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## **Equities as a Hedge Against Inflation in South Africa**

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# **EQUITIES AS A HEDGE AGAINST INFLATION IN SOUTH AFRICA**

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## **Abstract**

Conventional wisdom holds that equity investments should provide an effective hedge against inflation but empirical tests of this relationship in South Africa have produced conflicting results. We examine the relationship between equity returns and inflation for the Johannesburg Stock Exchange between 1982 and 2013. Contrary to the findings of several studies including Eita (2007), Hancocks (2010) and Khumalo (2013) but in keeping with Alagidede and Panagiotidis (2010) we find strong evidence of cointegration between equity returns and inflation with equity returns providing good protection against the effects of inflation. Our analysis, however, reveals substantial time variation in the relationship and that while the relationship between equity returns and inflation exhibits a strong positive coefficient of 2.254 equity returns respond extremely slowly to a change in inflation indicating that equity returns' ability to protect against inflation is likely to be restricted to long-term investment horizons.

“In the absence of the gold standard, there is no way to protect savings from confiscation through inflation. There is no safe store of value.” – Alan Greenspan

## 1. INTRODUCTION

The impact of inflation is a major concern for any investor concerned about the long-term effect it will have on the value of their investments. Conventional wisdom holds that equities should act as an effective hedge against inflation (Lee, 1992: 1591) as they represent a claim against real assets whose real returns should not be affected by inflation (Lee, 2010: 1257; Siegel, 2011: 1). This expectation is famously captured in the Fisher Hypothesis that the nominal interest rate is simply the sum of the real interest rate and the expected inflation rate (Gultekin, 1983a: 50; Li, Narayan and Zheng: 2010: 519). Despite the strong theoretical expectation that the returns on equities should be positively related to expected inflation, the empirical evidence has generally not supported this hypothesis with multiple studies finding in fact that the correlation between stock returns and inflation is negative (Fama and Schwert, 1977; Mayya, 1977; Gultekin, 1983a; Day 1984, Kaul, 1990; Li et al., 2010: 520; Valcarcel, 2012: 118).

This evidence of a negative relationship has resulted in authors proposing several alternative explanations including the Inflation Illusion Hypothesis of Modigliani and Cohn (1979) Fama’s Proxy Hypothesis (Fama, 1981, 1983), the Tax Hypothesis of Feldstein (1980), and the Tax-augmented hypothesis of Anari and Kolari (2001). More recent research, however, reflecting advancements in the modelling of non-stationary time series through the use of cointegration techniques, has found evidence of a positive relationship between the rate of inflation and the rate of return on equities (Gregoriou and Kontonikas, 2010: 167). In addition the empirical evidence suggests that the relationship is time-varying (Prabhakaran, 1989; Lee, 2010: 1257) and that it is market dependent (Claude, Campbell and Viskanta 1995; Alagidede and Panagiotidis, 2010: 99). To date though, there has been relatively few attempts to interrogate the current status of the relationship between stock returns and inflation for the South African market. Two recent studies that have attempted to apply the cointegration framework using South African data, Eita (2012) and Alagidede and Panagiotidis, (2010), have found conflicting results and neither has provided a detailed analysis of the structure of the long-run relationship between the returns on equity and inflation in the South African context. This study seeks to provide greater clarity regarding this important relationship by modelling the relationship between equity returns and inflation using Johansen’s Vector Error Correction Model (VECM).

## 2. LITERATURE REVIEW

### 2.1 Theoretical Framework

Fisher (1930) proposed that the nominal interest rate consists of the sum of the real interest rate and the expected inflation rate and so the nominal interest rate will differ from the real interest rate by the expected rate of inflation (Cooray, 2002: 2). The Fisher Hypothesis implies that because the value of equities is inherently based on underlying assets and capital investments, which should maintain a constant real value irrespective of the rate of inflation (Bradley and Jarrell, 2008: 67), the return on stocks should vary positively with the actual rate of inflation, which would make stocks an effective hedge against unexpected inflation (Sharpe, 2000: 4; Alagidede and Panagiotidis, 2010: 92). Until the mid-1970’s, it was generally accepted that Fisher’s Hypothesis should hold and that the nominal return on equities should be positively correlated with changes in the expected inflation rate (Khil and Lee, 2000: 458).

However, Valcarcel (2012: 117) states that although the theory predicts a strong positive relationship between equity returns and inflation, it is difficult to find empirical evidence to

substantiate this prediction. Additionally, Berument and Jelassi (2002: 1645) state that there is a disparity in the academic community over how long a period this relationship exists for, with some authors predicting the existence of a positive relationship regardless of the time period considered (Boudoukh and Richardson, 1993) and others who found evidence that the relationship exists exclusively in the long-run (Mishkin, 1992: 195). Boudoukh and Richardson (1993: 1354) argue that the relationship still exists in the short run, but the Fisher effect is stronger over longer time horizons. They provide strong evidence of a positive relationship over long horizons but also state that their evidence should be consistent with certain sub-periods during the past two centuries.

Conflicting empirical evidence since the introduction of the Fisher Hypothesis shows that the relationship between inflation and stock prices may be indirect and inconsistent and that the stock-return inflation relationship has in many cases been shown to be significantly negative or less than unity (Khil and Lee, 2000). A potential reason for this is that the real rate of return on equities does not remain constant in light of inflation, because nominal equity returns do not necessarily increase at the same rate as the increase in inflation in reality. Instead the literature shows that nominal equity returns may be subject to an increase that is less than the inflation rate and therefore do not experience the one-to-one increase alongside the inflation rate as dictated by the classical theory (Bodie, 1976; Jaffe and Mandelker, 1976; Nelson, 1976; Fama and Schwert, 1977).

Possibly the most important contribution to the post-classical thinking was made by Fama (1981: 563), who proposed what is termed the Proxy Hypothesis, which sought to prove that the negative relationship between inflation and real stock returns after 1953 can be attributed to proxy effects.

Fama's (1981: 563) hypothesis rests on the theory that inflation is merely a proxy for more relevant, "real-activity" variables in models that relate the inflation rate to the rate of real stock returns. According to Ely and Robinson (1997: 142) the negative relationship previously observed between stock returns and the rate of inflation is attributed by the Proxy Hypothesis to two fundamental relationships: the stock return; and inflation rates' independent relationships with expected economic activity. In other words, according to Ely and Robinson (1997: 142) the Proxy Hypothesis is primarily dependent on two independent relationships, firstly the inflation rate and expected economic activity relationship and secondly, the equity return and expected economic activity relationship. The foundation of the Proxy Hypothesis is not, therefore, based on the direct relationship between equity returns and the inflation rate; rather it is based on the autonomous relationships between each factor and expectations of economic activity.

Several alternative theories have been presented in the literature to try and provide an explanation for why the relationship between equity returns and inflation might be negative. Geske and Roll (1983) present the Reverse Causality Hypothesis. They expand on the proxy hypothesis by suggesting that a chain of macroeconomic events would lead to an inaccurate correlation between stock returns and inflation. Geske and Roll (1983) base this on the theory that relationship between stock prices and future economic activity as proposed by Fama's Proxy Hypothesis is highly correlated with government revenue. Therefore, when the economic activity decreases the government experiences a deficit and either borrows or issues money via the Reserve Bank, which leads to inflation, and explains the negative relationship between stock returns and inflation (Jorgenson and Terra, 2006: 4). Kaul (1990) argues that the negative relationship between real stock returns and inflation is dependent on the monetary sector's current equilibrium process, in which a counter-cyclical monetary response is responsible for

the negative relationship. Hess and Lee (1999) theorise that supply shocks, including real output shocks, contribute towards a negative relationship between the variables while demand shocks, including monetary shocks, contribute towards a positive relationship.

## 2.2 Empirical Evidence

Some initial studies did find evidence supporting the Fisher Hypothesis. Firth (1979), for example, found a positive relationship in Britain while Gultekin (1983b) found a relationship greater than unity, a finding consistent with what would now become known as the tax-augmented Fisher Hypothesis. Most early studies, however, found evidence of a negative relationship between inflation and equity returns, ultimately giving rise to Fama's Proxy Hypothesis. Mayya (1977) found that a negative relationship existed between equity returns and inflation while Prabhakaran (1989) found similar results although he found some evidence that equities provided a partial hedge against inflation but only in a limited number of years. Gultekin (1983a) found across multiple countries that the relationship was generally negative but not statistically significant while Day (1984) found a significant negative relationship. Similarly, Bodie (1976); Jaffe and Mandelker (1976); Nelson (1976); Hess and Lee (1977); Kaul (1990) and Claude, Campbell and Viskanta (1995) all found a significant negative relationships between equity returns and inflation.

These early studies, however, preceded the development of cointegration techniques that facilitated the study of the long-term relationship between time-series variables. In an early study using cointegration theory Ely and Robinson (1997) failed to find the unitary relationship predicted by the classical theory but did find evidence for most of the across sixteen countries analysed that equities maintained their values against inflation. Kasman, Kasman and Turgutlu (2006) also found evidence of a significant positive relationship which varied between being equal to, or less than perfect unity. Kim and Ryoo (2011) on the other hand found that the positive relationship exceed unity. Khil and Lee (2000), however, found that out of 11 sample countries, 10 exhibited evidence of a negative relationship

The empirical evidence pertaining to South Africa is limited and conflicting. Hancock (2010: 45), as part of a multi-variate analysis of macroeconomic variables that affected stock prices in South Africa reported that both inflation and the JSE-ALSI were non-stationary and integrated of the first order. Using a Johansen's cointegration approach Hancock (2010: 55) found a significant negative relationship between inflation and the All Share Index in South Africa. This is in direct contrast to the findings of Alagidede and Panagiotidis (2010) who, in a study of six African markets, concluded that not only was the relationship between equity values and inflation positive but that in the case of South Africa exceeded unity.

In contrast to the findings of these previous studies, Eita (2012) found that both inflation and equity returns were stationary for South Africa and that stock market returns and inflation were positively related. The finding of non-stationarity, however, is surprising and would imply that he used the changes in the CPI and All Share Indexes rather than the absolute index levels. To further confuse the picture Khumalo (2013) found that while inflation is non-stationary, stock prices in South Africa were stationary. Khumalo (2013), using a Granger causality test, concluded that inflation has a substantial negative effect on stock prices with stock prices expected to fall by some 31 percent for a one percent increase in inflation.

### 3. METHODOLOGY

#### 3.1 Research Problem

The above discussion clearly highlights the lack of consensus within both the theoretical and empirical literature regarding the nature of the relationship between equity returns and inflation. Internationally it would appear that the earlier findings of a negative relationship may largely be explained by the methodological limitations of these early studies with later studies employing more sophisticated cointegration techniques generally finding evidence of a positive relationship. Nevertheless, even these later studies have produced mixed results regarding the exact nature of the relationship suggesting that it may be time varying (Kim and Ryoo, 2011) and /or country dependent (Claude, Campbell and Viskanta, 1995; Khil and Lee, 2000; Alagidede and Panagiotidis, 2010).

The empirical evidence for South Africa is even more challenging as the limited number of studies that have investigated the relationship between equity returns and inflation have produced such conflicting and confusing results. This study, therefore, attempts to address the important question of what is the long-term relationship between inflation and equity returns in South Africa?

#### 3.2 Data

Following the methodology of Prabhakaran (1989); Ely and Robinson (1997); Alagidede and Panagiotidis (2010) and Kim and Ryoo, (2011), the FTSE/JSE All Share Index stock price indices were used to estimate equity returns for all JSE listed companies. Both the FTSE/JSE capital return index, which measures capital performance, and the FTSE/JSE total return index, which measures both capital performance and reinvested income based on declared dividends, were used. The sample period was from 1982 to 2013, which exceeded the minimum sample size requirement determined by Seo (2006) and used by Kim and Ryoo (2011), who determined stable results within a similar context. Following Kim and Ryoo (2011), the data set was converted into natural log form prior to the regression analysis in order to avoid the issue of heteroscedasticity.

Following the general practice in the literature, see for example Alagidede and Panagiotidis (2010), Kim and Ryoo (2011), the Consumer Price Index (CPI) was used as a proxy for the inflation variable, following the . The actual goods and inflation price data were used as proxies for expected goods prices and inflation after Madsen (2007) illustrated that it is possible for model based expected inflation to introduce bias into the results of for the Fisher Hypothesis. The CPI data spanned the same period as the All Share Index data. The CPI time series data was also converted into natural log form prior to the regression analysis to avoid the heteroscedasticity issue.

#### 3.3 Method of Analysis

This study used a similar methodology to that of Alagidede and Panagiotidis (2010) in order to test for a long-term relationship between equity returns and inflation. Following the aforementioned methodology, tests for stationarity were initially conducted. This study used the Augmented Dickey Fuller (ADF), the Phillips-Perron (PP) and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests prior to testing for cointegration.

Subsequently, following the determination that both time series were integrated of the first order, the Johansen's multivariate method was employed, following the methodology common in the literature (Alagidede and Panagiotidis, 2010). A VAR model was initially constructed in

order to determine the appropriate lag length to be used in the Vector Error Correction Model (VECM), with the lag length being determined by the Akaike (AIC) and Schwarz-Bayesian (SIC) information criterion. The optimal lag length is the lag length which minimizes the Akaike (AIC) and Schwarz-Bayesian (SIC) information criterion.

Following the determination of cointegration by the Johansen's test, a VECM was constructed for each lag length, which provides an indication of the  $\beta$  coefficient that defines the nature and magnitude of the relationship between equities and inflation. The model in terms of the Fisher hypothesis was specified as shown below:

$$\Delta \text{LogSP}_t = C + \beta \Delta \text{LogCPI}_t + \varepsilon_t$$

Where LogSP represents the log of the share price variable, LogCPI represents the log of the inflation variable, C represents the intercept or constant term if it exists and  $\varepsilon_t$  represents a white noise disturbance term (Brooks, 2002: 290). The  $\beta$  coefficient in the above equation represents the magnitude and nature of the relationship between equities and inflation. In the context of this study, any  $\beta$  coefficient that exceeds unity would make equities an effective hedge against inflation, according to the theory of the tax-adjusted Fisher hypothesis.

Subsequent to the determination of the nature of the relationship between 1982 and 2013 using the methodology described earlier in this section, the regression analysis was run over sub-periods between 1982 to 2000 and 1982 to 2013, in order to investigate whether the nature of the relationship has experienced a change over time.

#### 4. RESULTS

The graphical analysis of the logs of the two series showed an upward trend over time in both cases. The CPI variable exhibited slight levels of volatility, with higher levels of volatility shown by the share price (SP) variable.

Table 1 reports the summarized results of the stationarity tests at the 5% level of significance, which all showed a rejection of stationarity, with the exception of the KPSS test on the CPI variable at first differences which could only reject the null of stationarity at the 1% level.

Table 1: Results of the stationarity tests between 1982 and 2013

	ADF test statistic	PP test statistic	KPSS test statistic	ADF test Crit.	PP test Crit.	KPSS test Crit.
SP in levels	-3.059446	-3.224479	0.188702	-3.421983	-3.421983	0.146000
CPI in level terms	-1.616089	-1.834282	0.582224	-3.422049	-3.421983	0.146000
SP at first difference	-18.05666	-18.03464	0.026018	-18.05666	-3.422016	0.146000
CPI at first difference	-12.94237	-3.133835	0.208036	-12.94237	-3.422016	0.208036

Based on the above results, we can conclude that the data is non-stationary in level terms and therefore that using standard OLS testing may result in a spurious regression, indicating the need for the application of a cointegrating regression in order to make inferences regarding the nature of the relationship between the variables. Should the variables be shown to be

cointegrated the possibility of the occurrence of a spurious regression can be eliminated (Gujarati and Porter, 2009).

As such it was concluded that because both variables are  $I(1)$  processes they would need to be tested in a cointegration model such as the Johansen's test in order to assess the relationship between the variables. These results are contrary to the results obtained by Eita (2012) who determined that the variables were stationary in level terms and could be tested using the standard OLS methodology.

Following the confirmation of stationarity at first differences, the Johansen's test was conducted. Initially the time series were tested for the optimal lag order to be used in the Johansen's test by constructing a VAR model and then analysing the lag structure of the model. Regardless of the lag order used as indicated by the varying information criterion as being optimal, the conclusions that were determined were equivalent, although there is slight variation between the results, and so the results of the tests at both lag orders are reported.

Table 2 shows the results of the Johansen's test in each period from 1982 to 2000, 2002, 2004 and 2006 respectively, for the lag lengths as dictated by both the AIC and SIC criterion.

Table 2: The Johansen's test results for various sub-periods between 1982 – 2006

	Hypothetical Number of Cointegrating Equations.	Lag Length	Trace Test Statistic	Max. Eigen Value Statistic	Trace Test, Critical Value	Max. Eigen Value, Critical Value	Number of Cointegrating Equations
1982 - 2000 (AIC)	None	2	34.46163	18.69519	15.49471	14.26460	2
	Max 1	2	15.76644	15.76644	3.841466	3.841466	2
1982 - 2002 (AIC)	None	2	42.98932	25.87648	15.49471	14.26460	2
	Max 1	2	17.11283	17.11283	3.841466	3.841466	2
1982 - 2004 (AIC)	None	2	47.92252	15.49471	28.76465	14.26460	2
	Max 1	2	19.15787	19.15787	3.841466	3.841466	2
1982 - 2006 (AIC)	None	4	49.16294	31.42453	15.49471	14.26460	2
	Max 1	4	17.73841	17.73841	3.841466	3.841466	2
1982 - 2000 (SIC)	None	2	34.46163	18.69519	15.49471	14.26460	2
	Max 1	2	15.76644	15.76644	3.841466	3.841466	2
1982 - 2002 (SIC)	None	2	42.98932	25.87648	15.49471	14.26460	2
	Max 1	2	17.11283	17.11283	3.841466	3.841466	2
1982 - 2004 (SIC)	None	2	47.92252	15.49471	28.76465	14.26460	2
	Max 1	2	19.15787	19.15787	3.841466	3.841466	2
1982 - 2006 (SIC)	None	2	48.17084	35.68750	15.49471	14.26460	2
	Max 1	2	12.48334	12.48334	3.841466	3.841466	2

Irrespective of the indication of optimal lag length, the results of the Johansen's test shows the existence of two cointegrating relationships between the variables in each case, because the

test statistics for both the trace test and maximum eigenvalue test exceed their respective critical values. This indicates that a linear cointegrating relationship existed between the variables in each period considered. The finding of two cointegrating relationships at the 5% level of significance when only one can exist is an indication that the relationship is of greater significance than was initially tested for. For example, in this case the test indicated that we can be 95% sure of the existence of a linear cointegrating relationship, however, the test only provided evidence of one cointegrating relationship when the level of significance was increased to the 0.5% level, indicating that we can be 99.5% confident that a single cointegrating relationship exists between the variables.

Table 3 shows the equivalent results for each period beginning in 1982 and ending in 2007, 2010 and 2013 respectively. It was also found that over these periods, the cointegrating relationship remained significant between the variables, showing that there has been a consistent cointegrating relationship in each period considered over the time period. The results ending in 2013 are of particular interest as these are the most modern results for the South African case. Following the determination of a cointegrating relationship, a number of VECM models were constructed using specific periods between 1982 and 2013. These periods all began in 1982 and ended in 2000, 2004, 2007, 2010 and 2013 respectively, in order to determine whether the cointegrating relationship has remained consistent over time.

**Table 3: Johansen's test results for the period 1982-2013 and sub-periods**

	Hypothetical Number of Cointegrating Equations	Lag Length	Trace Test Statistic	Max. Eigen Value Statistic	Trace Test Critical Value	Max Eigen Value Critical Value	Number of Cointegrating Equations
1982 - 2007 (AIC)	None	2	43.07194	37.96244	15.49471	14.26460	2
	Max 1	2	5.109504	5.109504	3.841466	3.841466	2
1982 - 2007 (SIC)	None	2	43.07194	37.96244	15.49471	14.26460	2
	Max 1	2	5.109504	5.109504	3.841466	3.841466	2
1982 - 2010 (AIC)	None	4	67.42135	62.54395	15.49471	14.26460	2
	Max 1	4	4.877400	4.877400	3.841466	3.841466	2
1982 - 2010 (SIC)	None	1	41.94458	34.31348	15.49471	14.26460	2
	Max 1	1	7.631104	7.631104	3.841466	3.841466	2
1982 - 2013 (AIC)	None	1	79.01067	74.60528	15.49471	14.26460	2
	Max 1	1	4.405393	4.405393	3.841466	3.841466	2
1982 - 2013 (SIC)	None	4	47.27157	40.52712	15.49471	14.26460	2
	Max 1	4	6.744445	6.744445	3.841466	3.841466	2

Table 4 shows the summarised results of the VECM model conducted over the period. In each case the share price variable LogSP was used as the dependent variable, according to the Fisher equation and following the work of Kim and Ryoo (2011). It can be seen that in most of the periods considered, the  $\beta$  coefficient is slightly higher than two, with the exception of 2004 and 2007. This value for a  $\beta$  coefficient indicates that for every percentage increase in inflation, the stock price would increase by more than two percent. This percentage would be slightly less using the value obtained up until 2004, and significantly higher using the value obtained

between 1982 and 2007. These effects may be attributed to either the all-time low inflation rate in 2004 with the increase in 2007, or to the lagged effects of the significant spike in inflation in 2003 and the inflation rate of almost zero in 2004. The value greater than two correlates with the value obtained by Alagidede and Panagiotidis (2010), who obtained a similar value of 2.264.

Table 4: A Summary of the results of the Vector Error Correction Model for each period

	Cointegrating Equations		
	$\Delta \text{LogSP}_t = C + \beta \Delta \text{LogCPI}_t + \varepsilon_t$		
	LogSP(-1)	C	LogCPI(-1)
2000	1.000	1.496335	2.121193
2004	1.000	2.652835	1.710342
2007	1.000	3.576872	3.579089
2010	1.000	0.995628	2.190291
2013	1.000	0.716577	2.254915

The magnitude of the  $\beta$  coefficient in South Africa has been greater than the coefficients determined in previous studies including the studies by such as those by Berument and Jelassi (2002) and Kasman, Kasman and Turgutlu (2006) which consider a range of other countries such as the United States, France, the United Kingdom, Mexico and Zambia. By comparison, the coefficients determined in other African countries by Alagidede and Panagiotidis (2010) were 0.215 for Egypt, 0.292 for Kenya, 0.44 for Nigeria and 0.015 for Tunisia. The specific values obtained tend to exhibit less variability in developed countries than in developing countries, as determined by Berument and Jelassi who found values that ranged from 0.113 to 1.302 in developed countries and -.312 to 1.586 in developing countries, for a sample that did not include South Africa. As can be seen, the only African country whose equity market was shown to act as an effective inflationary hedge in the study by Alagidede and Panagiotidis (2010) was South Africa. Examples of the coefficients that have been determined internationally were provided by Berument and Jelassi (2002: 1648) who found a coefficient of 0.98 in Canada, 1.302 in Denmark and 0.963 in Finland. From an investment perspective, findings such as these would advocate the South African market as a highly profitable investment option when aiming to hedge against inflation, far more so than in comparable countries. Alagidede and Panagiotidis (2010) attribute this relatively high relationship in part due to the positive effects on the stock market following the abolishment of apartheid in 1994 alongside the lifting of the sanctions which resulted in increased capital flows.

Alagidede and Panagiotidis (2010) also tested for the stability of the cointegrating relationship. As can be seen by the VECM results reported in table 4 there has been a consistent long-term relationship between the variables which has exceeded unity in each period considered. This shows that the variables have consistently exhibited a long-term linear relationship.

The results in this section have shown that a consistent and significant relationship has existed between share prices and the inflation rate and that the relationship has remained consistently positive over the period. The relationships shown in each period indicate that although there has been variance in the  $\beta$  coefficient, it has also significantly exceeded unity. This finding is consistent with the findings of Valcarcel (2012: 142) who determined that while the stock price-inflation relationship was relatively more stable than the volatility of either series, it does experience a measure of variation over time.

In Table 4 it can be seen that the coefficient of the LogCPI is -2.254915. Therefore the equation would take the form according to the generalized Fisher Hypothesis:

$$\text{LogSP} = 0.716577 + 2.254915\text{LogCPI}$$

The Error Correction terms for the VECM were constructed using data between 1982 and 2013 using the data based on the SIC criterion. The error correction term D(LogSP) indicates that about 0.2% of the disequilibrium is corrected in each period by adjustments of the stock price variable, while D(LogCPI) indicates that about 0.5% of the disequilibrium in each period is corrected by adjustments of the inflation variable. However, only the D(LogCPI) error correction term was significant, indicating that it is the CPI variable that adjusts to correct for disequilibrium in the system. From this it can be concluded that it is the inflation variable that undergoes adjustment in order to bring the system back into equilibrium, not the stock returns variable. This indicates that although the  $\beta$  coefficients indicate that equities are able to act as an effective inflationary hedge in South Africa, this may only be the case over long investment horizons and that in the short-term equity values may not have sufficient time to adjust for inflationary shocks, a conclusion similar to that reached by Mishkin (1992: 195) and Boudoukh and Richardson (1993: 1354) for the United States.

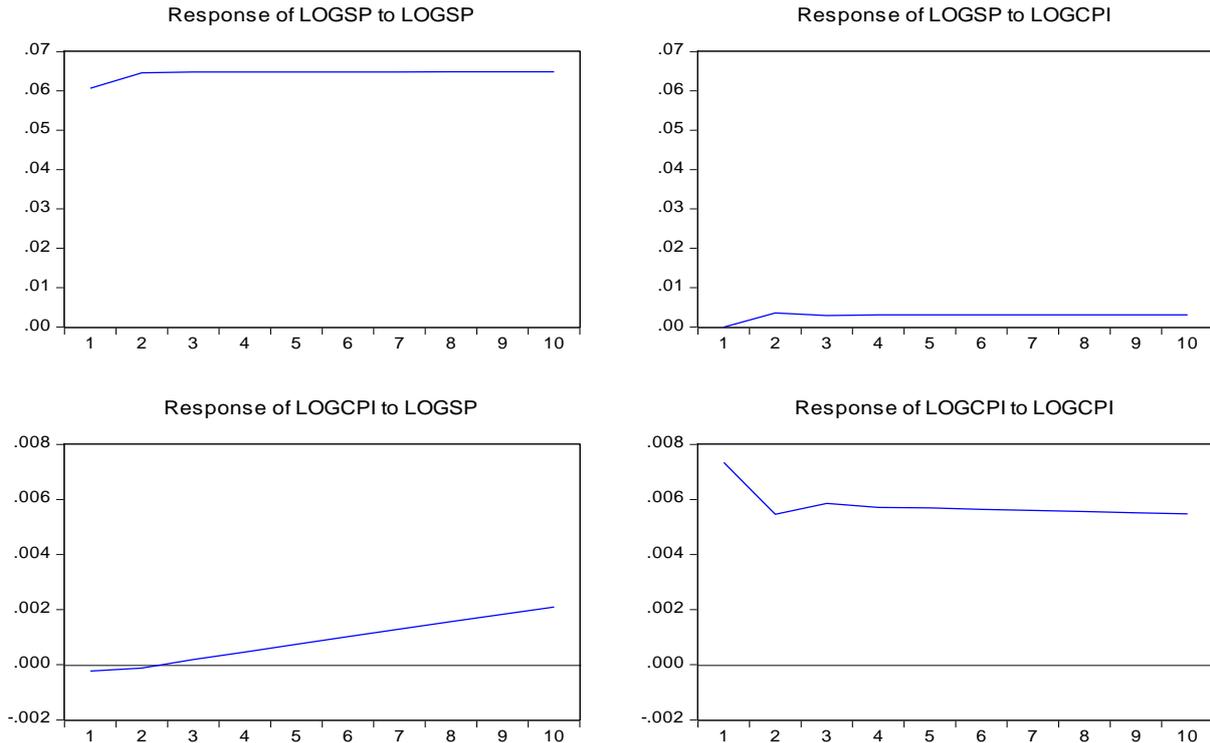
While it can be difficult to interpret causality within the parameters of the VECM it can be investigated via the application of impulse response functions. The impulse response functions for the previous VECM are shown in Table 5, below. The impulse response functions indicate the response of the CPI and stock price variables to a shock as well as their response to a shock to the alternative variable. Based on the impulse response functions it can be seen, in the top left hand graph, that stock price is significantly affected by its own past values. In this case stock price is expected to increase following a positive shock, increasing slightly more after 2 periods and then remaining consistent. Due to the monthly data used, each period indicated in the impulse response functions effectively represent a month ahead.

The bottom right hand graph shows that goods prices are also significantly affected by their own past values, showing that the goods price increases following a shock, with a slightly lower increase after 2 periods. In this case the response is very small. The top right hand graph shows that stock prices have been only slightly affected by changes in the goods price overall, while they are not affected in the first period and only experience an effect in the second period.

The bottom left hand graph shows that stock prices have marginally affected the goods price. In the first period this indicates a negative response of the goods price to the stock's price, which increases to become positive by the third period. What is odd in the case of this graph is that when cointegration is determined it is expected that a stable equilibrium will be reached, as is evident from the other response graphs, while this is not shown in this particular graph. It is evident however that the response is very small and so a shock to the stock price would not be expected to significantly affect the CPI variable, which would be expected to adjust towards a stable equilibrium over time. However, this graph does indicate that the stock market does lead inflation. When considering that increases in stock prices reflect an increase in real economic activity, a theory that originated with Fama's (1981) proxy hypothesis, which in turn leads to inflationary increases it is not counter intuitive to consider that the stock market is the leading variable in the equity returns – inflation relationship.

**Table 5: Impulse response functions of the VAR model**

Response to Cholesky One S.D. Innovations



The findings of this study imply that the South African equity market is an especially useful investment option for investors concerned about inflation, as the evidence shows that equity returns in South Africa are not only positively correlated with inflation but that the relationship is greater than unity. Based on the determination of non-stationarity of the variables, the findings of Eita (2012) can be disregarded in this context, while the determination of two cointegrating relationships by Alagidede and Panagiotidis (2010) can be attributed to the nature of the VECM and is indicative of a single, highly significant cointegrating relationship. Due to the positive relationship between the variables investors would, initially, be able to hedge fully against inflation by investing in the equity markets, and secondly, would realise a far greater nominal rate of return than the increases in the price level, meaning that on aggregate investors would in fact increase their level of real wealth by investing in the South African equity markets during inflationary periods, in the long-term. It is important to note that this increase in real wealth during inflationary periods would only occur for investments with a long investment horizon, due to the slow rate of adjustment of the variables towards their equilibrium.

## 5. CONCLUSION

The empirical evidence concerning the relationship between equity returns and inflation in South Africa is mixed with several studies producing widely contradictory results. Using equity return and CPI data for the period 1982 to 2013 this paper investigated the relationship between equity returns and inflation in order to assess the ability of shares to protect investors from the effects of inflation. Contrary to the findings of Eita (2012) and Khumalo (2013) but supporting Alagidede and Panagiotidis (2010) we find that both equity returns and inflation series are stationary in first differences. Using Johansen's cointegration framework we find strong evidence of cointegration between equity returns and inflation. Our results find that equity investments in South Africa provide good protection against the effects of inflation with equity returns displaying a coefficient of 2.254 similar to the value of 2.264 found by Alagidede and Panagiotidis' (2010). An analysis of several sub-periods, however, shows substantial time variation in this coefficient which may partially explain why different studies have obtained

such varying results. The results of the impulse response coefficients obtained from the VECM, however, indicate that while equity returns respond positively to an increase in inflation the response occurs over an extended number of periods indicating that equity returns will provide greater protection against inflation over longer-term investment horizons than in the short-run.

The results of this study contribute to our understanding of this important relationship by helping to clarify the existing confusion resulting from the conflicting findings evident in the empirical literature. Productive areas for further research would be to conduct the analysis on a sectoral basis in an attempt to ascertain which sectors are most responsive to the effects of inflation. Conducting a cointegration analysis allowing for structural breaks also offers potential value in the light of our evidence that the relationship between equity returns and inflation is time varying. In particular it would be of interest to investigate the impact upon the relationship, if any, of the introduction of inflation targeting in South Africa in February 2000.

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