macroeconomic variables and stock returns. This test was first proposed by Granger (1969) and later by Sims (1972). Both theoreticians proposed causality tests between two series, X_t and Y_t , based on the evaluation of whether past values of X_t increase the prediction of the current value of Y_t . If this is correct then it is said that X_t Granger-causes Y_t (van Rensburg, 1999). Granger causality is tested by estimating the following unrestricted (1) and restricted (2) OLS regressions:

$$y_t = \sum_{k=1}^K \alpha_k y_{t-k} + \sum_{k=1}^K b_k x_{t-k} + \varepsilon_t \text{ (Unrestricted)}$$
$$y_t = \sum_{k=1}^K \alpha_k y_{t-k} + \varepsilon_t \text{ (Restricted)}$$

To conduct this causality test, an F-statistic $\sim F(K, N-K)$ where N = the number of observations is used to test the null hypothesis that $\beta_1 = \beta_2 = \dots = \beta_k = 0$. If the null hypothesis is rejected, the test will suggest that past values increase the prediction accuracy of current values. The objective of this test is to ascertain which of the selected macroeconomic variables has predictive power to stock returns and vice-versa (van Rensburg, 1999). This test has appeared in a number of related studies such those conducted by van Rensburg (1999), Chauque and Rayappan (2018), MacFarlane (2011), and Barakat, Elgazzar and Hanafy (2016).

Chapter 6 – Results and Discussion

This chapter presents tests for stationarity, descriptive statistics, correlation analysis, multiple regression analysis as well as Granger causality tests. The results presented will be discussed in each subsection.

6.1 Test for stationarity

This subsection presents the results of the ADF test. The main purpose of this test is to check whether the data contains a unit root or not. A separate test is conducted using each country's data. This test is important because time series containing a unit root can cause the regressions to be spurious, as mentioned in the methodology section.

Egypt

Table 3: ADF test for Egypt, for the period 2009-2019.

Variable	Levels		First Difference		Levels		First Difference	
	ADF T-Stat	P-Value	ADF T-stat	P-Value	ADF T-Stat	P-Value	ADF T-stat	P-Value
	Intercept				Intercept and Trend			
LEGX30	-0.5073	0.8848	-11.6532	0.0000	-2.6363	0.2653	-11.6152	0.0000
LMS_EGP	1.0761	0.9972	-11.2362	0.0000	-1.8233	0.6874	-11.3568	0.0000
LEGP_USD	-0.6561	0.8525	-11.3655	0.0000	-2.1265	0.5256	-11.3216	0.0000
INF_EGP	-1.3887	0.5858	-10.3335	0.0000	-1.5782	0.7960	-10.2987	0.0000
LIR_EGP	-1.7768	0.3904	-7.5307	0.0000	-1.6559	0.7645	-7.5373	0.0000

Note: LEGX30 = Log stock market index; LMS_EGP = Log money supply; LEGP_USD = Log Egyptian pound/Dollar; INF_EGP = inflation rate; LIR_EGP = Log interest rates.

The ADF test results for Egypt (reported in Table 3) show that none of the variables are stationary in levels, in both intercept and intercept and trend, as evidenced by the p-values greater than 10%. Variables were first differenced in order for them to become stationary.

Mauritius

Table 4: ADF test for Mauritius, for the period 2009-2019.

Variable	Levels		First Difference		Levels		First Difference	
	ADF T-Stat	P-Value	ADF T-stat	P-Value	ADF T-Stat	P-Value	ADF T-stat	P-Value
LSEMDEX	-1.5453	0.5073	-8.5380	0.0000	-2.3565	0.4003	-8.5386	0.0000
LMS_MU	0.9031	0.9953	-14.2867	0.0000	-4.2561	0.0051	-14.3670	0.0000
LMUR_USD	-1.1228	0.7053	-12.3454	0.0000	-2.5421	0.3077	-12.2957	0.0000
LIR_MU	-3.6489	0.0061	-9.4910	0.0000	-3.6913	0.0267	-9.4614	0.0000
INF_MU	-3.0477	0.0334	-8.0645	0.0000	-3.7381	0.0235	-8.0913	0.0000

Note: LSEMDEX = Log stock market index; LMS_MU = Log money supply; LMUR_USD = Log Mauritius Rupee/Dollar; INF_MU = inflation rate; LIR_MU = Log interest rates.

For Mauritius the ADF test results (reported in Table 4) indicate that interest rates and inflation are stationary in levels under the intercept assumption, and additionally money supply is also stationary in levels in the intercept and trend version of the ADF test. The other variables became stationary when first differenced.

South Africa

Table 5: ADF test for South Africa, for the period 2009-2019

Variable	Levels		First Difference		Levels		First Difference	
	ADF T-Stat	P-Value	ADF T-stat	P-Value	ADF T-Stat	P-Value	ADF T-stat	P-Value
LALSI_SA	-1.7028	0.4273	-13.3811	0.0000	-1.8443	0.6769	-13.5057	0.0000
LOIL	-1.2226	0.6632	-9.2824	0.0000	-2.0990	0.5407	-9.2531	0.0000
LGOLD	-2.3171	0.1683	-12.6973	0.0000	-2.5018	0.3269	-12.6336	0.0000
LMS_SA	-0.6115	0.8626	-7.2302	0.0000	-1.1519	0.9147	-7.2228	0.0000
LZAR_USD	-0.7609	0.8260	-13.2192	0.0000	-2.3509	0.4033	-13.1603	0.0000
INF_SA	-2.5580	0.1047	-9.0614	0.0000	-2.5879	0.2866	-9.0629	0.0000
LIR_SA	-0.9833	0.7577	-8.6245	0.0000	-2.6876	0.2437	-8.7325	0.0000

Note: LALSI_SA = Log stock market index; LMS_SA = Log money supply; LZAR_USD = Log Rand/Dollar; INF_SA = inflation rate; LIR_SA = Log interest rates; LOIL = Log oil price; LGOLD = Log gold price

The ADF test results for South Africa (reported in Table 5) show that none of the variables are stationary in levels, in both intercept and intercept and trend, as evidenced by the p-values. Variables were first differenced in order for them to become stationary.

6.2 Descriptive statistics

This section begins with the descriptive statistics of the data used in this study, allowing us to comprehend the underlying data better and observe trends across the period 2009–2019. The data is represented graphically and numerically by way of a summary table displaying metrics such as the mean, maximum, and minimum values, as well standard deviation. It is important to include the standard deviation to get an indication of the dispersion of the data.

Egypt

Table 6: Summary statistics, Egypt for the period 2009-2019 (%)

	DLEGX30	DINF_EGP	DLMS_EGP	DLEGP_USD	DLIR_EGP	DLOIL	DLGOLD
Mean	0.0084	-0.0009	0.0131	0.0090	0.0041	-0.0019	0.0031
Maximum	0.3157	0.0580	0.1683	0.7037	0.2200	0.1951	0.1208
Minimum	-0.2437	-0.0480	-0.0279	-0.1685	-0.1384	-0.2511	-0.1171
Std. Dev.	0.0841	0.0170	0.0166	0.0688	0.0481	0.0808	0.0476
Observations	120	120	120	120	120	120	120

Note: D before each variable represents the first difference. LEGX30 = Log stock market index; LMS_EGP = Log money supply; LEGP_USD = Log Egyptian pound/Dollar; INF_EGP = inflation rate; LIR_EGP = Log interest rates LOIL= Log oil price; LGOLD = Log gold price

The summary statistics for Egypt (reported in Table 6) shows that stock prices in the EGX had a maximum return of 32% and a minimum of -24%, while having a standard deviation of 8.4%, which is the highest standard deviation amongst all the variables. Inflation growth oscillated between -5% and 5%. Money supply has mostly increased, given its maximum 16% and minimum -2%. Exchange rate had a maximum depreciation of 70% and a maximum appreciation of 16% throughout the period, which indicates that either the currency was volatile or the central bank devaluated it. Interest rates growth ranged from -13% to 22%, also showing some macroeconomic instability. Oil prices have also been volatile, given its 8% standard deviation, a

maximum price increase of 19%, and maximum price decrease of 25%. Gold prices had a maximum increase of 12% and minimum decrease of 12%.

Mauritius

Table 7: Summary statistics Mauritius, for the period 2009-2019 (%)

	DLSEMDEX	DINF_MU	DLMS_MU	DLMUR_USD	DLIR_MU	DLOIL	DLGOLD
Mean	0.0044	0.0000	0.0060	0.0016	-0.0052	-0.0019	0.0031
Maximum	0.0564	0.0299	0.0411	0.0802	0.7253	0.1951	0.1208
Minimum	-0.0554	-0.0292	-0.0581	-0.0549	-0.5302	-0.2511	-0.1171
Std. Dev.	0.0210	0.0084	0.0110	0.0209	0.1721	0.0808	0.0476
Observations	120	120	120	120	120	120	120

Note: D before each variable represents the first difference LSEMDEX = Log stock market index; LMS_MU = Log money supply; LMUR_USD = Log Mauritius Rupee/Dollar; INF_MU = inflation rate; LIR_MU = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

The summary statistics for Mauritius (reported in Table 7) show that stock prices in the SEM had a maximum return of 6% and a minimum of -6%, while having a standard deviation of 2%. Inflation has been stable given its mean increase of zero %. Money supply growth ranged from -6% to 4%. Exchange rate had a maximum depreciation of 8% and a maximum appreciation of 5% throughout the period. Interest rates growth ranged from -53% to 72%. Interest rates appear to have been volatile, given its large standard deviation.

South Africa

Table 8: Summary statistics, South Africa, for the period 2009-2019 (%)

	DLALSI_SA	DINF_SA	DLMS_SA	DLZAR_USD	DLIR_SA	DLOIL	DLGOLD
Mean	0.0088	-0.0001	0.0056	0.0055	-0.0002	-0.0019	0.0031
Maximum	0.0894	0.0140	0.0382	0.1468	0.0647	0.1951	0.1208
Minimum	-0.0594	-0.0090	-0.0185	-0.1009	-0.0957	-0.2511	-0.1171
Std. Dev.	0.0337	0.0038	0.0122	0.0428	0.0235	0.0808	0.0476
Observations	120	120	120	120	120	120	120

Note: D before each variable represents the first difference LALSI_SA = Log stock market index; LMS_SA = Log money supply; LZAR_USD = Log Rand/Dollar; INF_SA = inflation rate; LIR_SA = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

The summary statistics for South Africa (reported in Table 8) show that stock prices in the JSE had a maximum return of 8% and a minimum of -6%, while having a standard deviation of 3.4%. Inflation has been stable given its mean increase of zero. Money supply growth ranged from -2% to 4%. Exchange rate had a maximum appreciation of 10% and a maximum depreciation of 15% throughout the period. Interest rates growth ranged from -10% to 6%.

6.3 Correlation analysis

This subsection covers the individual country correlation results between stock returns and the macroeconomic indicators selected for this study. The Pearson correlation has been applied for this analysis. For the correlation, only the logged values of the variables have been included.

Egypt

Table 9: Correlation matrix for Egypt, for the period 2009-2019.

Variable	DLEGX30	DINF_EGP	DLMS_EGP	DLEGP_USD	DLIR_EGP	DLOIL	DLGOLD
DLEGX30	1.0000						
DINF_EGP	0.0627	1.0000					
	0.4960	-----					
DLMS_EGP	0.4107	0.2521	1.0000				
	0.0000	0.0055	-----				
DLEGP_USD	0.3996	0.2924	0.9134	1.0000			
	0.0000	0.0012	0.0000	-----			
DLIR_EGP	0.0126	0.2699	0.4112	0.4440	1.0000		
	0.8914	0.0029	0.0000	0.0000	-----		
DLOIL	0.1202	0.1225	0.0395	0.0524	-0.0100	1.0000	
	0.1911	0.1824	0.6682	0.5698	0.9136	-----	
DLGOLD	0.0784	-0.2384	-0.1713	-0.1725	-0.1628	0.1770	1.0000
	0.3947	0.0087	0.0614	0.0595	0.0756	0.0531	-----

Note: P-values are below each correlation. D before each variable represents the first difference. LEGX30 = Log stock market index; LMS_EGP = Log money supply; LEGP_USD = Log Egyptian pound/Dollar; INF_EGP = inflation rate; LIR_EGP = Log interest rates LOIL= Log oil price; LGOLD = Log gold price

From the above Table 9, the correlation matrix shows that stock returns in Egypt have relatively low correlation with the macroeconomic variables. All the macroeconomic variables have

positive correlation with stock returns. Money supply and exchange rate are significant at the 1% level. The results indicate that an increase in money supply is likely to result in an increase in stock prices and an increase in exchange rate (depreciation of the Egyptian pound relative to the dollar) will contribute to an increase in stock prices.

When looking at the correlation amongst macroeconomic factors, it can be noted that money supply has a strong positive correlation with exchange rate. This could indicate the presence of multicollinearity, however the VIF score is below 10, implying that multicollinearity is not serious.

Mauritius

Table 10: Correlation matrix for Mauritius, for the period 2009-2019.

Variable	DLSEMDEX	DINF_MU	DLMS_MU	DLMUR_USD	DLIR_MU	DLOIL	DLGOLD
DLSEMDEX	1.0000						
DINF_MU	0.1617	1.0000					
	0.0777	-----					
DLMS_MU	-0.0612	-0.0688	1.0000				
	0.5065	0.4555	-----				
DLMUR_USD	-0.2912	-0.0375	0.2569	1.0000			
	0.0013	0.6839	0.0046	-----			
DLIR_MU	0.0260	0.1337	0.0955	0.0597	1.0000		
	0.7783	0.1454	0.2994	0.5171	-----		
DLOIL	0.0190	-0.0109	-0.0140	-0.3180	-0.0100	1.0000	
	0.8369	0.9064	0.8795	0.0004	0.9136	-----	
DLGOLD	-0.1396	0.0596	-0.0318	-0.1595	-0.1628	0.1770	1.0000
	0.1283	0.5181	0.7300	0.0818	0.0756	0.0531	-----

Note: P-values are below each correlation. D before each variable represents the first difference; LSEMDEX = Log stock market index; LMS_MU = Log money supply; LMUR_USD = Log Mauritius Rupee/Dollar; INF_MU = inflation rate; LIR_MU = Log interest rates; LOIL = Log oil price; LGOLD = Log gold price

The correlation matrix for Mauritius (reported in Table 10) shows that stock returns are positively correlated with inflation, interest rates, and oil prices, and negatively correlated with the exchange rate, money supply, and gold price. The results also indicate that the correlation of inflation and exchange rate with stock returns is statistically significant. The correlation between

stock returns and macroeconomic factors is relatively low, and the same outcome is observed when looking at the correlation amongst macroeconomic variables.

South Africa

Table 11: Correlation matrix for South Africa, for the period 2009-2019

Variable	DLALSI_SA	DINF_SA	DLMS_SA	DLZAR_USD	DLIR_SA	DLOIL	DLGOLD
DLALSI_SA	1.0000						
DINF_SA	-0.1675	1.0000					
	0.0675						
DLMS_SA	0.0133	0.1214	1.0000				
	0.8852	0.1865					
DLZAR_USD	-0.2017	0.1056	0.0091	1.0000			
	0.0272	0.2512	0.9215				
DLIR_SA	-0.1172	0.2119	-0.0725	0.1386	1.0000		
	0.2024	0.0201	0.4311	0.1311			
DLOIL	0.4292	-0.0393	-0.0776	-0.2665	-0.2524	1.0000	
	0.0000	0.6697	0.3998	0.0033	0.0054		
DLGOLD	0.1946	-0.0361	-0.2512	-0.3247	-0.1153	0.1770	1.0000
	0.0332	0.6953	0.0057	0.0003	0.2100	0.0531	-----

Note: Probabilities are below each correlation. Note: D before each variable represents the first difference
 LALSI_SA = Log stock market index; LMS_SA = Log money supply; LZAR_USD = Log Rand/Dollar; INF_SA = inflation rate; LIR_SA = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

The correlation matrix for South Africa (reported in Table 11) shows that stock returns are positively correlated with money supply, gold, and oil prices, and negatively correlated with inflation, the exchange rate, and interest rates. The result also indicates that the correlation of inflation, the exchange rate, oil price, and gold price with stock returns is statistically significant. The correlation between stock returns and macroeconomic factors is relatively low, and the same outcome is observed when looking at the correlation amongst macroeconomic variables.

6.4 Regression results

This section presents the regression results. The main objective of this statistical technique is to determine whether a dependent variable (in this case stock returns), can be predicted by a set of

independent variables (i.e. the macroeconomic variables: inflation, money supply, gold and oil prices, interest rates, and exchange rate). This technique helps us to understand the relationship between dependent and the independent variable and whether it is statistically significant or not. It also provides a measure to explain how much variation in the dependent variable can be explained by the independent variable.

The standard regression equation post stationarity test is represented by:

$$DLStockReturns_t = \beta_0 + \beta_1 DINF_t + \beta_2 DLIR_t + \beta_3 DLlocal\ currency/USD_t + \beta_4 DLGOLD_t + \beta_5 DLOIL_t + \beta_6 DLMS_t + \varepsilon_t$$

Where:

DLStockReturns = First difference log of local stock index (EGX30, SEMDEX, and ALSI_SA)

DINF = First difference of inflation rate

DLIR = First difference log of interest rate

DLLocal currency/USD = First difference log of exchange rate (EGP/MUR/ZAR/ USD)

DLGOLD= First difference log of international gold price in USD

DLOIL = First difference log of international oil price in USD

DLMS = First difference log of money supply (local currency)

Due to the fact that some of the variables were not stationary, as evidenced by the ADF test, the original regression equation needs to be adapted to included variables that are first differenced.

Some diagnostic tests were conducted to check whether or not the main assumptions of the regression model were violated. Tests for normality of residuals, multicollinearity, of independent variables, autocorrelation as well as heteroscedasticity. Where the assumptions are not met, we used alternative methods to correct for that, which are explained below.

Egypt

Table 12: Regression results on DLEGX30, Egypt, for the period 2009–2019, using Newey-West adjusted standard errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0129	0.0163	-0.7925	0.4297
DINF_EGP	-0.0423	0.2980	-0.1420	0.8873
DLMS_EGP	1.4915	1.2052	1.2376	0.2184
DLEGP_USD	0.2863	0.2802	1.0217	0.3091
DLIR_EGP	-0.3318	0.1299	-2.5540	0.0120
DLOIL	0.0766	0.0784	0.9763	0.3310
DLGOLD	0.2181	0.2045	1.0668	0.2883
R-squared	0.2304			
Adjusted R-squared	0.1895			
F-statistic	5.6377			
Prob(F-statistic)	0.0000			
Durbin-Watson stat	2.2261			
Observations	120			

Note: D before each variable represents the first difference. LEGX30 = Log stock market index; LMS_EGP = Log money supply; LEGP_USD = Log Egyptian pound/Dollar; INF_EGP = inflation rate; LIR_EGP = Log interest rates LOIL= Log oil price; LGOLD = Log gold price

An initial regression was run to determine the effect of macroeconomic variables on stock returns. In order to validate those results, diagnostics tests were conducted to check whether or not the regression assumptions had been violated. The Breusch-Pagan test revealed that the error term was heteroscedastic, as the null hypothesis was rejected at the 5% level of significance, thus violating the assumptions. Similarly, the Breusch-Godfrey test revealed serial correlations in the model. An alternative regression was conducted using the Newey-West (HAC) method to correct for heteroscedasticity and autocorrelation, and obtain reliable standard errors. All the other assumptions were met.

The regression model for Egypt (reported in Table 12) is valid, as shown by the F-test which has a p-value of less than 1%. The coefficient of determination R-squared shows that selected macroeconomic variables explain 23% of the variation in Egyptian stock returns. As can be seen

in the results, inflation has negative but insignificant impact on Egyptian stock prices. On the contrary, the price of gold and oil have positive but equally insignificant coefficients in explaining stock prices in Egypt. Using this model, only interest rates are significant in explaining Egyptian stock prices.

Interest rates obtained a coefficient of -0.3318, which is significant at 5%. This implies that interest rates have a negative impact on stock prices in Egypt. A 1% increase in interest rates will decrease Egyptian stock prices by 0.33%. This corresponds perfectly with theoretical expectations. Increases in interest rates will cause the money markets and debt securities to be more attractive, hence causing significant portfolio adjustments from stocks to debt instruments by institutional and retail investors (holding everything constant), which will lower the prices of stocks due to sell offs. The opposite is true for decreases in interest rates.

Decreases in interest rates mean that the returns generated from holding debt and money market instruments will fall. As such, rational investors tend to readjust their portfolio allocations by holding more equity instruments than debt. This adjustment therefore increases the demand for stocks while increasing the supply of debt, which simultaneously increases the stock prices while lowering the prices of debt instruments. Investors in Egypt are mostly risk averse and as interest rates increase, they prefer to invest in risk-free securities rather than stock markets (Kamal, 2018).

Seen from another angle, a decrease in interest rates is good for companies because it reduces the cost of debt and the overall cost of capital. This enables companies to save on interest payments and take on more debt to finance operations and to grow. This growth presents a signal to the market, and investors expect the stock to appreciate in value. This result is in line with the observations of Alam and Uddin (2009) and Kamal (2018).

Mauritius

Table 13: Regression results on DLSEMDEX, Mauritius, for the period 2009–2019

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0048	0.0021	2.3082	0.0228
DINF_MU	0.4078	0.2198	1.8551	0.0662
DLMS_MU	0.0601	0.1724	0.3483	0.7282
DLMUR_USD	-0.3411	0.0957	-3.5633	0.0005
DLIR_MU	-0.0048	0.0390	-0.1218	0.9033
DLOIL	-0.0137	0.0241	-0.5674	0.5715
DLGOLD	-0.0860	0.0397	-2.1646	0.0325
R-squared	0.1496			
Adjusted R-squared	0.1044			
F-statistic	3.3127			
Prob(F-statistic)	0.0048			
Durbin-Watson stat	1.6686			
Observations	120			

Note: D before each variable represents the first difference LSEMDEX = Log stock market index; LMS_MU = Log money supply; LMUR_USD = Log Mauritius Rupee/Dollar; INF_MU = inflation rate; LIR_MU = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

All of the regression assumptions were met for Mauritius, hence there was no need to use alternative methods to remedy the OLS assumptions violations.

The Mauritius results (reported in Table 13) are valid as the F-test for model validity is significant at the 1% level. The overall coefficient of determination of the model shows that 15% of the variation in the stock prices can be explained in terms of the model. The intercept term has a coefficient of 0.0048 and is significant at the 5% level, implying that regardless of all the macroeconomic factors, stock prices maintain a positive drift of 0.0048. The results show that inflation and money supply have a positive association with stock returns, while the exchange rate, interest rate, gold and oil price negatively affect stock returns in Mauritius.

Inflation obtained a coefficient of 0.4078 and is significant at the 10% level. This shows that a 1% increase in inflation leads to a 0.41% increase in stock prices. This positive impact running from inflation to stock prices is common in emerging markets where retail and institutional investors tend to use stocks as safe haven assets during times of high inflation. When inflation rises as a result of increased demand exceeding existing supply, companies' profits and dividends grow, making stocks more appealing and investors more likely to invest in the stock market. This leads, in turn, to a rise in stock prices (Barakat, Elgazzar, and Hanafy, 2016). The positive influence of inflation affirms the findings of Assagaf et al. (2019) and Fisher (1930).

Exchange rates has a coefficient of -0.3411 and is significant at the 1% level. This implies that exchange rates have a negative impact on the stock prices in Mauritius. A 1% increase in exchange rates (depreciation of the Mauritius Rupee) reduces the stock prices by 0.34%. The significant result is justified by the fact that Mauritius is known to offer attractive investment incentives for foreign investors, such as no restrictions of repatriation of earnings, dividends, and capital gains. In addition the country allows settlements to be made in foreign currency and the possibility of opening offshore accounts. Since Mauritius is a country which mostly imports its products, the Rupee depreciation negatively affects stock returns in the local exchange. A consistent result was obtained by Seetanah et al. (2012) in Mauritius.

Gold has a coefficient of -0.0860 and is significant at the 5% level. This implies that gold price has a negative and significant impact on the Mauritian stock prices. A 1% increase in gold prices will lead to a 0.09% decrease in the Mauritian stock prices. This is typical of any emerging market economy. Gold is known to preserve its value overtime—and thus during economic headwinds, investors tend to look into value investing by heavily weighting their portfolios on gold. This tends to stimulate the demand for gold while increasing the supply of stocks due to sell offs. This, in turn, increases the price of gold at the expense of stocks. The other factors for Mauritius are not significant in explaining stock prices. The overall coefficient of determination of the model shows that 15% of the variation in the stock prices can be explained in terms of the model.

The Bank of Mauritius has purchased gold since the last decade. In 2009, the Bank of Mauritius bought metric tons of gold worth USD 71.7 million (IMF, 2009). The idea was to use gold as a hedge for exchange rate risk and increase its reserves. If gold price decreases, it implies that the central bank has less value in reserves and this is likely to affect the investors' confidence in the Mauritius economy, reducing the appetite for Mauritius assets and thus leading to a fall in stock prices.

South Africa

Table 14: Regression results on DLALSI_SA, South Africa, for the period 2009–2019, with AR term

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0065	0.0025	2.6110	0.0103
DINF_SA	-1.7696	0.7025	-2.5190	0.0132
DLMS_SA	0.4186	0.2283	1.8335	0.0694
DLZAR_USD	-0.0276	0.0713	-0.3866	0.6998
DLIR_SA	0.0540	0.1150	0.4692	0.6398
DLOIL	0.1668	0.0333	5.0154	0.0000
DLGOLD	0.0813	0.0630	1.2915	0.1992
AR(1)	-0.3069	0.0917	-3.3477	0.0011
R-squared	0.3010			
Adjusted R-squared	0.2573			
F-statistic	6.8899			
Prob(F-statistic)	0.0000			
Durbin-Watson stat	1.9917			
Observations	120			

Note: D before each variable represents the first difference LALSI_SA = Log stock market index; LMS_SA = Log money supply; LZAR_USD = Log Rand/Dollar; INF_SA = inflation rate; LIR_SA = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

Following the initial regression and subsequent diagnostic tests for the South African market, it was concluded that the error term exhibited autocorrelation, hence one of the assumptions was not met. In order to correct for that, an autoregressive AR(1) term was included.

The overall model for South Africa (reported in Table 14) is significant at the 1% level, as reflected by the p value of the F-test for model validity. The coefficient of determination R-squared shows that the model explains 30% of the variation of stock prices on the JSE. The model shows that the constant term has a coefficient of 0.0065 and is significant at 5%. This implies that regardless of all the factors, the stock prices on the JSE will maintain a positive value of 0.0065 cents on average.

There is also an interesting pick in the model—inflation has a coefficient of -1.7696 and is statistically significant at 5%. This implies that inflation has a negative and significant impact on the JSE stock prices. A 1% increase in inflation will lead to a 1.8% fall in stock prices at the JSE. The explanation for this is that an increase in the rate of inflation would increase the general cost of living. The implication is that as basic products become more expensive, people will have less money to save and therefore to invest in the stock exchange. This results in a lower demand for stocks, which triggers a decrease in stock prices. An increase in inflation also means that people buy less, thereby hindering the sales and earnings growth of businesses, and as a consequence firms lose value. The negative effect of inflation is consistent with the studies of Fama and Schwert (1977), Hsing (2011) and Olivier (2018). Lastly, the negative effect of inflation means that the stock market cannot be used as hedge against inflation in South Africa.

Oil price has a positive coefficient of 0.1668 and is significant at 1%. This means that oil price has a positive and significant impact on stock prices in South Africa. An increase in oil price by 1% will increase JSE stock prices by 0.17%. Surprisingly, oil price is statistically significant for the South African market. The result indicates that as oil prices increase, stock prices also increase on the JSE. South Africa is a net importer of oil, which implies that South Africa imports more oil than it produces. As a critical component of the energy sector, oil is crucial for any national economy and is especially important for driving the economic growth of developing countries. An increase in the international price of oil therefore affects the domestic economy of net importing countries, as goods become more expensive due to the inflation caused by rising input costs.

The regression also shows that money supply is significant at the 10% level and is positively associated with stock returns. The model thus suggests that a 1% increase in money supply will command a 0.42% increase in stock prices. As money supply is increased through various channels, reduced interest rates, reduced reserve requirements, and the effect of other open market operations, mean that there is an increased demand for goods and services. This is supported through endogenous money creation by commercial banks via credit creation. This stimulates demand for goods and services and the demand for investment instruments, thus feeding directly into asset price inflation. In his study on stock market returns, Hsing (2011) reached the same conclusion—that money supply has a positive and significant impact on stock returns.

An unexpended finding is the positive, although not significant, relationship between stock returns and interest rates. The theory and the vast majority of the related literature suggest an inverse relationship, as a lower interest rate decreases the cost of capital for firms and allows them to get funding and invest to grow their business and subsequently earnings. The outcome of this study is different to the results obtained by Olivier (2018) and Jefferis and Okeahalam (2000), who found that interest rates were significantly and negatively related to stock market returns in South Africa. However, the results are consistent with those of Phillipus (2019), who investigated the link between the two variables in the Namibian stock exchange, and those of Marozva (2020), whose findings were the same on the JSE. According to Firth (1979), holding stocks can be an efficient hedge against inflation, and the Fisher effect can therefore justify this positive relationship. Furthermore, Marshall (1992) argues that if money shock triggers inflation, the rate of interest will plummet, and investors will transfer their cash reserves to stocks and bonds to increase future capital gains. These factors could possibly explain the positive association between interest rates and stock prices.

The gold price is not significant in explaining stock returns, and this is surprising given that mining companies have a significant weight on the JSE. Although not significant, exchange rates are

inversely related to stock prices in South Africa. This supports the majority of the literature and implies that a depreciation of the rand is a negative factor for local stocks.

6.5 Granger causality tests

Granger causality tests aim to test whether a time series can forecast another time series. In this case, the idea is to test whether macroeconomic variables can be used to forecast stock returns in the countries under analysis. The test is calculated individually for each country and results are presented below.

Egypt

Table 15: Granger causality test, Egypt, for the period 2009-2019, with three lags

Null hypothesis	Obs	F-Statistic	Prob.
DINF_EGP does not Granger-cause DLEGX30	117	0.30732	0.8201
DLEGX30 does not Granger-cause DINF_EGP		1.54001	0.2082
DLMS_EGP does not Granger-cause DLEGX30	117	0.69928	0.5545
DLEGX30 does not Granger-cause DLMS_EGP		0.4628	0.7088
DLEGP_USD does not Granger-cause DLEGX30	117	1.26271	0.2908
DLEGX30 does not Granger-cause DLEGP_USD		0.76589	0.5155
DLIR_EGP does not Granger-cause DLEGX30	117	1.33687	0.2661
DLEGX30 does not Granger-cause DLIR_EGP		0.76343	0.5169
DLOIL does not Granger-cause DLEGX30	117	0.27323	0.8446
DLEGX30 does not Granger-cause DLOIL		3.29533	0.0232
DLGOLD does not Granger-cause DLEGX30	117	0.31626	0.8136
DLEGX30 does not Granger-cause DLGOLD		0.98313	0.4035

Note: D before each variable represents the first difference. LEGX30 = Log stock market index; LMS_EGP = Log money supply; LEGP_USD = Log Egyptian pound/Dollar; INF_EGP = inflation rate; LIR_EGP = Log interest rates LOIL= Log oil price; LGOLD = Log gold price

The Granger causality test (reported in Table 15) reveals that there is no causal relationship between macroeconomic variables and stock returns in Egypt, except for stock returns and oil prices, for which there is a unidirectional relationship between stock returns and oil prices, from stock returns. The null hypothesis can be rejected at the 5% level of significance, implying that stock prices in Egypt can be used to forecast oil prices as a leading indicator. Overall, this test suggests that most of the selected macroeconomic variables cannot be used to forecast stock returns in Egypt. The results obtained in this research, therefore, do not agree with the study of Barakat, Elgazzar, and Hanafy (2016), who showed a bidirectional causal relationship between exchange rate, money supply, and the EGX 30. This study also found a causal relationship between interest rate and the EGX 30, running from interest rate to the EGX 30. As for CPI, the results indicate that there is a causal relationship between CPI and the EGX 30, running from the EGX 30 to CPI. The results are likely different due to the longer period used in the Barakat, Elgazzar, and Hanafy (2016) study.

Mauritius

Table 16: Granger causality test, Mauritius, for the period 2009-2019, with three lags

Null hypothesis	Obs	F-Statistic	Prob.
DINF_MU does not Granger-cause DLSEMDEX	117	0.67501	0.5692
DLSEMDEX does not Granger-cause DINF_MU		2.10892	0.1032
DLMS_MU does not Granger-cause DLSEMDEX	117	3.08848	0.0302
DLSEMDEX does not Granger-cause DLMS_MU		0.30314	0.8231
DLMUR_USD does not Granger-cause DLSEMDEX	117	1.30537	0.2764
DLSEMDEX does not Granger-cause DLMUR_USD		5.88015	0.0009
DLIR_MU does not Granger-cause DLSEMDEX	117	0.5649	0.6393
DLSEMDEX does not Granger-cause DLIR_MU		0.60704	0.6118
DLOIL does not Granger-cause DLSEMDEX	117	1.43095	0.2377
DLSEMDEX does not Granger-cause DLOIL		1.86577	0.1396

DLGOLD does not Granger-cause DLSEMDEX	117	2.39451	0.0722
DLSEMDEX does not Granger-cause DLGOLD		0.24182	0.867

Note: D before each variable represents the first difference LSEMDEX = Log stock market index; LMS_MU = Log money supply; LMUR_USD = Log Mauritius Rupee/Dollar; INF_MU = inflation rate; LIR_MU = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

The Granger causality test in Mauritius (reported in Table 16) shows that, from stock returns, there is a unidirectional causal relationship between money supply and stock returns from money supply, suggesting that money supply can be used to predict stock returns. This is significant at the 5% level. The test also reveals a unidirectional causal relationship between the exchange rate and stock returns, from stock returns. The implication is that stock returns can lead exchange rates in Mauritius. This is significant at the 1% level. This finding, however, is different from the findings of Seetanah et al. (2012), who found that exchange rate leads stock prices. Finally, gold price appears to be a leading factor for stock returns in Mauritius, evidenced by the unidirectional causal relationship between gold prices and stock returns, from stock returns. This is significant at the 10% level.

South Africa

Table 17: Granger causality test, South Africa, for the period 2009–2019, with three lags

Null hypothesis	Obs	F-Statistic	Prob.
DINF_SA does not Granger-cause DLALSI_SA	117	0.31874	0.8118
DLALSI_SA does not Granger-cause DINF_SA		0.91008	0.4387
DLMS_SA does not Granger-cause DLALSI_SA	117	1.05568	0.3711
DLALSI_SA does not Granger-cause DLMS_SA		0.95075	0.4188
DLZAR_USD does not Granger-cause DLALSI_SA	117	1.05468	0.3715
DLALSI_SA does not Granger-cause DLZAR_USD		0.27087	0.8463
DLIR_SA does not Granger-cause DLALSI_SA	117	1.0837	0.3592
DLALSI_SA does not Granger-cause DLIR_SA		0.67729	0.5678
DLOIL does not Granger-cause DLALSI_SA	117	1.01004	0.3912

DLALSI_SA does not Granger-cause DLOIL		0.18233	0.9082
DLGOLD does not Granger-cause DLALSI_SA	117	0.42355	0.7365
DLALSI_SA does not Granger-cause DLGOLD		1.13787	0.3371

Note: D before each variable represents the first difference LALSI_SA = Log stock market index; LMS_SA = Log money supply; LZAR_USD = Log Rand/Dollar; INF_SA = inflation rate; LIR_SA = Log interest rates; LOIL= Log oil price; LGOLD = Log gold price

The South African data (reported in Table 17) suggests that there is not a causal relationship between macroeconomic factors and stock returns. None of the null hypotheses can be rejected, even at the 10% level of significance. The results indicate that the selected macroeconomic forces cannot be used as predicting variables for stock returns in South Africa in the short term. MacFarlane’s (2011) study supports these findings, as he found that macroeconomic variables have no significant causal linkage with stock market returns for South Africa. However, these results are not in line with those of van Rensburg (1999), who found that equity prices are forward looking and lead economic activity. Nonetheless, it is noted that van Rensburg’s (1999) study covered a different time period.

Chapter 7 – Conclusion, Limitations, and Further Research

This chapter aims to provide a conclusion for this study. It starts with the summary of the results, followed by an analysis of the study's limitations. It concludes by considering areas for further research.

7.1 Summary of results

The main objective of this study was to investigate the impact of macroeconomic variables on stock returns in emerging markets; specifically Egypt, Mauritius, and South Africa. The study aimed to provide answers to whether or not macroeconomic variables influence stock returns in these countries; whether the influence is similar across countries; and whether causal relationships exist between macroeconomic variables and stock returns. To answer these questions, the study employed the multiple linear regression model and the Granger causality test. The latter econometric technique was used primarily to test the lead-lag relationships between variables.

7.2 Regression results

The results from the multiple linear regression model showed that the impact of macroeconomic variables on stock prices in emerging markets are different from country to country. This heterogeneity can be explained by differences in economic fundamentals from country to country.

For Egypt we found that all the factors fed into the model could not significantly explain stock returns—except for interest rate, which had a negative impact on stock returns. The results for Egypt also varied significantly with the results for Mauritius. In Mauritius, inflation, exchange rates, and gold prices were found to be significant in explaining stock market returns. These differences in model output validates the point that economic fundamentals do not have a homogenous impact on stock returns across countries. Therefore, it is advised that asset

managers should be careful not to use one model to explain or predict stock market returns across countries.

For Mauritius, three factors were found to significantly impact stock prices: inflation, exchange rates, and gold price. As expected for a small country like Mauritius (at least in terms of GDP and market capitalisation), inflation appears to have a positive impact on stock prices as investors use stocks as a safe haven asset during times of economic headwinds. Like inflation, gold price has a positive impact on the bourse due to similar reasons. By contrast, exchange rates in Mauritius have a negative impact on stock prices, hence the need for the government to stabilise the exchange rate in that country.

For South Africa, three macroeconomic factors were found to be significant: oil price, money supply, and inflation. Oil prices and money supply were found to have a positive impact on stock returns, while the impact of inflation was found to be negative. An increase in inflation is not good news for the JSE, as it leads to investor panic and subsequent sell offs—ultimately leading to a fall in stock returns. By contrast, an increase in oil prices and money supply is good news for stock returns. These findings for South Africa stand in stark opposition to the findings obtained for Mauritius and Egypt.

For Mauritius, while inflation is significant in explaining stock returns, it has a positive impact. This is exactly the opposite effect that inflation appears to have on South African stock returns, where inflation is negatively correlated. Moreover, in Mauritius, gold prices and exchange rates are significant in explaining stock market returns, while in South Africa, they are not significant. This again proves the heterogeneity of stock markets across emerging markets. In comparing Egypt and South Africa, we found that interest rates only significantly impacted stock returns in the case of the former. In South Africa, interest rates did not prove significant in explaining stock returns—again solidifying the lack of homogeneity between countries.

7.3 Granger causality results

The Granger causality test revealed that there is a unidirectional relationship between stock returns and oil prices coming from the direction of stock returns in Egypt. The South African data suggests that there are not causal relationships between macroeconomic factors and stock returns. The Granger causality test in Mauritius showed that money supply can be used to predict stock returns. The test also revealed that stock returns Granger-causes gold prices and exchange rates in Mauritius.

7.4 Implications for investors and recommendations

Given the findings obtained above, the question remains: what are the implications for investors and policy makers? The findings point to the fact that investment managers should worry about monetary policy (interest rates announcements and broad money supply growth), exchange rates, oil prices, inflation, and gold prices in emerging markets. It is clear that investment managers cannot avoid the impact of these variables in their asset returns forecasts.

The heterogeneity of the findings (explained in the summary of results section) solidifies the need for asset managers to study each emerging market as a stand-alone entity, and shows that there is no such thing as 'one-model-fits-all' when it comes to emerging market economies. Thus, the study deepens the need for fundamental analysis when choosing investment destinations across the emerging markets, as the fundamentals are not homogeneous.

On the side of policy makers, this study has proven that there is much to be done going forward into the next decade. Interest rates policies, inflation policies, exchange rate policies, and broadly, monetary policies, should be carefully thought through as they can be used to kill two birds with one stone. That is, these factors can be used to tackle both economic development and stock market development. Hence, this study recommends that the governments and policy makers in emerging markets look to contain factors such as inflation, as they can be very bad for financial markets, especially for South Africa. We recommend the continuation of the mandate

of the South African Reserve Bank (SARB) to contain inflation and preserve the value of the rand over time. This study supports the independence of the SARB and recommends the independence of central banks across Africa, as this will enable them to stabilise exchange rates and inflation, which have proven to be influential on stock market returns.

Finally, this study advises the careful increase of money supply over time, especially for South Africa, as money supply has been shown to be significant in explaining stock prices. Interest rate policies were also found to be very significant in explaining stock market development in emerging markets. Therefore, this study recommends that the central banks use this tool in mapping their stock market growth agenda.

7.5 Limitations

This first limitation of this study is data availability. As the study made use of total return indices, the sample period was limited to 2009–2019 (as some of the indices data were unavailable prior to 2009). It is noted that a longer sample period could potentially provide more accurate results. However, this study did make use of monthly (as opposed to quarterly) data, which allowed for more observations. Another limitation was that it was not possible to get M2 (representing money supply) data for Mauritius and, as result, this study used M3, as opposed to M2 used for the remaining countries. GDP a key variable measuring economic growth is not included in this study, as it is only released quarterly and would not provide enough observations given the time period that this study covers. The fact that many of the relationships tested were not statistically significant is also a limitation of this study, not allowing further conclusions to be drawn for investors.

7.6 Further research

The main suggestions for further research are:

- Use of other macroeconomic variables not included in this study. The models indicated that the selected variables did not appropriately explain stock returns. Other variables could be long-term interest rates, unemployment rate, GDP, and foreign reserves.

- Use of panel regression. Given this study incorporates three different countries, it could be interesting to investigate how the results would be with the combination of cross-section and time-series data.

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Appendix

A. Data sources

Country/Variable	South Africa	Egypt	Mauritius
Index price	Bloomberg	Bloomberg	Bloomberg
Inflation	DataStream	DataStream	DataStream
Three-month T-bill rate	DataStream	DataStream	Bank of Mauritius
Exchange rate in terms of USD	Bloomberg	Bloomberg	Bloomberg
Oil Price in USD	Bloomberg	Bloomberg	Bloomberg
Gold price in USD	Bloomberg	Bloomberg	Bloomberg
Money Supply in local currency	South Africa Reserve Bank	Egyptian Central Bank	Bank of Mauritius

B. Regression analysis diagnostics

Appendix B includes the regression diagnostics tests for each country respectively. Tests for autocorrelation, heteroscedasticity and multicollinearity were conducted in EViews.

Egypt

Breusch-Godfrey test for autocorrelation

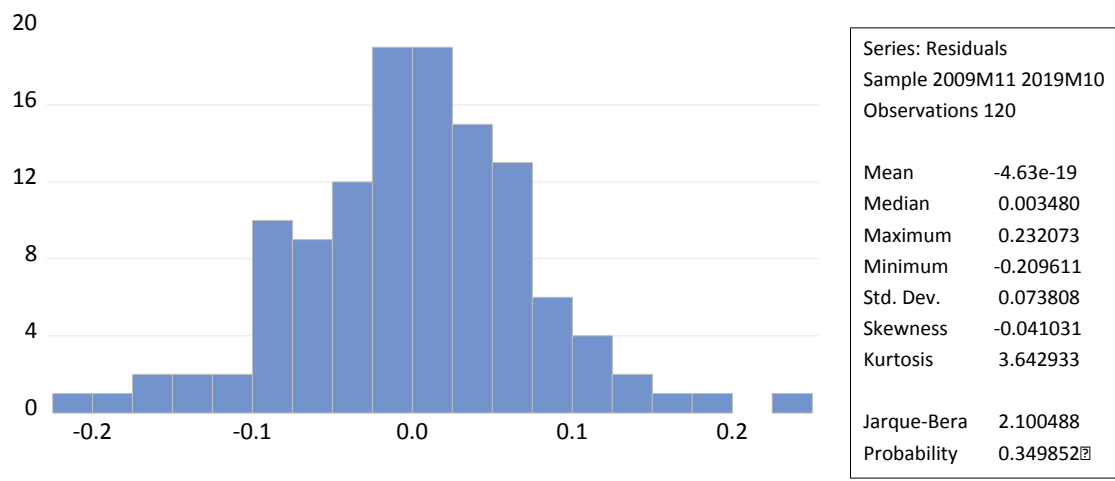
Breusch-Godfrey serial correlation LM test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	2.643228	Prob. F(2,111)	0.0756
Obs*R-squared	5.455276	Prob. Chi-Square(2)	0.0654

Breusch-Pagan-Godfrey test for heteroscedasticity

Heteroskedasticity test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	2.576479	Prob. F(6,113)	0.0224
Obs*R-squared	14.44093	Prob. Chi-Square(6)	0.0251
Scaled explained SS	16.92177	Prob. Chi-Square(6)	0.0096

VIF test for multicollinearity

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	0.000179	3.748442	NA
DINFI_EGP	0.200321	1.200682	1.197654
DLMS_EGP	1.054467	9.840567	6.05988
DLEGP_USD	0.064692	6.468956	6.359216
DLIR_EGP	0.026868	1.297949	1.288464
DLOIL	0.007889	1.068472	1.067908
DLGOLD	0.02408	1.136714	1.131934



Mauritius

Breusch-Godfrey test for autocorrelation

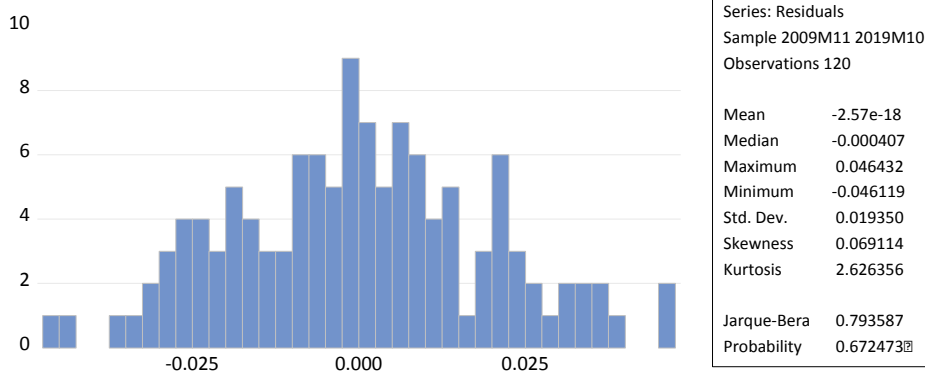
Breusch-Godfrey serial correlation LM test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.631143	Prob. F(2,111)	0.2004
Obs*R-squared	3.426103	Prob. Chi-Square(2)	0.1803

Breusch-Pagan-Godfrey test for heteroscedasticity

Heteroskedasticity test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.482679	Prob. F(6,113)	0.1904
Obs*R-squared	8.757694	Prob. Chi-Square(6)	0.1877
Scaled explained SS	6.314946	Prob. Chi-Square(6)	0.3888

VIF test for multicollinearity

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	4.32E-06	1.316119	NA
DINF_MU	0.048324	1.033388	1.033382
DLMS_MU	0.029734	1.417586	1.089934
DLMUR_USD	0.009165	1.219058	1.212185
DLIR_MU	0.001522	1.069603	1.061787
DLOIL	0.000579	1.141683	1.14108
DLGOLD	0.001578	1.084114	1.079556



South Africa

Breusch-Godfrey test for autocorrelation

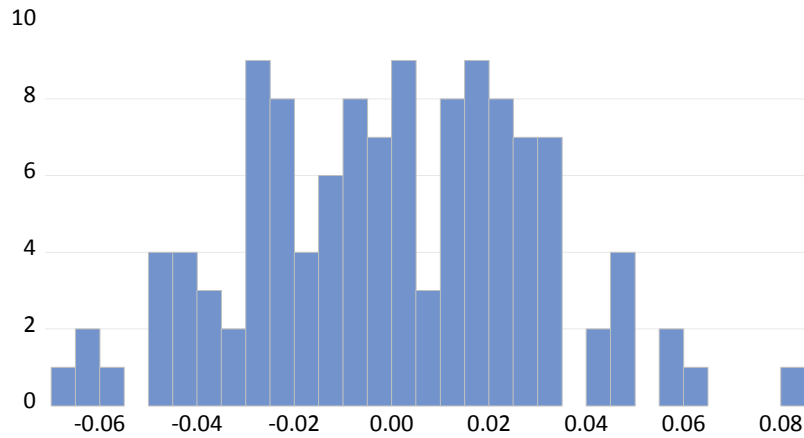
Breusch-Godfrey serial correlation LM test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	5.299311	Prob. F(2,111)	0.0063
Obs*R-squared	10.45929	Prob. Chi-Square(2)	0.0054

Breusch-Pagan-Godfrey test for heteroscedasticity

Heteroskedasticity test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	0.723841	Prob. F(6,113)	0.6313
Obs*R-squared	4.441382	Prob. Chi-Square(6)	0.6172
Scaled explained SS	3.328069	Prob. Chi-Square(6)	0.7667

VIF test for multicollinearity

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	9.94E-06	1.299446	NA
DINF_SA	0.590951	1.080697	1.079791
DLMS_SA	0.058041	1.350578	1.116747
DLZAR_USD	0.005058	1.220751	1.200834
DLIR_SA	0.016061	1.147102	1.147052
DLOIL	0.001362	1.152502	1.151893
DLGOLD	0.004153	1.225094	1.219943



Series: Residuals	
Sample 2009M11 2019M10	
Observations 120	
Mean	2.62e-18
Median	0.000412
Maximum	0.082781
Minimum	-0.066580
Std. Dev.	0.029527
Skewness	0.047720
Kurtosis	2.690090
Jarque-Bera	0.525765
Probability	0.768832