

Original Research Article

RELATIONSHIP BETWEEN STOCK PRICES, STOCK RETURNS AND MACROECONOMIC VARIABLES

ABSTRACT

This study has examined the relationship between certain macroeconomic variables, stock prices and stock returns in the UK and South Africa. Using the Johansen co-integration technique based on vector error correction model (VECM), the study finds one co-integrating vector for the UK data suggesting that macroeconomic variables have long run effect on stock prices, with the stock prices being positively related to industrial production but negatively related to both long term and inflation rates. No long run relationship was however found for the South African data. The inflation rate was found to respond the most to shocks for the UK. The UK inflation rate can serve as a signal for the condition and state of the economy.

Keywords: [Stock market returns, Cointegration analysis, Arbitrage Pricing Model, Vector Error Correction Model]

1. INTRODUCTION

The stock market is that part of financial market that attracts the most attention and usually under close surveillance. Stock markets have witnessed so much volatility over time. Having superior information about an asset can either increase returns or reduce risk. However, buying a stock involves venturing into the unknown concerning the future stream of cash flows that may accrue from such an investment. Many studies have been done on investigating the sort of relationship that exists between stock market return and sets of macroeconomic variables, for different countries and for varying time horizons. Studies have shown that certain relevant information is contained in fundamental macroeconomic variables over time. Changes in such variables are therefore of interest to participants in the financial market. Based on the efficient market hypothesis, stock prices are said to fully reflect all available information.

A number of factors may affect either directly or indirectly the growth potential or expected future expansion of a company. This provides and makes room for a basis for this study. Though, the study is on the aggregate level, modelling relationship between market indices and relevant macroeconomic variables, aggregate and firm level studies are analogous. The focus of this study will be on the relationship that exists between stock prices and return and important

24 components in the economy as a whole which are capable of impacting stock returns either in the short term or long
25 term.

26 Many models of stock valuation predict that the discounted value of expected cash flow affects stock prices. The linkage
27 between stock returns, interest rates and economic variables has been explained using different models among which are,
28 the consumption asset pricing model (Balvers et al., 1990); general equilibrium model (Canova and De Nicolo, 1995);
29 Arbitrage Pricing model (Ross, 1976); and the Present Value model (Humpe and Macmillan, 2007). The methodological
30 approach to all these related studies remains the co-integration analysis. However, the co- integration technique adopted
31 may have implications for the result. For instance, the Engle-Granger tests were found to lack power (Timmermann, 1995)
32 and besides it can only model a univariate relationship. The Johansen framework is able to incorporate the dynamic co-
33 movement and interactions of variables. Some studies that adopted this technique include Nasseh & Strauss (2000) and
34 Humpe & Macmillan (2006) among others. The scope of this study covers the markets in the United Kingdom and South
35 Africa over the period 2000 (3) to 2009 (12). The choice of United Kingdom as the country of interest is influenced by the
36 ready availability of the relevant data for a robust study including the international significance of the London stock
37 exchange. South Africa is an emerging economy and the market is significant in the African continent as it is rated best.

38 The research problem arises from the difficulty that is associated with stock pricing. The problem however seem to be that
39 errors often times occur in valuation. This suggests that asset pricing may not always be perfect (Malkiel, 2003). Stock
40 valuation problems have largely been adjudged a major cause of market inefficiencies or bubbles. The focus of this
41 research is however not market efficiency or otherwise but the information contained in the result of the robust long run
42 analysis may be found useful for stock valuation. As a result, where a change in a particular set of macroeconomic
43 variables could be said to signal a movement in the underlying systematic risk factor impacting returns, it may suggest
44 important information for proper stock pricing and this may help alleviate the mispricing problem. The argument is that
45 macroeconomic factors which impact expected future flow of cash stream for a firm should also affect the price of the
46 firm's stock. In effect, this can also be extended to the market as a whole as this study is an aggregate analysis of the
47 supposed relationship. The existence of a co-integration relation between stock market prices and macroeconomic
48 variables suggests that these variables are considerably and consistently priced in the resulting stock market returns.
49 Mispricing leads to inefficiency in markets. A co-integrated nexus among the stock market index and macroeconomic
50 variables offers substantial support signalling that the set of macro variables are important explanatory factors of
51 expected stock returns and that there exist a certain level of relationship amid them(Kwon & Shin, 1999).

52 To investigate the relationship between stock returns and the macroeconomic variables, the main question is – are
53 economic indicators significant explanatory factors of stock market returns? The main purpose of this study is to examine
54 both the short and long run relationship between macroeconomic variables and stock market prices for the UK and South
55 Africa.

56 The study is limited to the availability of data as the same study over a longer period may be better. The second part
57 presents an up to date review of recent and related literature to serve as a guide to having a sound understanding of the

phenomenon. The third section presents the methodological approach that the study will adopt for data processing including the necessary information about the data set. The fourth section gives the detailed analyses of empirical tests and results. The fifth and final part summarises and concludes the study.

2.0 LITERATURE REVIEW

By co-owning a company through shareholdings, investors pay in advance for the expected growth of such a firm. The expectation of the market in terms of the future relative growth rate, expressed in the earnings and dividends' are discounted into current share market price. This means if investors think that a stock's dividend are most likely to grow at a faster than average rate consistently for a long period of time, the current stock price may be bid up relative to its current dividend per share. This translates to buying a stock at a higher than average expected growth or level of performance. This can result in the realization of a below average rate of return. This is because the dividends that accrue will then be small relative to the share price paid.

The starting point and basis for studies on macroeconomic variables and stock returns can be attributed to some theories in financial economics. Notable theories are - the arbitrage pricing theory, generalized dividend value model and the present value model among others. The theoretical justification for this piece of work is necessary in order to build and establish a solid basis in economic theory for the study.

The generalised dividend valuation model is rested on the premise that share prices depend on the anticipated stream of dividend payments and the discounting rate as well. The dividend stream and discount rate may be influenced by some macroeconomic variable which in turn affects aggregate stock prices and eventually returns. Understanding the relationship between them and the information contained in macroeconomic variables is therefore justified based on theory. Dividends are the only source of cash payments and value to a common stock investor. As a result, the changes that occur in the stock price are attributable to changes in the market's expectations with respect to the amount of dividends receivable in the future. Hence, the current market price for the stock can be expressed as a function of the market's expectation of the dividend to be received at the end of the year and the market price that will be in effect at that time.

In theory, a linkage can be established between the arbitrage pricing model (Ross, 1976) and stock market returns. Although most empirical studies testing the arbitrage pricing model (APM) are with respect to individual security returns and characterised by modelling the short run relationship, it can still be extended to aggregate studies. The APM explains the situation where many factors may affect returns on an asset. The APM assumes that the co-variances that exist between security returns can be attributed to the fact that the securities respond, to one degree or another, to the pull of one or more factors. A linear relationship is assumed to exist between a stock's rate of return and the indices that are adjudged capable of affecting the rate of return. This theory is credited to Ross (1976).

90 In fact, return can also be determined on the basis of unexpected changes in some specific factors (Chen, Roll, & Ross,
91 1986). Distinction was made between the following factors, the growth rate of industrial production; rate of inflation; long
92 term and short term Treasury bond yield among others. There is evidence that these factors affect the prices that
93 investors are willing to pay for securities. When changes in a fundamental factor is found to be affecting stock returns,
94 then changes can be predicted in the returns based on a forecast of a factor change (Haugen, 1997). The factor loadings
95 represent sensitivities and also similar to beta (measure of market risk) in the Capital Asset Pricing Model.

96 Their conclusion shows the four macroeconomic variables stated earlier were found to be significant explanatory factors.
97 The basis for these underlying factors is well founded and appears to make sense intuitively. Prices of common stock
98 indicate the present value of the discounted cash flows. The index of industrial production has implications for profitability
99 while the rest of the variables are clearly related to the discount rate. The Arbitrage Pricing Model shall be tested in this
100 study.

101 In the empirical literature, Schwert (1990) distinguished 3 possible reasons for the strong linkage between stock returns
102 and economic activities. First, macroeconomic information may reflect in stock prices before it comes to be – hence
103 portraying stock prices as a leading indicator of an economy's health. Second, rates may affect stock prices and even real
104 investment though with a time lag. Third, stock prices changes are viewed as changes in wealth which is capable of
105 influencing the demand for consumption and investment goods in the real economy. The current price of a share stands
106 for the worth investors place on the existing stock of shares. Meanwhile, when prices rise or fall, the stock valuation
107 changes, even though the supply and quantity of shares remains unchanged unless there is a new issue.

108 Price stability is important because for an investment to be desirable and rewarding, investors expect that prices should
109 be relatively stable over time. A relatively stable price can best be explained by a moderate rate of inflation. A cross
110 section of studies that have been done regarding inflation mostly concluded an indirect association between inflation and
111 stock market returns (Bottazzil & Corradi, 1991). Other related work conducted studies covering both short and long
112 period and arrived at varying conclusions. Boudoukh and Richardson (1993) discovered a negative relationship between
113 stock returns and inflation rate in the short run but a somewhat positive association in the long run. But in contrast, a
114 negative relationship ensued between realized inflation and realized stock market returns both in the long and short run
115 in another related study (Erb et al, 1995). A different line of reasoning based on another study was that volatility of
116 inflation increases the volatility of stock returns causing a higher return which also translates to stock price fall (Najand &
117 Rahman, 1991).

118 Kwon and Chin (1999) studied the Korean stock market asking whether certain economic variable like (production level,
119 trade balance, exchange rate and money supply) can explain Korean stock market returns. Their analysis shows that stock
120 prices are co-integrated with economic variables; that is, there is a long run nexus between variables but they stated that
121 stock price index is not a leading indicator for economic variables. This is however not consistent with the finding that
122 stock market rationally signals changes in real activities (Fama, 1991).

123 Contrary to what obtains in the developed economies like the US and Japan, the Korean market was found to be more
124 sensitive to international trading activities rather than inflation or interest rate. The distinction between impacts of the

measures of domestic and international macroeconomic variables on stock returns was carried out (Nasseh & Strauss, 2008). Evidence from Nasseh & Strauss (2008) supports the long run relationship between stock prices and domestic and international economic activity and concludes that stock prices are determined by macroeconomic activity. Omran & Pointon (2001) investigated the impact of inflation rate on the Egyptian stock performance in terms of size and liquidity. A significant short and long run relationship was detected between these variables showing that inflation has impacted on stock market performance in Egypt. Summarily, the inter-relationship between interest rate and stock returns on one hand and industrial production on the other hand has been widely explored in literature. Industrial production growth/innovation can be linked to changing expectations of future cash flow (Balvers et al., 1990). Changes in interest rates or interest rate modifications can also be a determining factor in industrial production. This is because changes in investment and stock prices occur via the changes in discounted cash flow value. Nasseh & Strauss (2008) found that long term rates negatively influence stock prices – and this is consistent with the role of interest rate as a discount factor and that short term rates are positively related to stock prices.

3.0 RESEARCH METHODOLOGY

The aim of this study is to model a long run relationship between some selected fundamental macroeconomic variables and stock market returns. The Johansen (1991) approach which is based on a vector error correction model (VECM) is adopted. The method makes it possible to test for at least a long run relationship between variables. Co-integration within the vector error correction framework is more appropriate for multivariate analysis and less ambiguous. To set out the analysis, it is required that the order of integration of variables be determined by employing a sequence of test like the augmented Dickey Fuller and Phillips Peron tests. This section sets out how the methods and techniques will emerge.

The variables of interest are stock market index, index of industrial production, treasury bill rate and inflation rate. This study uses monthly data that spans from the period 2000:M3 to 2009:M12. UK data for industrial production and inflation rate is obtained from the UK Office of National Statistics website, while the 10-year nominal monthly yield on government securities (treasury bill rate) is from the statistical interactive database of the Bank of England. The stock market indices for the UK (FTSE 100) and South Africa (JSE All share) are all from the Thomson One Banker database. The South African data for index of industrial production is from Economagic. The inflation rate is both obtained from the Statistics South Africa online database and financial database of Liberta, South Africa. The real prime overdraft rate proxy for long term rate and sourced from the South African reserve bank database.

3.1 Specification of the Model

The focus is on the co-integration process arising from the linear combination of non-stationary variables. Some series share co-movements with other series and this may be due to the existence of a common underlying economic force. The phenomenon is referred to as co-integration. A VAR modelling allows for the consideration of several endogenous

158 variables together. Each variable is explained by its past value and lagged values of all other endogenous variables in the
159 system.

160 Economic theory often times suggests that some variables should be related by a long term equilibrium relationship. Even
161 though, the variable may sometimes wander away from equilibrium, eventually equilibrium is expected to be restored.
162 The application of the concept of equilibrium to variables containing unit roots results in co-integrated variables.

163 To use the Johansen method, we turn to the VAR of the form-

$$164 \quad Z_t = \beta_1 Z_{t-1} + \beta_2 Z_{t-2} + \dots + \beta_k Z_{t-k} + u_t \quad (1)$$

165 Where Z_t is a vector of variables. In a vector error correction model format, it can be stated as

$$166 \quad \Delta Z_t = \Pi Z_{t-k} + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots + \Gamma_{k-1} \Delta Z_{t-k} + u_t \quad (2)$$

167 Π can be broken down and then the equation re-written as

$$168 \quad \Delta Z_t = \alpha \beta' Z_{t-k} + \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \dots + \Gamma_{k-1} \Delta Z_{t-k} + u_t \quad (3)$$

169 Z_t is the m dimensional vector of variables (in this case, stock market index, industrial production index, long term rate
170 and inflation rate), k = no of lags, β if any = vector of constants, t refers to the number of observations while u_t is the
171 error vector which is multivariate, normal and independent across observations and $t = 1, 2, \dots, T$.

172 The equation above is analogous to the Augmented Dickey Fuller test of stationarity, but expressed in vector form as a
173 VAR. The presence of the lagged terms like allows for the capturing of dynamic co-movements. The rank of Π is
174 particularly of interest since it gives information on the number of co-integrating vectors. The matrix Γ_1 consists of the
175 short term adjustment parameters while the matrix Π comprises the long term equilibrium association between the Z
176 variables. Π is decomposable to the product of two m by r matrix such that $\Pi = \alpha \beta'$ where β matrix contains r co-
177 integrated vectors and α represents the speed of adjustment parameters. Two likelihood ratio tests have been developed
178 for testing the number of co-integrating vectors (r), that is contained with the trace test and maximum Eigen value test.
179 The trace test statistic tests the null of $r = 0$ (no co-integration) as against the general alternative that $r > 0$ (one or more
180 co- integrating vector exist). While the maximum Eigen value tests the null that the number of co- integrating vectors is r
181 as against the specific alternative of (r+1) co-integrating vectors. *A priori*, there are 3 possible outcomes. The first is that
182 rank (Π) = p and so vector Z_t is stationary; secondly, rank (Π) = 0 meaning the absence of long run relationship among the
183 variables of Z_t . Lastly, the rank (Π) < p and therefore r determines the number of co-integrated relationships.

184 4.0 DATA ANALYSIS AND DISCUSSION OF RESULTS

185 To start out, the unit root tests for the UK and SA dataset are carried out. Prior to this, the log of each country's index is
 186 regressed on the other three variables just to pre-examine the relationship. The outputs suggest study can progress. The
 187 result of the unit root test performed on all variables both at levels and on first differences for the UK and South Africa
 188 shows all series are found to be integrated of first order i.e. I (1) using the Augmented Dickey fuller and Phillips Peron
 189 tests.

190 4.1 Johansen Multivariate Co-integration Test Results

191 Here, we establish the existence or otherwise of co-integration between logged stock market index and macroeconomic
 192 variables. For the UK case, the trace statistics suggests one co-integrating vectors while the maximum Eigen value
 193 statistics also propose one co-integrating vector at 5% and 1% significance levels also. The trace and Eigen value statistic
 194 agree on one co-integrating vector.

195 *Analysis of Co-integrating Equations and Short Run Adjustment Parameters from the VECM*

196 To interpret the co-integrating equations, more importance is given to the sign and significance rather than the magnitude
 197 of the coefficients. For the UK market, the CPI was seen to have significant influence and negatively related to the stock
 198 price index. The long term rate is also significant and negatively related to stock price index while the index of industrial
 199 production is significant and positively associated with the stock price index.

200 The co-integrating equation normalized on the log of stock market prices for the UK shows that, long term and inflation
 201 rate has a negative relationship with stock price index and also statistically significant. Also, the index of industrial
 202 production has a significant positive relationship with stock price index. The diagnostic tests are satisfactory as the
 203 Lagrange multiplier test shows that we cannot reject the null that there is no autocorrelation at the chosen lag length.

204 Table 4A: Co-integrating equations for the UK

Lspm	Ltb	Lip	Lcpi	Trend	constant
1	-11.618	45.7006	-5.984	0.0786	-210.2791
	(-3.09)	(4.21)	(-6.06)	(5.12)	

Table 4B below gives the result for the adjustment parameters (α), about 0.3% of disequilibrium is corrected by changes in stock prices/index. About 0.5% of disequilibrium is corrected by changes in long term rates. About 9% of disequilibrium is corrected by changes in inflation rates. About 0.1% of disequilibrium is corrected by changes in the industrial production index. Only index of industrial production and inflation rate are statistically significant at 5%. The results suggest that when there is a shock or change in the system, the inflation rate responds the most, followed by the stock market, then index of industrial production and long term rates. This suggests that the inflation rate may be the most affected in the event of a sudden shock. We recall that inflation targeting is a central objective of the UK monetary policy goal. For instance, during the very recent economic downturn, the Bank of England used the monetary policy tools of interest rate and money supply (via quantitative easing) in a bid to influence the inflation rate back to the desired range.

Table 4B: Adjustment parameters for the UK

	Coefficient	Z-values	P-values
D_lspm	0.00377	0.92	0.357
D_ltb	0.005275	1.58	0.115
D_lspi	0.09312	5.96	0.000
D_lip	0.00182	2.18	0.029

For the South African case however, co-integration test performed in levels show that the co-integrating rank is zero and hence no long run relation is implied between macroeconomic variables and the South African stock index. But the test run on first differences show that a full rank exists since all series used are stationary. However, in this case a long run relationship is not implied even though a strong co-integration is inferred. With the trend term in the model, a positive but insignificant relationship is between index of industrial production and stock price index. While both inflation and prime rates are significantly negatively related to the stock price index. The diagnostic tests are satisfactory, as the Lagrange multiplier test shows that we cannot reject the null of no autocorrelation at the chosen lag order.

Table 5A: Co-integrating equations for South Africa

Lspm	Ltb	Lip	Lspi	Constant	Trend
1	-1.8711	2.5656	-0.7688	-15.4703	-0.0195
	(-3.74)	(1.31)	(-4.40)		

For South Africa, the short run adjustment parameters shows that with the inclusion of trend in the model, about 3.6% of imbalance is rectified by changes in the stock price index. Meanwhile just 0.2% of imbalance is amended by changes in the index of industrial production. Around 2.1% of the imbalance is adjusted by changes in the prime rate. While about 33% of the imbalance is corrected by changes the inflation rate.

Table 5B: Short-run Adjustment parameters for South Africa

	Coefficient	Z-values	P-values
D_lspm	-0.0363	-2.14	0.032
D_ltb	0.0214	0.62	0.533
D_lspi	0.3376	3.45	0.001
D_lip	0.00207	0.92	0.360

5.0 SUMMARY AND CONCLUSION

The Johansen test indicates that there is at least one co-integrating vector for the UK based on the maximum Eigen value test result. The Johansen test indicates that there exist a long run relationship between FTSE 100 and the macroeconomic variables tested. This is not similar to the findings of Chen et al. (1986). They concluded in their studies that macroeconomic variables seem not to impact share returns in the UK market. The difference in findings may largely be due to the dissimilar study period and technique of analysis spent.

The error correction process for the UK shows that the inflation rate and industrial production index contribute to the error correction process. The UK stock market also shows a significant negative relationship with both inflation rate and long term rate, while a statistically positive relationship is with the index of industrial production.

The short run adjustment parameters show that inflation rate appear to be the variable that responds the most to shocks in the system as it is highly significant. The results based on the UK data are largely in order with the existing theory and literature. However, for the South African case, no long run relationship exists between the stock market index and macroeconomic variables. The absence of a long run relationship suggests that past values of series are not useful or consistent predictors of stock prices. It could be that the market is relatively efficient. From the findings, the UK inflation rate can serve as a signal for the condition and state of the economy and stock market returns is important in explaining changes to industrial production in South Africa. The conclusions reached on this study are only suggestive and limited to the available data. Further investigation is necessary in this regard in the light of a richer dataset.

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