INFLATION AND STOCK PRICES INTERACTIONS IN SOUTH AFRICA: VAR ANALYSIS

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Abstract

The study is based on the time series analysis of stock prices in South Africa. It uses the data covering the period 1980Q1 to 2010Q4 to test the effect of inflation on stock prices. The analysis is done using Auto-Regressive Distributed Lag Model (ARDL). First, we investigate time series properties of data. The unit root test results reveal stock prices, interest rate, economic growth and real effective exchange rate are integrated of order zero ~I(0), while the growth of money supply and inflation are ~I(1). Causality test suggests a unidirectional causation from inflation to stock prices. The establishment of the longrun relationship leads us to performing VECM to establish short-run and long-run dynamics. Our results indicate that inflation exerts a significant and negative impact on stock prices in South Africa.

Keywords*: Stock prices, inflation, causality, cointegration, VECM, VAR*

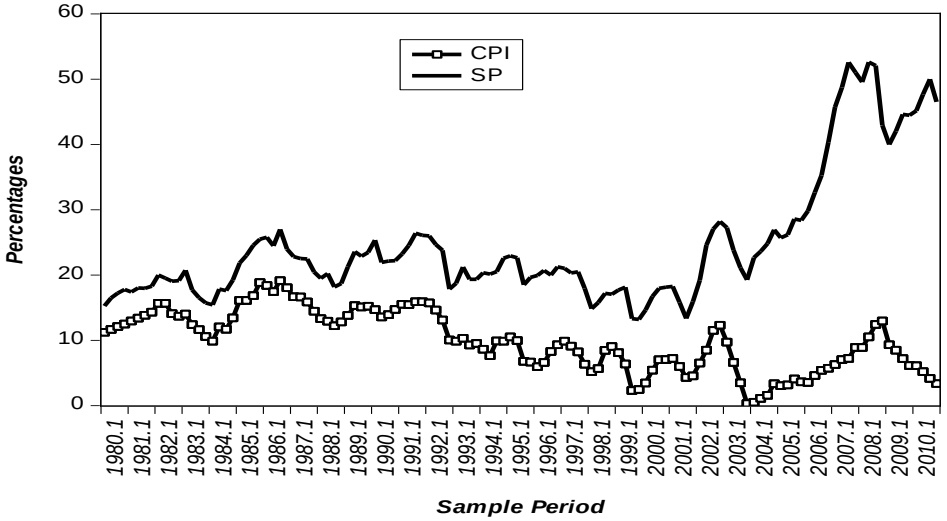
JEL Classification*:* C10, C50, E31, G15

1.1 INTRODUCTION

Over the past few decades, the interaction of the stock price and other macroeconomics variables has been a subject of interest among financial economists and practitioners. It is often argued that stock market performance is determined by some fundamental macroeconomic variables such as the interest rate, Gross Domestic Product (GDP), exchange rate, inflation and money supply. Anecdotal evidence from the financial press indicates that investors generally believe that monetary policy and macroeconomic events have a large influence on the volatility of the stock market. This implies that macroeconomic variables could exert shocks on share returns and influence inventors' investment decision.

In both the domestic and international markets, investors face the problem of diversification, security analysis, security selection and asset allocation. On a broader scope, international investments pose extra problems such as exchange rate risk, restrictions on capital flows across national boundaries, an additional dimension of political risk, inflation risk and country specific regulations and differing accounting practices in different countries. Inflation risk exposure reflects a stock's sensitivity to unexpected changes in the inflation rate. Unexpected increases in the inflation rate put a downward pressure on stock prices, leading to stocks to have a negative exposure to inflation risk. Figure 1-2 below shows the trend of stock prices and inflation in South Africa over thirty years.

Figure 1-2(a): Stock Prices and Inflation in South Africa



In the 1960s and 1970s, Inflation[1] was relatively low until the early 1970s, averaging 2.5% during the 1960s. It subsequently accelerated and entered the double-digit range in 1973. During the 1970s, the average inflation rate was 10.3%. After a period of relative stability around a level of 11% in the late 1970s, inflation rose again in the early 1980s.

Table 1: Inflation in South Africa and its major trading partners

Country	**Average annual rate (%)**		
	1980–1990	**1991–2000**	**2001–2010**
RSA	14.57	8.99	6.13
UK	7.62	3.05	2.60
USA	5.54	4.69	4.03
Germany	2.50	2.40	5.08
China	11.84	10.18	9.54

Source: World Bank data bank

The 1980s were characterised by high, but relatively stable rates of inflation ranging from 11.5 to 18.6%. The average inflation rate for the decade was 14.7%. Inflation subsided significantly in the early part of the 1990s. After peaking in

[1] Note that data for the decades 1960s and 1970s is not included in the analysis but used for historical analysis only.

1986, the rate of inflation began decreasing and in 1993 it dropped to beneath 10%. It subsequently decreased further to 5.2% in 1999. On average, consumer prices rose by 9.3% during the 1990s. Stock prices also depicted an opposite trend in those years. The pattern suggests that there is a negative relationship between inflation and the growth of stock prices.

2.1 EMPIRICAL LITERATURE

Several studies have been conducted to examine the effects of macroeconomic variables on stock market of industrialized economies but many yielding mixed results. Geyser and Lowies (2001) attempts study the impact of inflation on stock prices in two SADC countries which are South Africa and Namibia. The study used simple regression analysis. The result was not one of the two selected countries offers a perfect hedge against inflation. The South African experience shows that the companies listed in the mining sector are negatively correlated against inflation, while it is found to the opposite in the case of Namibia. Gregoriou and Kontarikas (2006) on panel analysis finds also mixed results.

Al-Rjoub (2003) reveals that both the GARCH and OLS provide evidence of the negative relationship between stock returns and inflation. Campbell and Vuolteenaho (2004) on the other hand followed the previous studies by Campbell (1991) and Campbell and Ammer (1993) in an attempt to combine the valuation framework with a VAR that predicts stock returns finds that high inflation is positively correlated with expected long-run real dividend growth. This suggests that the negative effect of inflation on stock prices could not be explained through the VAR analysis. Another study by Saryal (2007) investigates the impact of inflation on conditional stock market volatility in Turkey and Canada. Using the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model for Turkey and Canada. She finds that inflation has the high prognostic power for explaining stock market volatility in both countries. The results show that high rates of inflation are followed by high nominal stock returns consistent and hence inflation was considered one of the underlying determinants of conditional stock market volatility.

Boucher (2006) considered a new perspective on the relationship between stock prices and inflation, by estimating the common long-term trend in the earning–

price ratio and inflation. The study focuses on the subjective inflation risk premium explanation by considering a present value model with a conditional time-varying risk premium and estimates the common long-term trend in the earning–price ratio and actual inflation. He investigates the role of the transitory deviations from this common trend for forecasting stock returns (S&P 500). The study finds that these deviations exhibit substantial out-of-sample forecasting abilities for excess stock returns at short and intermediate horizons. The results indicate that the earning–price inflation ratio has displayed statistically significant out-of-sample predictive power for excess returns over the post-war period at short and intermediate horizons.

Geetha *et al* (2011) in an attempt to establish cointegration among macroeconomic variables including inflation and stock returns finds that there is indeed a long run relationship in Malaysia, US and China. Their study reveals that market returns may be adversely affected by inflation because of the inflationary pressures that may threaten future corporate profits and nominal discount rates rise under inflationary pressures, reducing current value of future profits and thus to stock market. Al-Khazali (2003) also determines a long-term equilibrium between stock prices, CPI and the real economic activity by using cointegration tests and evidence proves that there is negative relationship between stock returns and CPI.

One strand of studies that investigated the link between exchange rate and stock prices include Kim (2003), Ozair (2006), Hatemi-J and Irandoust (2002), Tsoukalas (2003), Adjasi and Biekpe (2005), Mishra (2004) among others, some of which found conflicting results. Based on these and other studies, we investigate the relationship between stock prices and inflation in the case of South Africa.

3. RESEARCH METHODOLOGY

In order to analyze the short-run dynamics and long-run relationships among macroeconomic variables[2], we use of the Autoregressive Distributed Lag (ARDL) model and the Error Correction Mechanism specifications in this study. The application of the ARDL is adopted from Hendry and Richard (1983) because this method helps us to consider the behaviour of the variable over time and that the

[2]Stock prices, interest rate, Gross Domestic Product (GDP), exchange rate, inflation, and money supply

effect of the exogenous variables on stock market is spread over a period of time. The VAR method is also utilised in order to establish the impulses.

3.1 Model specification

The connection between stock prices and inflation is somehow a difficult one to establish for certain reasons. Firstly, empirical studies trying to capture the link between stock prices and inflation are bound to produce results that are quite sensitive to the choice of the model being used when one considers the number of possible versions that can be constructed. In view of the discussions above and the adaptation to be followed, the linear regression equation to be estimated takes the following general:

$$SP_t = (CPI_t, Ex_t, GDP_t, Ms_t, IR_t, SP_{t-i}) \qquad \textbf{(3.0)}$$

Where SP is the dependant variable (JSE price index), Ex is the exchange rate, GDP is the gross domestic product, Ms is the broad money and IR is the interest rate. This can be written in a multivariate as below:

Stock prices: $$X_t = \sum_{i=0}^{n} \beta_i X_{t-i} + \sum_{i=0}^{n} \psi_i Y_{t-i} + \sum_{i=0}^{n} \eta_i M_{t-i} + \Pi^x \theta_t^x \qquad \textbf{(3.1)}$$

Inflation: $$Y_t = \sum_{i=0}^{n} \Upsilon_i X_{t-i} + \sum_{i=0}^{n} \Theta_i Y_{t-i} + \sum_{i=0}^{n} \phi_i M_{t-i} + \Pi^y \theta_t^y \qquad \textbf{(3.2)}$$

Exchange rate: $$M_t = \sum_{i=0}^{n} \Re_i X_{t-i} + \sum_{i=0}^{n} \square_i Y_{t-i} + \sum_{i=0}^{n} \varpi_i M_{t-i} + \Pi^m \theta_t^m \qquad \textbf{(3.3)}$$

Where β_i, ψ_i, Π^x, Υ_i, Θ_i, η_i, ϕ_i, $\Re_i$, $\square_i$, ϖ_i and Π^y are square coefficient matrices. The equations above group variables into policy (Y and M), and non-policy (X) blocks. The vector X_t contains monetary policy variables that are considered as monetary policy indicators, such money supply.

4. EMPIRICAL ANALYSIS

4.1 Unit Root Tests Results

The results pertaining to the most parameterized model are presented in Table 4.1. The results indicate that SP, GDP, IR and EXCR are stationary. On the other hand, series CPI and MS are non-stationary since the null hypothesis of unit root cannot be rejected for each of the series at any conversional level of significance. For the non-stationary series, the trend appears to be insignificant.

Table 4-1.: Unit Root Test Results using model with intercept only

Name	*ADF Lag*	*t-stat ADF*	*PP Lag*	*t-stat PP*	*Inference*
SP	1	12.264***	1	12.264***	Stationary
CPI	4	1.113	4	1.07	Non- Stationary
MS	1	0.217	5	0.553	Non- Stationary
GDP	1	11.289***	6	11.292***	Stationary
IR	2	3.510***	5	2.571*	Stationary
EXR	2	10.787***	4	5.397***	Stationary

Notes: ***(i)*** *Asterisks *and ** indicates significant at 5% and 1% level of significance respectively*

The results reveal that MS and CPI are integrated of order one. Having variables integrated of different orders does not imply that we cannot run a regression. (Pesaran *et al* (2001).

4.2 Granger Causality Analysis

The results of causality test are reported in table 4-2 below. We conclude that there is unidirectional causality with causality running from CPI to SP

Table 4-2:Granger Causality Test Results

Null Hypothesis:	*Obs*	*F-Stats*	*Prob.*
CPI does not Granger Cause SP	*123*	*4.32636*	*0.0397*
SP does not Granger Cause CPI		*0.39691*	*0.5299*

4.3 Model Estimation

The estimation results are reported in table 4-3 below. Economic theory leads to believe that the long-run relationships could be found between SP, CPI, GDP, MS, IR and EXCR.

Table 4-3: Model Estimation

SP =	*85* –	*0.319CPI* –	*0.099GDP* –	*34.604MS* –	*0.306IR* +	*0.034EXCR*	
t-stats	(24.596)	(-2.658)	(-0.538)	(-16.400)	(-2.206)	(0.403)	
p-val	[0.000]	[0.008]	[0.591]	[0.000]	[0.029]	[0.687]	R^2=0.803

Variables CPI, GDP, MS and IR have a negative effect on SP, while the exchange rate has a positive effect. This contradicts the theoretical underpinnings of, among others; Ito and Yuko (2005), Kawai and Khalid (2003). This implies that in South Africa, when the rand[3] appreciates, the value of the stock increases, which is not the case. The model suggests that SP will fall by about 31 percent if CPI was to increase by one percent.

4.5 Cointegration Analysis

The trace test rejects null hypothesis of zero cointegrating vector at 5 percent level of significance and that of at least two cointegrating vectors at 5 percent level of significance, in favour of at most three cointegrating vectors. Therefore, the computed trace statistics that are greater than the critical trace values at 5 percent level of significance explains the rejection of the null hypothesis of either zero, one or at most two cointegrating vectors.

Table 4-5 (a): Cointegration analysis, and testing for Cointegration Rank (r) Results

Null	*Alter.*	*E-Val.*	*LL*	*Trace*	*P-Val.*
H_0: r = 0	H_1: r ≥ 1	0.348	884.37	133.330	(0.000)*
r ≤ 1	r ≥2	0.236	868.29	82.396	(0.003)*
r ≤ 2	r ≥3	0.189	855.80	50.230	(0.029)*
r ≤ 3	r ≥ 4	0.109	848.93	25.259	(0.152)

Source: Author

Notes: (i) *Asterisks *and ** indicates significant at 5% and 1% level of significance respectively.*

However, in an attempt to pin down the exact number of cointegrating vectors, the maximum eigenvalue test was conducted and the results are reported in Table 4-5(b). The results of the maximum eigenvalue test reject the hypothesis of one cointegrating vector at 1 percent level of significance and pins down that there are two cointegrating vectors. The rejection of the null hypothesis is explicated by the computed maximum eigenvalue statistic at 5 percent level of significance for null hypothesis of one cointegrating. See the table below.

Table 4-5(b): Cointegration Analysis – Results from E-value test

[3] The South African currency

Null	*Alter.*	*E-val.*	*LL*	λ_{max}	*95%CV*
H_0: r = 0	H_1: r = 1	0.348197	884.37	50.933	40.077*
r = 1	r = 2	0.236856	868.29	32.166	33.876
r = 2	r = 3	0.189287	855.80	24.971	27.584

4.6 Vector Error Correction model (VECM)

Since the variables guaranteed existence of cointegration, there was a need to perform the error correction mechanism. The results of the short-run dynamics are presented in Table 4-6 below.

Table 4-6: The VECM Results

Error Correc.	Δ(SP)	Δ(CPI)	Δ(GD	Δ(MS)	Δ(IR)	Δ(EXCR)
CointEq1	-0.012	-0.020	-0.04	-0.001	0.022	-0.082
	(0.012)	(0.007)	(0.01)	(0.02)	(0.008)	(0.035)
	[-0.97]	[-2.82]	[-2.65]	[-2.87]	[2.68]	[-2.31]

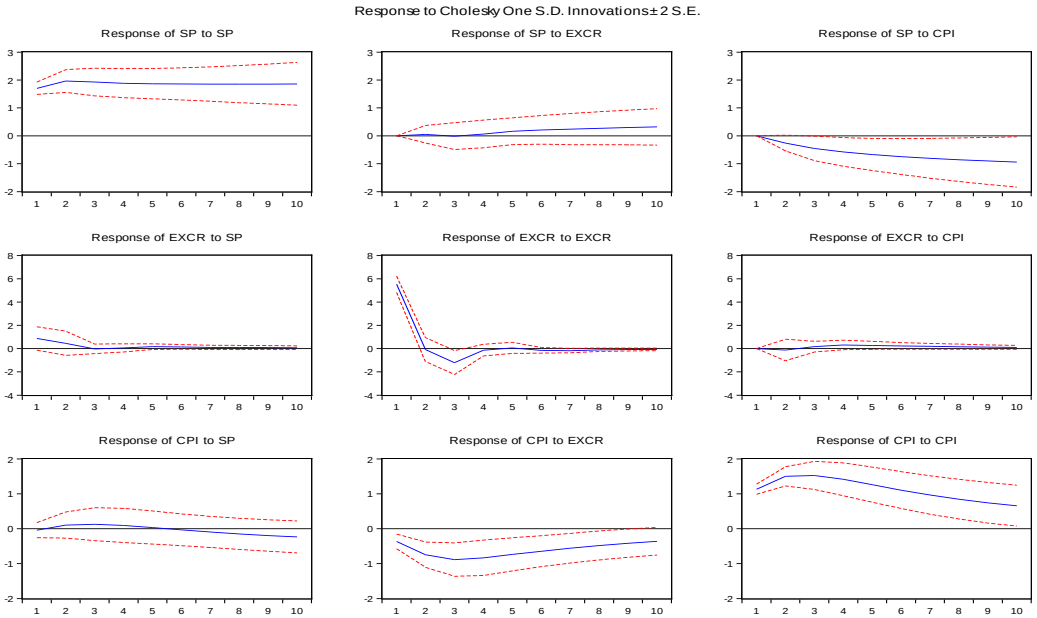
***Note**: Numbers in parenthesis () are the standard deviations and those in brackets [] are the t-values*

The VECM results reveal that about 1 percent of the disequilibrium is corrected each quarter by changes in stock prices in South Africa. This is justified by the coefficient -0.012. The error correction suggests the validity of the equilibrium relationship, indicating the existence of market forces that operate to restore long – run equilibrium after a short – run short. Most variables coefficients bear negative signs as was expected, except the interest rate (0.022).

4.7 Impulse responses

The results of the VAR are presented below in the form of the impulses in figure 4.7 below. The dashed lines in each graph show the 95% confidence bands. The impulse response functions are plotted over a 10 – year horizon. It is expected that during an inflationary shock, stock prices, GDP and exchange rate would fall. The fall in SP is shown by solid line falling in period one up to period ten. The graph that shows response of SP to CPI suggests that the unexpected increase in general price levels tends to provide a negative jolt to stock prices about two years later. SP reacts positively to a shock in exchange rate, meaning that when the value of the local currency falls unexpectedly, there will be slide decline in stock prices.

Figure 4-7: Impulse response functions



4.8 CONCLUSION

The regression results in this study revealed a strong relation between the stock prices and inflation and other explanatory variables. The key finding is that stock prices and inflation are negatively related. The evidence provides that stock prices appear to react mainly negatively to inflation rates and interest rate.

The growth of money supply was found to be negatively related to stock prices, which contradicts theoretical bearing. Only the lagged money supply appeared to have a negative impact on equity price movements implying that investors could earn profits by using a trading strategy based on the past behaviour of the money stock. One most influential macroeconomic variable is the exchange rate, which displays mainly a negative relation to stock prices. The implication of this finding is that, for an export dominant economy, the currency appreciation has a negative effect on the stock market of which the currency appreciation enhances the stock market for an import dominant country. The results obtained seem to indicate that, contrary to a commonly held belief among economists, investment analysts as well as researchers, the stock prices react negatively related to inflation. These findings imply that stock prices decline during the inflationary phase.

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