

The Stock Market and Macroeconomic Variables in a BRICS Country and Policy Implications

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ABSTRACT: This paper examines the effects of selected macroeconomic variables on the stock market index in South Africa. The exponential GARCH (Nelson, 1991) model is applied. It finds that South Africa's stock market index is positively influenced by the growth rate of real GDP, the ratio of the money supply to GDP and the U.S. stock market index and negatively affected by the ratio of the government deficit to GDP, the domestic real interest rate, the nominal effective exchange rate, the domestic inflation rate, and the U.S. government bond yield. Therefore, to maintain a robust stock market, the authorities are expected to pursue economic growth, fiscal prudence, a higher ratio of the money supply to GDP, a lower real interest rate, depreciation of the rand, and/or a lower inflation rate.

Keywords: Stock market, monetary policy, fiscal policy, interest rates, exchange rates, inflation

JEL Classification: E44, G15

1. Introduction

The global financial crisis had caused South Africa to suffer a substantial decline in the value of financial assets including stocks. The Johannesburg Stock Exchange (JSE) index decreased 43.5% during May 2008 - November 2008, which was better than the 56.8% decline of S&P 500 during its recent worst-performing period. By early May 2011, the JSE index has bounced back and almost reached the pre-crisis high. The substantial decline in stock prices is expected to have negative impacts on household consumption spending through the wealth effect, business investment spending through Tobin's q theory and the balance-sheet effect, international capital flows, the demand for money, and other economic variables.

The purpose of this paper is to examine the impacts of selected macroeconomic variables on the stock market for South Africa with the following focuses. First, the paper presents theoretical analysis to find the possible relationship between the stock market index and the government budget deficit, the money supply or the exchange rate. Second, this study incorporates the world stock market index and the world interest rate as the South African stock market is expected to be affected by the world stock market and as international investors compare the attractiveness of financial assets in different countries in order to increase the rate of return on their financial assets. Third, the exponential GARCH (Nelson, 1991) model is applied in empirical work in order to estimate the variance equation properly.

2. Literature Survey

There are several recent studies examining the impacts of selected macroeconomic variables on the stock market index for South Africa and related countries. Jefferis and Okeahalam (2000) study the relationship between stock prices and selected economic variables for South Africa, Zimbabwe and Botswana. For South Africa, they show that the stock market is positively affected by real GDP and the real exchange rate and negatively influenced by the long-term interest rate.

Alam and Uddin (2009) examine the relationship between stock prices and interest rates for 15 countries. For South Africa, they indicate that stock prices are significantly affected by interest rates

and that a change in stock prices is significantly influenced by a change in interest rates. In addition, they also show lack of evidence of the random walk model or weak-form efficiency for all the countries.

Chinzara and Aziakpono (2009) find that stock returns and volatility in South Africa are linked to major world stock markets with Australia, China and the U.S. having the most impacts and that volatility exhibits asymmetry and stability over time, and that there is lack of evidence of the risk-premium hypothesis.

Alagidede and Panagiotidis (2010) investigate the relationship between the stock price and inflation for selected African stock markets. For South Africa, they reveal that the elasticity of the stock price with respect to the consumer price is 2.264 and that the stock price shows a transitory negative response to the consumer price in the short run and a positive response in the long run. Hence, stocks are a hedge against inflation in the long run. Arjoon, Botes, Chesang and Gupta (2010) analyze the relationship between stock prices and inflation for South Africa. They find that real stock prices are not affected by a permanent change in the inflation rate in the long run and that any deviation in real stock prices in the short run will be adjusted toward real stock prices in the long run.

Gupta and Modise (2011) estimate the predictive power of selected macroeconomic variables for South Africa. They report that for in-sample forecasts, interest rates, the money supply and world oil production growth have some predictive power in the short run, that for out-of-sample forecasts, interest rates and the money supply exhibit short-run predictability, and that the inflation rate shows a strong out-of-sample predictive power.

Chinzara (2011) studies macroeconomic uncertainty and stock market volatility for South Africa. He indicates that stock market volatility is significantly affected by macroeconomic uncertainty, that financial crises raise stock market volatility, and that volatilities in exchange rates and short-term interest rates are the most influential variables in affecting stock market volatility whereas volatilities in oil prices, gold prices and inflation play minor roles in affecting stock market volatility.

3. The Model

Extending previous studies, we can express the South African stock market index as:

$$S = F(Y, D, M, R, \mathcal{E}, \pi, S^*, R^*) \tag{1}$$

where

- S = the stock market index in South Africa,
- Y = real output,
- D = the government deficit,
- M = the money supply,
- R = domestic real interest rate,
- \mathcal{E} = the nominal effective exchange rate (An increase means an appreciation of the South African rand.),
- π = the inflation rate,
- S^* = the world stock market index, and
- R^* = the world interest rate.

We expect that in the long run, the South African stock market index has a positive relationship with real output and the world stock market index, a negative relationship with the domestic real interest rate, and an uncertain relationship with the government deficit, the money supply, the nominal effective exchange rate, the inflation rate or the world interest rate.

More government deficit or debt would increase aggregate expenditures (AE) in the short run, the price level (P), the nominal interest rate (r), the demand for financial assets including stocks (E) due to the theoretic portfolio approach, and future tax liabilities (T) (Brunner, 1961; Cagan, 1972; Barro, 1974; Feldstein, 1982; Hoelscher, 1986; Darrat, 1990a, 1990b):

$$\partial S / \partial D = S_{AE} AE_D + S_P P_D + S_r r_D + S_E E_D + S_T T_D > \text{ or } < 0 \tag{2}$$

where

$$AE_D > 0, P_D > 0, r_D > 0, E_D > 0, T_D > 0.$$

Because the sign of the first and fourth terms is positive whereas the sign of the remaining terms is negative, the net impact of more government deficit is unclear.

More money supply would change the nominal interest rate (r) and increase output, the demand for stocks (E) due to the portfolio adjustment, the price level and the expected inflation rate (Bulmash and Trivoli, 1991; Abdullah and Hayworth, 1993; Dhakal, Kandil and Sharma, 1993; Mukherjee and Naka, 1995; Cheung and Lai, 1999; Wongbangpo and Sharma, 2002; Chaudhuri and Smiles, 2004; Ratanapakorn and Sharma, 2007; Humpe and Macmillan, 2009):

$$\partial S / \partial M = S_r r_M + S_Y Y_M + S_E E_M + S_P P_M + S_{\pi^e} \pi_M^e > \text{or} < 0$$

(3)

where

$$r_M > \text{or} < 0, Y_M > 0, E_M > 0, P_M > 0, \pi_M^e > 0.$$

The sign in the first term may be negative or positive depending upon whether the liquidity effect would dominate other effects. The sign of the second and third terms is positive whereas the sign of the remaining terms is negative. Therefore, the net effect is ambiguous.

An appreciation of the South African rand would reduce exports (X), import costs (C) and domestic prices and increase international capital inflows (CI) to South Africa (Abdullah and Hayworth, 1993; Mukherjee and Naka, 1995; Choi, 1995; Ajayi and Mougoue, 1996; Abdalla and Murinde, 1997; Nieh and Lee, 2001; Wongbangpo and Sharma, 2002; Kim, 2003):

$$\partial S / \partial \mathcal{E} = S_X X_{\mathcal{E}} + S_C C_{\mathcal{E}} + S_P P_{\mathcal{E}} + S_{CI} CI_{\mathcal{E}} > \text{or} < 0 \quad (4)$$

where

$$X_{\mathcal{E}} < 0, C_{\mathcal{E}} < 0, P_{\mathcal{E}} < 0, CI_{\mathcal{E}} > 0.$$

Since the sign of the first term is negative whereas the sign of the remaining terms is positive, the net impact is uncertain.

A higher inflation rate may increase stock prices as stocks are a hedge against inflation or reduce stock prices due to the negative impact of a higher inflation rate on economic and business activities (Fisher, 1930; Fama, 1981). A higher world interest rate would cause the South African rand to depreciate and increase its exports but reduce international capital inflows to South Africa and the demand for financial assets including stocks.

4. Empirical Results

All the data were collected from the *International Financial Statistics* (IFS). S is represented by the share price index for South Africa with 2005 as the base year. Y is represented by real GDP measured in billion rands at the 2005 price. The percent change in real GDP is employed to reduce multicollinearity. D is measured by the government deficit as a percent of GDP. M is represented by the M3 money supply as a percent of GDP. R is measured by the difference between the lending rate and the inflation rate. \mathcal{E} is represented by the nominal effective exchange rate. An increase means an appreciation of the rand versus a basket of major foreign currencies. π is measured by the inflation rate derived from the consumer price index. S^* is represented by the U.S. share price index with 2005 as the base year. R^* is represented by the 10-year U.S. government bond yield. Both the logarithmic form and the linear form will be considered in empirical work. Because the growth rate of real GDP, the ratio of the government deficit to GDP, the domestic real interest rate and the inflation rate have potential negative values, the logarithmic scale is not used. The sample ranges from 1980.Q2 to 2010.Q3. The quarterly data for the growth rate of real GDP before 1980.Q2 are not available.

The ADF unit root test shows that except for the ratio of the government deficit to GDP, the ratio of M3 to GDP and the U.S. stock market index, all other variables in level do not have unit roots and that all the variables in first difference are stationary at the 1% or 5% level. In order to determine

whether the regression may be spurious, the ADF test on the regression residuals is performed. Based on the AIC, a lag length of 0 is selected. The critical value at the 1% significance level is -2.584, and the test statistic is -2.983. Hence, these time series variables are cointegrated and have a long-term stable relationship.

The exponential GARCH or EGARCH (Nelson, 1991) model is applied in empirical work. The EGARCH (1,1) process is selected based on the significance of the coefficients in the variance equation. Table 1 presents estimated parameters and related statistics. Figures in the parenthesis are z-statistics. In Version (a), the logarithmic form is considered. The value of adjusted R² is 0.936, suggesting that 93.6% of the variation in the South African stock market index can be explained by the eight right-hand side variables. All the coefficients are significant at the 1% level. The South African stock market index is positively influenced by real GDP growth, the ratio of the M3 money supply to GDP and the U.S. stock market index and negatively associated with the government deficit/GDP ratio, the domestic real interest rate, the nominal effective exchange rate, the inflation rate, and the U.S. government bond yield.

Table I. Estimated Regressions of the South African Stock Market Index: 1980.Q2-2010.Q3

	(a)	(b)	(c)
Growth of real GDP	0.013* (3.168)	0.438* (4.772)	0.022* (3.431)
Government deficit/GDP ratio	-0.010* (-2.159)	-0.191* (-2.803)	-0.017* (-2.559)
Log(M3/GDP ratio)	0.597* (15.889)		1.927* (35.567)
M3/GDP ratio		1.328* (72.162)	
Domestic real interest rate	-0.017* (-11.475)	-0.644* (-19.499)	-0.041* (-25.572)
Log(Nominal effective exchange rate)	-0.074* (-2.712)		-0.156* (-5.978)
Nominal effective exchange rate		-0.016* (-12.266)	
Inflation rate	-0.023* (-2.797)	-1.706* (-10.186)	-0.138* (-20.182)
Log(U.S. stock market index)	0.771* (34.881)		
U.S. stock market index		0.471* (61.897)	
Log(U.K. stock market index)			0.925* (35.817)
Log(U.S. government bond yield)	-0.183* (-5.302)		
U.S. government bond yield		-0.317* (-3.922)	
Log(U.K. government bond yield)			0.201* (6.682)
Constant	-0.923* (-3.413)	-46.013* (-60.408)	-6.924* (-81.713)
Adjusted R ²	0.936	0.724	0.948
F-statistic	161.628	29.840	200.149
AIC	-1.045	6.630	-0.810
SC	-0.769	6.906	-0.534
Estimation method	EGARCH	EGARCH	EGARCH

Notes:

The dependent variable is log(S).

* means that the coefficient is significant at the 1% level.

The South African stock market index appears to be more sensitive to a percent change in the M3/GDP ratio or the U.S. stock market index than other variables. A 1% increase in the M3/GDP ratio

will increase the South African stock market index by 0.597%. If the U.S. stock market index rises 1%, the South African stock market index will rise by 0.771%.

The significant negative coefficient of the government deficit/GDP ratio suggests that negative impacts on higher prices, interest rates and future tax burdens outweigh positive impacts on increased aggregate expenditures and the demand for stocks. The significant negative coefficient of the nominal effective exchange rate indicates that the negative impact on reduced exports dominates the positive impacts on reduced import costs and domestic prices and increased international capital inflows.

In Version (b), the linear form is considered. The sign and significance of the coefficients remain unchanged. The value of adjusted R^2 of 0.724 suggests that the log form in Version I has a higher explanatory power than the linear form. In Version (c), if the U.K. share price index replaces the U.S. share price index and if the U.K. government bond yield replaces the U.S. government bond yield, the positive coefficient of the U.K. share price index is significant at the 1% level, and the positive coefficient of the U.K. government bond yield is significant at the 1% level. The value of adjusted R^2 is 0.948. Other results are similar.

5. Summary and Conclusions

This study has examined the relationship between the South African stock market index and selected macroeconomic variables. The EGAECH model is employed in estimating the variance equation. More real GDP growth, a lower ratio of the government deficit to GDP, a higher ratio of M3 to GDP, a lower domestic real interest rate, depreciation of the rand, a lower inflation rate, a higher U.S. stock price, or a lower U.S. government bond yield would help the South African stock market.

In comparison, the findings in this study are consistent with Jefferis and Okeahalam (2000) in the relationship with real GDP, the interest rate and the exchange rate; Alam and Uddin (2009) in the relationship with the interest rate; Chinzara and Aziakpono (2009) in the relationship with the world stock markets; Alagidede and Panagiotidis (2010) in the negative relationship with the inflation rate in the short run; Gupta and Modise (2011) in the relationship with the interest rate, the money supply, and the inflation rate; and Chinzara (2011) in the relationship with exchange rates and short-term interest rates. However, the results in this paper are different from Alagidede and Panagiotidis (2010) in the positive relationship with the inflation rate in the long run and Arjoon, Botes, Chesang and Gupta (2010) in the relationship with the inflation rate. Different outcomes between this paper and some of the previous studies may be attributable to model specifications, variable definitions and measurements, methodologies used in empirical works, sample periods, etc.

To help the stock market, the authorities are expected to pursue strong economic growth, fiscal discipline, a higher ratio of the M3 money supply to GDP, a lower real interest rate, depreciation of the rand and/or a lower inflation rate. The authorities need to monitor the developments in the world financial market such as movements in major world stock markets and interest rates since they also affect the South African stock market performance.

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