Interrelations among stock prices of South Africa and the United States and the rand/dollar exchange rate

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Abstract

This paper seeks to examine the dynamic short-term causal relations and the long-term equilibrium relations between the two major financial assets, stock prices of the US and South Africa and the rand/US$ exchange rate. The study uses a mixed bag of time series approaches such as cointegration, Granger causality, impulse response functions and forecasting error variance decompositions. The study identifies a long-run relationship among the rand/US$ exchange rate and the stock prices of South Africa and the United States. It was also observes that there is a causal relationship from the stocks in the United States to the rand/US$ exchange rate. In the short run however, the interactions among the variables are quite modest. The result of the study has implications for investors, policy makers and researchers.

Keywords: Exchange rate, cointegration, stock price, impulse response, variance decomposition and Granger causality

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1. Introduction

Even though the size of the South African equity market is quite small as compared with that of the US there appear to be some interactions among participants of the two markets. For example a number of South African firms are also listed on US stock exchanges such as the New York Stock Exchange (NYSE). Unlike South Africa the US has several stock exchanges with the biggest being the NYSE[1] followed by the NASDAQ[2]. Domestic market capitalisation of the NYSE and NASDAQ were 15.4 trillion and 3.9 trillion US dollars respectively at the end of 2006 (WFE, 2007). The Johannesburg Stock Exchange (JSE) on the other hand is ranked 18th in the world with a market capitalisation[3] of US$711bn. However the JSE is characterised by a considerable level of volatility just like most emerging market exchanges. Despite the relatively high market volatilities in emerging markets investors from the less volatile markets of the developed world continue to diversify their investments by including equities from emerging markets such as South Africa in their portfolios.

On the issue of trade, the relationship between South Africa and the US is an important one given the dominant role of the US in world trade and the global economic and financial system. On the other hand South Africa's economy is very much open to international trade and investment especially since the dawn of democracy in 1994. In recent time the US has become one of South Africa's major trading partners, the total value of South African trade with the US has more than doubled from US$5.2 billion in 1999 to US$10.8 in 2004 (IMF, 2006). One of the many implications of the openness of the South African economy to trade and to the US in particular is that changes in the rand/US$ exchange rate may impact local firms that export most of their output or those that import inputs in different ways. For example in a situation where the exchange rate depreciates competitiveness of local firms is increased as their output becomes cheaper on the international market and vice versa if the exchange rate appreciates. If firms lose their competitive edge profits will fall due to drop in sales thus leading to a subsequent drop in stock prices.

Until the Asian financial crisis in 1997 the question of a possible relationship between stock prices and exchange rate in developing countries did not engage the attention of researchers. Most of the studies in the literature that covers the period prior to the crisis focused on developed economies (Frank and Young, 1972; Sonlik, 1987; Aggarwal, 1981; Bahmani-Oskooee and Sohrabian, 1992). Since, 1997 a large number of papers have focused on the Asian economies regarding the issue of stock prices and exchange rate nonetheless Sub Saharan Africa including South Africa, a leading emerging market economy, has once again been overlooked (Abdallah and Murinde, 1997; Granger et al, 1998; Amare and Moshin, 2000; Yau and Nieh, 2006). The question that comes to the fore following the discussions above is as follows; is there an empirical relationship among the SA stock, US stock and the rand/US $ exchange rate? The purpose of this paper therefore is to examine the dynamic short-term causal relations and the long-term equilibrium relations among stock prices of the US and SA and the rand/US$ exchange rate using time-series analyses. The outcome of the paper regarding the short and long term co-movements among the three financial assets may offer local businesses and international investment portfolio managers additional empirical support for allocation of their assets across the two markets.

The rest of the paper is structured as follows; section 2 presents an overview of the empirical literature on stock market and exchange relationships. In section 3 the theoretical basis is briefly

[1] The NYSE is also the biggest exchange in the world while the NASDAQ is in 3rd position in terms of market capitalisation.

[2] NASDAQ stands for National Association of Securities Dealers Automated Quotations system; founded in 1971 it is the world's first electronic screen-based stock market, the NASDAQ exchange is uniquely dominated by technology stocks (FACTSHEET, 2007).

[3] This is defined as the total number of issued shares of domestic companies, including their several classes, multiplied by their respective prices at a given time. This figure reflects the comprehensive value of the market at that time (WFE, 2007)

discussed, the estimation procedure is also presented. The results of the estimations are given in section 4 while the conclusions of the work are the subject of the section 5.

2. Literature Review

There are two main theories underlying empirical studies concerning the relationship between stock price and exchange rate. These are the goods market approach (Dornbusch and Fisher, 1980) and the portfolio balance approach proposed by Frankel (1993). The two theories establish the theoretical basis for the relationship between stock price and the exchange rate. This part of the paper however, dwells on a review of empirical studies that investigates the relationship between stock prices and exchange rate.

One of the earlier studies that investigated the relationship between stock prices and exchange rates was the work of Frank and Young (1972). The paper assessed the relationship between six exchange rates and stock prices and found none. Later on Aggarwal (1981) with the aid of monthly stock prices and effective exchange rate data covering the period 1974 and 1978 examined the relationship between the two financial assets. The estimations, which were based on simple regressions, concluded that there was a positive relationship between stock prices and the US dollar in both the short run and the long run, but relationship was stronger in the short run than in the long run. Sonlik (1987) studied the effect of a number of variable including exchange rate, interest rate and changes in inflation expectations and stock prices. The paper dwelt on data from nine developed economies namely, the US, Japan, Germany, France, UK, Switzerland, Belgium, Canada and the Netherlands. Among the findings of the study was that a fall in the exchange rate impacted positively on the US stock market as against changes in inflation expectations. Soren and Hanniger (1988) observed a strong negative relationship between the value of the US dollar and Changes in the stock price for the period 1980-1986.

In another study Bahmani-Oskooee and Sohrabian (1992) estimated the relationship between stock prices and the exchange rate using cointegration analysis and Granger causality test. The paper used the Standard and Poor's 500 Index and the effective exchange rate for 1973-1988; the frequency of the data was monthly. The authors concluded that there existed a bi-directional relationship between stock prices and the real exchange rate in the Short run, however the paper found no long run relationship among the variables. Smith (1992) using a portfolio balance approach concluded that the equities had significant impact on the exchange rate but money supply and bonds had little impact on the exchange rate. The inference that can be drawn from the work is that equities play an important role in determining the level of the exchange rate and hence should feature in exchange rate portfolio balance models.

Bartov and Bodhar (1994) found little evidence to support the hypothesis that changes in the value of the US dollar explains abnormal stock returns. The work indicated that changes in past values of the dollar were negatively associated with abnormal stock returns. In the study by Ajayi and Mougoue (1996) domestic stock prices was found to impact domestic value of the currency negatively in the short run but in the long run stock price increases tended to impact the exchange rate positively. Abdalla and Murinde (1997) with the aid of monthly data covering the period 1985 and 1994 examined the relation between stock prices and exchange rates in four Asian countries including India, Pakistan, Korea and the Philippines. The study, which used the cointegration approach, found no long run relations between the two financial assets for Pakistan and Korea but found a long run relationship for Korea and India. On the question of causality regarding the two variables it was concluded that the there was a uni-directional causality from exchange rate to stock prices in Pakistan and Korea. Because of the existence of long-run relations for India and Philippines the study used an error correction model to examine the causality for the two countries. The causal relations for India was from exchange rate to stock prices but the reverse was true for the Philippines, in each case the relation was uni-directional.

Granger et al (1998), in a multi country study of the ten Asian economies excluding China and India with data spanning the period 1986 and 1997 found that exchange rate led stock prices in Japan and Thailand with a positive correlation. In Taiwan, stock prices led exchange rates with negative correlation but no correlation was found for Singapore. For the other countries, Hong Kong, Malaysia, Indonesia and Philippines bi-directional causality was observed. Amare and Moshin (2000) also investigated the relationships between stock prices and exchange rates for nine countries in Asia including, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand, Taiwan. Unlike Granger et al (1998) who used daily data, Amare and Moshin (2000) used monthly series. The authors found a long-run relationship for Singapore and Philippines. The reasons assigned for the seemingly absence of long-run relationship for the other countries was blamed on a possible omission of important variables in the estimated model.

3. Methodology

The theoretical basis of studies that seek to assess the relationship between stock prices and the exchange can be grouped into two. First, the goods market approach proposed by Dornbusch and Fisher (1980) argues that changes in exchange rates affects the competitive edge of a firm, which then impact on the firms profits and hence its stock price. On the aggregate level in an economy therefore, the net impact of exchange rate changes on stock market will largely depend on the degree of openness of a given domestic economy and her balance of trade position. The second approach put forward by Frankel (1983) emphasises the role of capital account transactions, this has been described as the portfolio approach. The theory indicates that rising stock market attracts capital flows, which in turn stimulates the demand for domestic currency and thereby leading to an appreciation of the domestic currency. Thus the two theories suggest a relation between exchange rates and stock prices. The direction and magnitude of causality can be either way. Since South Africa is an export-dominant economy and has considerable trade relations with the US, we test the hypotheses that a depreciation of the rand/US dollar exchange rate positively affect domestic stock prices. South Africa presents an example of a small open economy with a well-developed financial market even among the group of emerging economies; we thus test the a priori assumption that stock prices of SA and the US are related.

Though the structural approach to time series modelling efforts endeavours to use economic theory to estimate economic relationships among variables of concern, however in most instances economic theory do not appear to have the richness that provide dynamic specifications that incorporates all possible relationships. The estimations are compromised as the endogenous variables, which sometimes do feature on both sides of the estimated equations. This phenomenon informs the choice of vector autoregression models (Harris and Solis, 2003) as a tool in estimating the relationships in this paper.

The empirical analysis begins with an examination of the statistical properties of the variables selected for the analyses with the aid of unit root tests. The Johansen co-integration technique is then applied to ascertain the presence or otherwise of long-run relationship among SA stock price, US stock price and the rand/$ exchange rate. Impulse response functions and variance decompositions are then used to overcome the difficulty in explaining the coefficients of the VAR.

3.1 Unit root tests

The unit root tests are meant to help avoid the problem of spurious regressions, this has become standard in econometric practise. However, testing for unit roots in time series data may not be straight forward as certain assumptions usually associated with the traditional tests may not hold (Harris and Solis, 2003). In the present study three issues are considered, we work on the assumption that the underlying data-generating processes (d.g.p.) may include among other things a trend, which may be deterministic or stochastic. Second, it is noted that the d.g.p. may be more complicated than a simple autoregressive process (AR) and could possibly involve moving average terms. Third, the power of the test may be compromised when dealing with finite sample sizes hence the possibility of accepting the null hypothesis of non-stationarity when the actual dgp is in fact stationary. To ensure that the above concerns are addressed in testing for non-stationarity we use three different unit root test approaches.

The unit root tests used in the study are as follows; the augmented Dickey Fuller test, ADF (Dickey and Fuller, 1981), Philips and Peron test, PP (Philips and Peron, 1988) and the Peron and Ng test, NG (Peron and Ng, 2001). For each of the test models three possibilities are considered i.e., a model with pure random walk with lag terms (1); a model that has a drift (2); and a model (3) with drift and a time trend. Presented below in equations (1) to (3) are the differenced autoregressive models (AR) for the three variants;

$$\Delta y_t = \varphi y_{t-1} + \sum_{i=1}^{p-1} \gamma \Delta y_{t-i} + \varepsilon_t \tag{1}$$

$$\Delta y_t = \lambda + \varphi y_{t-1} + \sum_{i=1}^{p-1} \gamma \Delta y_{t-i} + \varepsilon_t \tag{2}$$

$$\Delta y_t = \lambda + \varphi y_{t-1} + \kappa t \sum_{i=1}^{p-1} \gamma \Delta y_{t-i} + \varepsilon_t \tag{3}$$

The null hypothesis considered in the ADF test is; $H_0 : \varphi = 0$, with the alternative, $H_A : -2 \prec \varphi \prec 0$. As to which of the three models should be employed in conducting the unit root test, we adopt the rule of thumb developed by Dolado et al (1990). This approach suggests the application of the test models in the order in which they appear from equations (1) to (3), the first model is selected only if the two outcomes in the models represented by equations (2) and (3) are insignificant.

The Philip and Peron (PP) test deals with the possibility that the underlying d.p.g. may be more complicated than a simple AR process by introducing a non-parametric adjustment of the t-test statistic undertaken to account for autocorrelation when the dgp is not AR (1). The PP test for unit root adopts the basic Dickey-Fuller type equations for unit root test. On the other hand, Peron and Ng (1996), improve the size (performance) of the Phillips-type test when there are negative moving average (MA) terms through the addition of appropriate adjustment factors to the original PP test statistics, Z-tests.

3.2 Granger causality test (GC)

The standard Johansen cointegration test begins with the estimation of a vector autoregression model (VAR) after which the Trace and Maximum-Eigen statistics based on the maximum likelihood ratio test is used to decide on whether the null hypothesis of no cointegration is accepted or rejected. The VAR involves the natural logarithms of the three variables, SA and US stock prices as well as the rand/US exchange rates in levels. The GC test (Granger, 1969) helps in investigating the presence of feedback (bi-directional) or one-way causality between variables. Assuming we have two series for variables, Y_t and Z_t the GC test can be represented in the form;

$$\Delta x_t = \alpha_1 + \sum_{i=1}^{n1} \alpha_{11}(i) \Delta x_{t-i} + \sum_{j=1}^{m1} \alpha_{11}(j) \Delta y_{t-j} + \varepsilon_{xt} \tag{4}$$

$$\Delta y_t = \alpha_2 + \sum_{i=1}^{n2} \alpha_{21}(i) \Delta x_{t-i} + \sum_{j=1}^{m2} \alpha_{22}(j) \Delta y_{t-j} + \varepsilon_{yt} \tag{5}$$

where ε_{xt} and ε_{yt} are stationary random processes intended to capture other pertinent information not accounted for in the lagged values of the variables, x_t and y_t. The optimal lag length are decided with the aid of Akaike information criteria, AIC in the present study. The series y_t fails to Granger cause x_t if $\alpha_{12}(j) = 0$ *(1,2,3,* m_1*);* and the series x_t fails to Granger cause y_t if $\alpha_{21}(i) = 0$ *(1,2,3,* n_1 *).*

3.3 Generalised impulse response functions and variance decompositions

The generalised impulse response function (G-IRF) and variance decomposition (G-VDC) have been found very useful in overcoming the challenges of interpreting the coefficients of estimated VAR models (Kama and Tufte, 1997; Yau and Nieh, 2006). The assumption here is that a shock to the *i^th^* variable do not only affect the *i^th^* variable but is also transmitted through the dynamic lag structure of the VAR. thus an impulse response traces the effect of a one-time shock to one of the innovations of current and future values of the endogenous variables. The G-IRF is formally written as follows;

$$x_t = \phi + \sum_{i=0}^{\infty} \beta_{jk}(i)\varepsilon_{t-i}$$

where ϕ is a 3x1 vector of constants, ε_{t-i} is an error vector, $\beta_{jk}(i)$ is a 3x3 matrix such that $\beta_{jk}(0) = I_3$ and the elements of $\beta_{jk}(i)$ are the "multipliers", which evaluates the interaction among the rand/US$ exchange rates, US Stock and SA Stock over the entire path[4].

Whereas an IRF trace the effect of a shock on one endogenous variable on the other variables in the VAR, variance decompositions seeks to separate the variation in an endogenous variable into the separate shocks to the VAR. Consequently, the VDC provides information about the relative importance of each random innovation that affects the variables in the VAR. The associated variance-covariance matrix representing k-step ahead forecast error and its decomposition can be given as;

$$E(X_t - \hat{E}_{t-k}X_t)(X_t - \hat{E}_{t-k} - X_t$$
$$= D_0E(\upsilon_t\upsilon_t')D_0' + D_1E(\upsilon_t\upsilon')D_1' + ... + D_{k-1}E(\upsilon_t\upsilon_t')D_{k-1}'$$

where $\hat{E}_{t-k}x_T = D[x_t[x_{t-k}, x_{t-k-a}, x_{t-k-2}, ...]$, X_t is VMA representation of

$X_t = \alpha' + \sum_{i=0}^{\infty} C_{i,}\varepsilon_{t-i}$, $D_i = C_iV$, $\upsilon_{t-1} = V'\varepsilon_{t-i}$, C_i is a 3x3 matrix with $C_0 = I_3$ and *V* is a 3x3 lower triangular matrix representing the Choleski decomposition.

The recent developed generalized VAR (and its associated G-IRF and G-VDC) by Pesaran and Shin (1998) which are by design invariant to the ordering of its constituent variables are a marked improvement on the traditional orthogonalised IRF and VDC which are rather robust to ordering of the variables in the VAR. In a study that compares the two approaches, Dekker et al (2001) observed the superiority of the generalised VAR against the traditional VAR in studying the linkages among Asia Pacific stock markets. Studies that apply the G-VAR include Yau and Nieh (2006), Peel and Venetis (2003), Hacker and Hatemi-J (2003) among many others.

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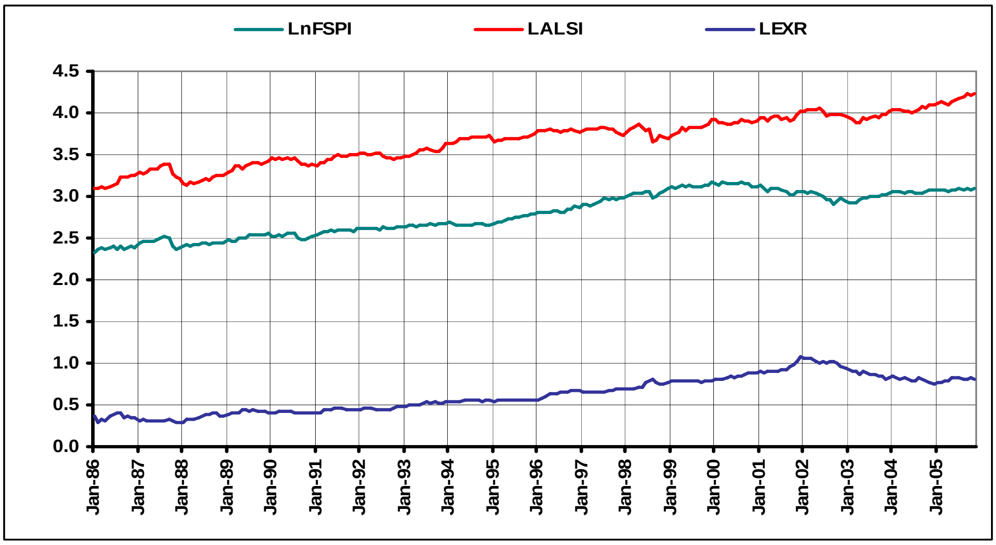
[4] The number three represent the number of variables in the present study

3.4 Data Issues

The frequencies of the data series' used in the study are monthly, and they cover the period, 1986 to 2006. The study period, 1986-2006 was chosen to capture the pre- and post-democracy periods in South Africa, thus we have 240 data points. Even though there are many stock market indices[5] in the US we chose the Standard and Poor's 500 Index (S&P 500) to represent stocks in the US market. The S&P 500 is widely acknowledged as the best single indicator of the US equity market the index includes 500 companies in the large cap segment of the US economy with approximately 75% coverage of US equities. It has therefore been touted as the ideal proxy for the total market. With regard to the South African market, we chose the Johannesburg Stock Exchange's All Share Index to characterise the equity market in the country.

The S&P 500 Index with a ticker of FSPI was obtained from I-Net Bridge, South Africa. I-Net also provided the JSE All Share index series. The JSE all share series with the ticker AJ301 was chosen because this was the adjusted share price index that allowed one to go further back in history. The stock market indices represented monthly closing figures. The rand/US dollar exchange rates were obtained from International Financial Statistics, IFS CD Rom published by the International Monetary Fund. All the analyses consider the variables in natural logarithms. Presented in the figure below are three variables in logarithms. It appears the US and SA stock prices as well as the rand/US$ exchange rates have moved fairly together over the study period for example the blip towards the end of 1987 in US stock is mirrored in SA stock as well.

Figure 1. US stock, SA stock and the rand/US$ exchange rate, 1986:1 – 2005:11



[5] The other major stock indices in the US are; (1) Dow Jones Industrial Average (stocks of 30 large firms in the US - popular indicator; (2) NYSE Composite Index (all companies listed on the NYSE); (3) Nasdaq Composite Index (All companies quoted on the NASDAQ; technology-heavy); (4) NASDAQ-100 Index (100 large NASDAQ stocks from the non-financial sector); (5) S & Poor (500 large companies often used for general market analysis); Russell 2000 (small-cap stocks) and the Wilshire 5000 Index (represents US market).

4. Results

The first stage of the empirical analyses involved examination of the statistical properties of the natural logarithms of all the variables under consideration, i.e., US Stock, SA Stock and the rand/US$ exchange rate. The results of the three unit root tests, ADF, PP and NP are summarised in Table 1 below. The results suggest that the null hypothesis of the presence of unit root in the variables in levels could not be rejected indicating that all the variables are non-stationary in levels. However, after first-differencing the variables the null hypothesis of the unit root in each of the series was rejected at the 1% level of significance. Therefore it can be inferred that all the variables are integrated of order 1, I (1).

Table 1. The results of various unit root tests

		US Stock			SA Stock			EX Rate		
ADF										
	Level	-2.283	[3]	(0)	-2.214	[3]	(0)	-1.342	[1]	(0)
	First difference	-5.402***	[1]	(0)	-14.558***	[1]	(0)	-14.955***	[1]	(0)
PP										
	Level	-2.134	[2]	(1)	-2.214	[3]	(0)	-1.312	[3]	(0)
	First difference	-15.127***	[1]	(7)	-14.928***	[1]	(4)	-15.184***	[3]	(3)
NP										
	Level	-1.974	[3]	(0)	-1.900	[3]	(0)	-1.358	[3]	(0)
	First difference	-4.228***	[1]	(0)	-7.682***	[1]	(0)	-3.041***	[2]	(0)

Notes: (1) US Stock, SA Stock and EXR Rate denote the Standard & Poor's 500 Index, the Johannesburg Stock Exchange's All Share Index and the Rand/US $ exchange rate respectively. (2) ***, ** and * represent significance levels at 1%, 5% and 10% respectively. (3) The critical values for the ADF and PP tests are obtained from MacKinnon (1996) one-sided p-values. These varied from model to model because of differences in the unit root model specifications. On the other hand the critical values for the PP tests are taken from Ng-Perron (2001, Table 1). (4) The test statistic for the NP test is the MZ_t. (5) The numbers in the bracket indicate the number of exogenous variables in the unit root test model; 3 constant, linear trend; 2 – only a constant; 1- no exogenous variable. The numbers in parenthesis for ADF and NP indicate appropriate lag lengths selected by Schwartz Information Criteria but the numbers in parenthesis for the PP indicate the optimal bandwidth decided by the Bartlett kernel of Newey and West (1994). The Eviews programme automatically selected the appropriate lag length.

All five Johansen cointegration models based on the linear and quadratic trend assumptions were tested. The trend assumptions included, no deterministic trend; quadratic deterministic trend; linear deterministic trend; linear deterministic trend (restricted) and no deterministic trend (restricted constant). The model with no deterministic trend identified one cointegrating vector in the VAR, both the Trace test and Maximum-Eigen value test results rejected the null hypotheses that the rank of the estimated VAR was zero. This null hypothesis was rejected at the 5% level of significance. The maximum likelihood values for each of the tests are presented in Table 4 below. It is also interesting to note that the cointegration test was robust regarding the order in which the variables entered the cointegration space.

Table 2. Unrestricted Rank Cointegration Tests

Rank	Trace test statistic (λ_{trace})	Maximun-Eigen value statistic ($\lambda_{\max}$)
r = 0	24.90**	17.79**
r ≤ 1	6.21	11.22
r ≤ 2	1.10	4.13

Notes: (1) Results of 5 out of the 6 selection criteria provided in Eviews 5.1, indicated lag one as the optimal lag order (2) ** denote 5% level of significance. The critical values for the hypothesis test are from Osterwald-Lenum (1992)

Instead of going on to estimate the VECM to ascertain the short run dynamics we rather use Granger causality test to ascertain the direction of causality and then evaluate the short run dynamics using impulse response functions and forecast error variance decomposition estimates. Table 3 shows the outcomes of Granger causality test. The results indicate a uni-directional causality from US stock to the rand/US$ exchange rate. The Table below also shows the absence of a significant lead-lag causal relationship between rand/US$ and stock prices of SA or Japan in the short-run.

Table 3. Pair wise Granger causality tests

Null hypothesis	F-Statistics	Probability
EX Rate does not Granger cause SA stock	0.89599	0.48454
SA stock does not Granger cause EX Rate	0.45672	0.80815
US stock does not Granger cause SA stock	1.49079	0.19380
SA stock does not Granger cause US stock	1.44056	0.21070
US stock does not Granger cause EX Rate	3.53817**	0.00425
EX Rate does not Granger cause US stock	0.88109	0.49450

Notes: (1) US stock, SA stock and EX Rate denote the S&P 500, the JSE All Share index and the rand/US$ exchange rate (2) ** denote significance level at 5% (3) the null hypothesis, H_0 is for 'no causal relation' (4) optimal lag length is 2, this was selected based on the Akaike information criteria (AIC).

The results of the impulse response and variance decomposition analyses are presented in figure 3 and Table 4 respectively. Inferences are drawn based on the interpretation of the transmission effects of IRF due to Lutekpol and Reimers (1992). The authors distinguish between permanent and transitory one-time impulse response as a result of shock from one variable to the other or to the variable itself. If a given shock generates a response path that returns to its previous equilibrium value of zero after some period then its is referred to as temporary and permanent if the response path does not return to the initial equilibrium. First, it can be argued that there is considerable response to own shock (self response) for all the variables. While this was strong for SA stocks the effect weakened after a period of 4 months thus own-shock for SA stock is transitory. The rand/US$ exchange like SA stock has a decreasing influence on itself but with a transition point one period shorter (i.e., 3 months) than SA stock. On the contrary, own shock to US stock appears to be permanent (see figure 3) as the response decreases slightly after a month and then flat into the long run.

When responses to shocks emerging from other variables under consideration are observed it seems that the response of SA stock to shock from US stock increases in the first month after impact and then declines albeit marginally. The response can therefore be considered as transitory since there is a reversion to equilibrium over time. On other hand response of US stock to shock from SA stock was found to be permanent but small in magnitude. Though the response by either SA stock or US stock to the rand/US$ was very small they were in opposite directions; negative for US stock and positive for SA stock. A consideration of the exchange rate's response to shock from the two markets indicate that there was virtually no effect on the exchange rate as a result of shock from the exchange market in SA. But in the case of shock from the US market a modest increasing response is recorded (see Figure 2).

The results of the forecast error variance decomposition (FEV) underscores the general observation made from the generalised standard deviation innovations in the impulse response analyses. The Table below shows that each of the variables commands the greatest proportion of the explanatory power in describing the FEV of its own shocks. One other interesting observation from the analyses is that while SA stock and the rand/US$ exchange rate explains a greater part of the variance or volatility of its values in the first period/month and then reduces slightly by the 10th month the US stock rather explains its variance better in 10month then say the 4month. Again, its important to note that US stock explains the volatility of either the SA stock or the rand/US$ exchange rate better in the future (for example see the decomposed portion of the forecast error variance of 0% and 5% in period 1 and 10 respectively in Table 4).

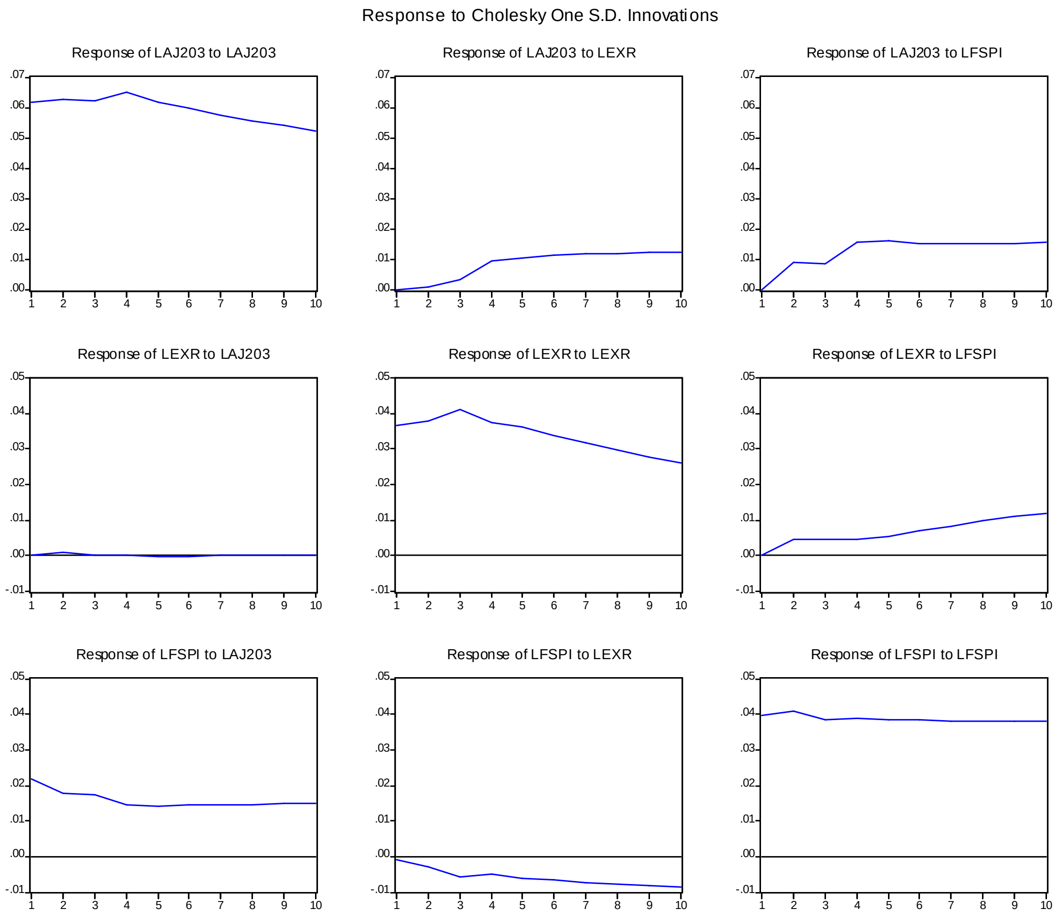


Figure. 2. Generalised-impulse response functions

Table 4. The results the forecast error variance decomposition

	Period	EX Rate	SA Stock	US Stock
EX Rate	1	99.99	0.01	0.00
	4	98.95	0.02	1.03
	7	97.78	0.01	2.21
	10	95.33	0.01	4.66
SA Stock	1	0.00	100.00	0.00
	4	0.62	96.95	2.43
	7	1.73	94.23	4.04
	10	2.49	92.63	4.88
US Stock	1	0.02	23.31	76.66
	4	0.86	17.19	81.96
	7	1.52	15.09	83.39
	10	2.16	14.42	83.42

Notes: (1) Each number is a percentage value (2) The values of variance decomposition decomposes Forecast variance (FEV) in an endogenous variable into percentage shocks to its own and other endogenous variables in the VAR.

5. Conclusions and recommendation

Increasingly the US has become one of South Africa's major trading partners and it would be important for international investors and policy makers to ascertain the empirical links between the stock exchanges from the two countries and the rand/dollar exchange rate. The purpose of this paper therefore was to assess whether there was relationship among the rand/US$ exchange rate and stock prices of South Africa and the US in either the short or long run. The study was undertaken with the aid of the Johansen cointegration technique, Granger causality test, generalised impulse response function and forecasting error variance decompositions. Monthly data of the three variables from 1986:1 to 2005:11 were used in the estimations.

The Johansen cointegration test identified a long run relationship among the variables of interest; this outcome is also consistent with conclusions based on a selection of the empirical literature such as the work of Abdalla and Murinde (1997). The results however contradict that suggested by Nieh and Yau (2006) where no long run relationship was observed. Though the results of the Granger causality test indicate the existence of a uni-directional relationship from US stock prices to the rand/US$ exchange rate there was no significant linkage between the stock prices of SA and Stock prices of the US. Given the vast differences in the character and performance between US stock markets and South Africa's stock market it's possible that the linkages between the two markets are probably through the exchange rate and not a direct one. Concerning the impact of innovations certain interesting observations were made. Though there appear to be some interaction between the variables under consideration the degree of interaction was marginal. The significant outcome though was the fact that own-response to shocks of each of the variables was relatively more significant than response to shocks from other variables. The high own-response to shock was further supported by the revelations from the FEVs that indicated that each variable accounted for the greatest proportion of explanatory power in describing its own shocks. This finding is consistent with Yau and Nieh (2006), which observes a similar phenomenon with the new Taiwan dollar/yen exchange rate and the stock prices of Taiwan and Japan.

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