The Relationship between Inflation and Stock Prices in Zambia

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The Relationship between Inflation and Stock Prices in Zambia

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ABSTRACT— *This study examines a relationship between inflation and stock prices for Zambia, over the period 1999–2011, using monthly all share stock prices and inflation rates. The study employed Augmented-Dickey-Fuller and Phillip-Perron for testing the stationarity of the series, Granger-causality test is used to determine the causality relationship between the variables, VAR and Cointegration techniques are employed to determine the short run and long run relationship respectively between the two variables. The unit root test results show that the series are non-stationary at level form but after differentiating they become stationary, the causality test results show a one way causal relationship running from inflation to stock prices and not vice-versa. There was no cointegration found among the variables meaning that there exists only a short run relationship. In general the results support the economic theory which suggests a negative relationship between inflation and stock prices.*

Keywords— Inflation, stock prices, unit root, Granger-causality, vector autoregressive, Zambia

1. INTRODUCTION

Many countries over the years have witnessed an increased preoccupation with the monetary variables such as inflation; this is due to the great increase in the average level of inflation over the years (Solnik, 1983). Zambia among other developing countries has been concerned with achieving stability in terms of the general price levels, monetary policy in 2011 focused on sustaining macroeconomic stability by restricting inflation to single digits, in 2011 the inflation rate was held at 8.7%, up from 8.5% in 2010, and it was projected at 8% in 2012 and 8.5% in 2013 (African Economic Outlook, 2012).

Inflation is defined as a rise in the average level of price for all goods and services over a given period of time, and it can also be defined as a permanent increase in the aggregate price level which implies a diminishing of purchasing power and an increase in the cost of living (Mousa, Al safi,Hasoneh and Abo-orabi, 2012). Hence keeping the levels of inflation in a steady state is the primary concern of monetary policy makers, as indicated by the monetary policy objective of the central bank (Mishkin, 2004). This is because the rate of inflation of a given country reflects the economic performance and the price stability of that particular country; it also affects a country's performance on the international market.

According to Mishkin (2004) a stock is a claim that represents a share of ownership on real assets and earnings of a company (or Corporation). The observed increase in the average level of inflation over the past years has led to extensive theoretical and empirical studies on the relation between asset prices (i.e. stocks) and monetary variables such as inflation. The general Economic theory states that, when there is an increase in the rate of inflation it signals poor performance of an economy and financial investors tend to sell their stock assets to avoid incurring loss. The increase in the supply of stock assets on the market brought about by the increase in the level of inflation leads to a decrease in the stock prices, suggesting that there exist a negative or inverse relationship between inflation and stock prices.

While according to Fisher's hypothesis, equity stocks which represents claims against the real assets of business, may serve as a hedge against inflation, this reasoning entails that there is a positive relationship between the two variables (inflation and stock prices). Various studies have been conducted to determine the relationship between inflation and stock prices in different countries over the years and the findings on these studies have been contradictory prompting further studies on this subject to extend on the existing findings. This paper will extend on the available knowledge on this subject by examining the relationship between inflation and stock prices in Zambia. Considering that inflation is an important monetary variable and knowing that it erodes on financial assets by diminishing the purchasing power, the worrying increases in inflation leaves policy makers with a challenge to keep this variable in check.

Hence from a policy, and empirical point of view, the question is whether inflation and stock prices are related and if they are related what is the nature of the relationship. This is the question that this study intends to investigate for the Zambian economy. The article is organized as follows: the next section presents a literature review. Section 3 discusses

the methodology. The empirical analysis and results are presented in section 4. Section 5 concludes the study.

2. LITERATURE REVIEW

2.1 Theoretical Literature

Literature has a number of theories regarding the relationship between stock prices and inflation. According to the general Economic theory given in the introduction, there exist a negative or inverse relationship between inflation and the stock prices, meaning that an increase in the rate of inflation should lead to a decrease in stock prices.

One of the early pioneers of this subject is Fisher (1930) who hypothesized that the real interest rate equals the discounted nominal interest rate, that is real interest rate equals nominal interest rate minus the anticipated rate of inflation, this hypothesis entails that there is a one-for-one adjustment in the nominal interest rate to the anticipated inflation rate meaning that the nominal interest rate and the anticipated inflation rate moves in the same direction, the mathematical expression for this hypothesis is as follows:

$$1 + r = (1 + R)(1 + I)$$
$$r = R + I$$

…1

Where: r is the nominal rate of interest, R is the real rate of interest, I is the real rate of inflation. In principle, the Fisher hypothesis can be extended to any asset, such as financial assets (i.e. stock), this would mean that nominal asset returns will move one for one with the expected inflation levels, meaning that if inflation rises to a higher level, stock prices should also rise along with inflation. According to this reasoning asset such as stocks offers a hedge against inflation, hence a positive relationship between inflation and stock prices.

Fisher's hypothesis has not gone unchallenged, Fama (1970) established a theory, which is commonly known as the theory of "Efficient Capital Market", the definitional statement of this theory is that in an efficient market prices "fully reflect" available information in the market. In this theory Fama proposed three types of efficiencies (i) the weak form; (ii) semi-strong form; and (iii) the strong form efficiency. These types of efficiencies are illustrated in the context of what information is factored in the market prices, in the weak form efficiency the information set contains historical prices, which can be predicted from historical price trend this set of information may not have any relevance to investors, the semi-strong form requires that all information is reflected in the prices, the concern here is whether prices efficiently adjust to other information which is publicly available (i.e. announcement of annual earnings, stock split etc.). Finally the strong form of efficiency is concerned with all information, including private information, it is concerned with whether given investors or groups have monopolistic access to any information relevant for price formation, given these three types of efficiencies the efficient capital market hypothesis entails that asset prices at any time fully reflect all available information on the market.

According to Geyser and Lowies (2001) Fama's hypothesis has influence on investors and as well as companies, in the sense that all information available on the market is immediately reflected in the prices, this would mean that an increase in the level of inflation will lead to an increase in the nominal value of financial assets such as stocks relative to their real value.

Considering that financial assets such as stocks represent a share of ownership on real assets according to (Mishkin, 2004), when the nominal value of these assets exceed their real value due to the inflation effect, investors are likely to sell their stocks on the market in exchange for real assets. As investors sell these financial assets, the market supply of stocks increases leading to a fall in the stock prices, and this in itself suggests a negative relationship between inflation and stock prices. Most empirical studies which have been conducted on this subject have based their focus on examining either of the two theories.

2.2 Empirical Literature

Early studies on the empirical relationship between inflation and the stock market were investigated by Jaffe and Mandelker (1976), Nelson (1976), and Bodie (1976). Jaffe and Mandelker (1976) examined the relationship between inflation and returns in the stock market, by conducting an empirical investigation on the "Fisher Effect" for risky assets, on all the securities listed on the New York Stock Exchange, using monthly data between the period of 1953 and 1971, the study used linear regressions to estimate the relationship, to measure the return on the market the study employed the Lawrence Fisher index, in general the study found a negative relationship between the returns and concurrent rates of inflation over two decades, but after using a longer time horizon the study found that there is a positive relationship between the variables.

Nelson (1976) studied the relationship between inflation and the rates of return on common stocks, the study used monthly data covering the period 1953 through to 1972, the study employed simple regression techniques to estimate the relationship between inflation and the rates of return on common stocks, the study also used the Scholes index of value weighted returns, findings of this study showed that common stocks are negatively correlated with the rate of inflation.

Bodie (1976) common stocks as a hedge against inflation, this study attempted to address the question of how effectively an investor can hedge against inflation with a "representative" well-diversified portfolio of common stocks. The study used annual, quarterly and monthly data for the period 1953 to 1972; the study employed the framework of the Markowitz-Tobin-Mean-Variance model of portfolio choice, the regression results obtained indicated that the real return on equity is negatively related to anticipated and unanticipated inflation.

Fama and Schwert (1977) estimated the extent to which various financial assets were hedges against the expected and unexpected components of the inflation rate, between the periods 1953 to 1971, using linear regression methods the study found that U.S government estate was a complete hedge against both expected and unexpected inflation. Labor income showed little short–term relationship with either expected or unexpected inflation. But the most anomalous result was that common stock returns were negatively related to the expected component of inflation rate and probably also to the unexpected component.

Schwert (1981) analyzed the reaction of stock prices to new information about inflation, using daily returns to the standard and poor composite portfolio between the period 1953-1978, the study used Fama's model to measure unexpected inflation and regression models to estimate the relationship between the two variable and the results obtained from this study showed that stock markets reacts negatively to the announcement of unexpected inflation.

A study conducted by Anari and Kolari (2001) examined monthly time series of stock price index and goods price index for six industrialized countries (United states, United Kingdom, France, Germany and Japan) from 1953 to 1998, the study employed a Vector Auto regression model (VAR) and the findings exhibited an initial negative relationship, which turned to be positive over longer horizons.

In the case of Egypt Omran and Pointon (2001) examined the impact of the inflation rate on the performance of the Egyptian stock Market, the study used Error Correction Mechanisms and the results indicated a negative relationship between inflation and market activity and liquidity.

Akmal (2007) investigated the relationship between stock prices and inflation for Pakistan, over the period 1971-2006, the study examined the relationship in question by utilizing the ARDL (autoregressive distributed lag) and ECM (error correction model) techniques and the findings supports the hypothesis that stock hedges against inflation in long-run but not in short-run.

An investigation by Al-Zoubi and Al-Sharkas (2010) on the relationship between stock prices and inflation, the case of Jordan, Saudi Arabia, Kuwait and Morocco used monthly data on stock price indices and goods price indices for the period 2000-2009, the study employed Unrestricted Vector Autoregressive (UVAR) model, the findings of this investigation were in consistence with the Fisher hypothesis that there is a positive relationship between inflation and stock prices.

A recent study on the relationship between inflation and stock prices in Jordan by Mousa, Al-Safi, Hasoneh, and Abo-orabi (2012) used data collected from a sample of companies that listed in the Amman stock exchange, the data covered the period 1998 to 2007. The study used econometric tables and econometric programs such as E-views to analyze this relationship and the results showed that not all companies offer a perfect hedge against inflation, some companies exhibited a negative relationship while others a slightly positive relationship.

There are lessons to be learnt from these studies, to start with most studies applied the vector autoregressive model (VAR) to estimate the relationship between inflation and stock prices, this justifies that a similar technique can be used in this study, in most of the studies reviewed the findings show that there is a negative relationship between inflation and stock prices, although some studies exhibit a positive relationship between the two variables.

3. METHODOLOGY

3.1 Econometric Framework and Model Specification

This study will make use of the Vector auto regressive (VAR) model to examine the relationship between inflation and stock prices in Zambia; vector autoregressive model (VAR) is an n-variable model in which each variable is explained by its own lagged values Gujarati and Sangeetha (2007)

This study adopts and modifies the VAR model as used by Anari and Kolari (2001). Consider a vector:

X=(S, Inf.) …2

Where: S is the stock price index and Inf. is the Inflation rate. The dynamic relation between S and Inf. is written in the following reduced-form VAR model:

$$X_t = c + \sum_{k=1}^{n} A_k X_{t-k} + \mu_t \qquad \qquad \dots 3$$

Where C is a 2x1 vector of constants, A_k are 2x2 matrices of coefficients to be estimated and vector μ_t represents the unexpected movements in S and Inf. it is assumed that $\epsilon(\mu_t) = 0$ and $\epsilon(\mu_t \; \mu_y) = 0$ when $v \neq t$. To avoid the problem of the residual serial correlation the model considers the order of n.

In order to estimate the VAR there are various steps to be conducted first.

(1) Testing for unit root and determine the order of integration for two variables by employing tests devised by Augmented Dickey - Fuller (ADF), Philips and Peron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). A series is said to be stationary when its mean, variance and covariance is constant over time.

(2) Testing for cointegration and if there is cointegration relationship the variables can be re-parameterised as an Error-Correction Model (ECM) which will contain both short and long-run effects. The Johansen cointegration can be applied in this respect. Cointegration indicates that the variables have a long run relationship or converge to some equilibrium in the long run.

(3) Granger-causality. That is if there is cointegration there should be Granger-causality in at least one direction. Causality implies that variables are able to predict one another.

(4) Impulse response and variance decomposition. The impulse response function traces out the response of the depended variable in the VAR system to shocks in the error term. The variance decomposition shows the effects of unexpected movements in the independent variable on the dependent variable. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variable in the VAR

3.2 Data and Data Sources

The study will use secondary monthly data covering the period 1999 to 2011; data will be obtained mainly from the Zambia central statistical office monthly bulletin and from the Lusaka Stock Exchange monthly reports and Bulletins. The Inflation Data will be measured in percentages while the stock prices will be measured in Kwacha.

4. EMPIRICAL ANALYSIS AND RESULTS

4.1 Unit Root Tests

The study applied the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. The results of the unit root test in levels and first difference are presented in Table 1. The series were found to be non-stationary in level form but after differencing them, the test statistic shows that the time series became stationary.

Table 1: Unit root tests: ADF and PP in levels and first difference

Variable	Model specification	ADF	PP	ADF	PP	Order of integration
		levels	levels	First Difference	First Difference	
Inf.	Intercept	-0.81	-0.99	-10.83**	-10.83**	1
	Intercept and trend	-2.23	-2.65	-10.81**	-10.81**	1
S	Intercept	-0.77	-0.77	-5.13**	-11.13**	1
	Intercept and trend	-1.11	-1.51	-5.13**	-11.11**	1

Source: author's compilation and values obtained from Eviews
*Note: ** means the rejection of the null hypothesis is at 5%*

After testing for stationarity and establishing the statistical properties of the time series data, based on the information criteria a reduced form VAR is estimated and the suggested optimal lag length is four. At the suggested optimal lag length four, no inverse root of the characteristics AR Polynomial lies outside the unit circle, meaning that the estimated VAR satisfies the stability conditions. The results for the lag structure and roots of characteristic polynomial are given in tables 2 and 3 respectively.

Table 2: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-202.4139	NA	0.061012	2.879068	2.920700	2.895986
1	338.6140	1059.195	3.17e-05	-4.684705	**-4.559810***	**-4.633953***
2	344.3230	11.01588	3.09e-05	-4.708774	-4.500618	-4.624188
3	346.2925	3.744846	3.18e-05	-4.680176	-4.388756	-4.561755
4	353.5220	**13.54267***	**3.04e-05***	**-4.725663***	-4.350980	-4.573407
5	354.0555	0.984301	3.19e-05	-4.676838	-4.218893	-4.490748
6	356.4621	4.372574	3.27e-05	-4.654396	-4.113188	-4.434471
7	358.3536	3.383348	3.37e-05	-4.624699	-4.000228	-4.370939
8	359.0223	1.177357	3.53e-05	-4.577779	-3.870046	-4.290185

Source: Author's compilation using Eviews
Note: * indicates lag order selected by the criterion

Table 3: Roots of characteristic polynomial

Root	Modulus
0.997046	0.997046
0.898800	0.898800
0.131672 - 0.050549i	0.141042
0.131672 + 0.050549i	0.141042

Source: Author's compilation using Eviews
Notes: No roots lie outside the unit circle. VAR satisfies the stability condition

4.2 Testing for Cointegration

Table 4: Johansen Cointegration Test Based on Trace and Maximum Eigen Values of the statistic matrix of Inflation and stock prices

Maximum Eigen Test				Trace Test			
$H_0: \text{rank} =$	$H_a: \text{rank} =$	statistic	95% critical value	$H_0: \text{rank} =$	$H_a: \text{rank} =$	statistic	95% critical value
r = 0	r = 1	10.27	14.26	r = 0	r >=1	10.44	15.49
r <= 1	r = 2	0.17	3.84	r <= 1	r >= 2	0.17	3.84

Source: Author's compilation using Eviews
Notes: Both the Max. Eigen test and the Trace test indicate that there is no Cointegration among the variables. Sample period 1999: Jan to 2011: June.

Table 4 presents the results for the Johansen test for cointegration based on the Maximum Eigen test statistic values and the Trace test statistic values. The test statistic value for both Maximum Eigen and Trace tests reveals that there is no cointegration between the variables (inflation and stock prices), this is because the test statistics for both tests are less than the critical values at 5% hence, accepting the null hypothesis of no cointegrating variables. Therefore, the study will apply VAR to estimate the short-run relationship between inflation and stock prices.

4.3 Granger-causality Test

Table 5: Granger causality test for inflation and stock prices

	Dependent variable in Regression	
Regressor	Inf.	S
Inf.	0.00	0.02
S	0.20	0.00

Source: Author's Compilation using Eviews.

Notes: (a) Inf. Denotes inflation and S denotes stock price all share index, (b) $\alpha = 5\% \ (or \ 0.05)$

If the probability values are less than 0.05, reject the null hypothesis that there is no causality between the variables, while if the probability values are greater than 0.05, accept the null hypothesis of no causality among the variables, table 5 presents the Granger causality results for the two-variable VAR model. The results indicate that there is a causality relationship between inflation and stock prices, because the *p*-value is less than $\alpha = 0.05$ meaning that a change in the levels of inflation would induce a change in stock prices, however on the other hand the results also shows that changes in stock prices would not induce any change in the levels of inflation, hence the causality relationship is a one-way relationship between inflation and stock prices running from inflation to stock prices and not from stock prices to inflation.

4.4 Impulse Response Function

The impulse response function reveal the way a change in inflation levels affects the stock price index overtime. Figure 1 below presents the response of stock price index to changes in the levels of inflation. In line with theoretical expectations stock prices decreases following an increase in the levels of inflation suggesting a negative relationship between inflation and stock prices. The effects of the shocks are transitory on the stock prices for about 10 months and thereafter they become permanent although slightly below the base line. The effects remained constant even after 20 months.

Figure 1: Impulse response function of Stock prices and Inflation
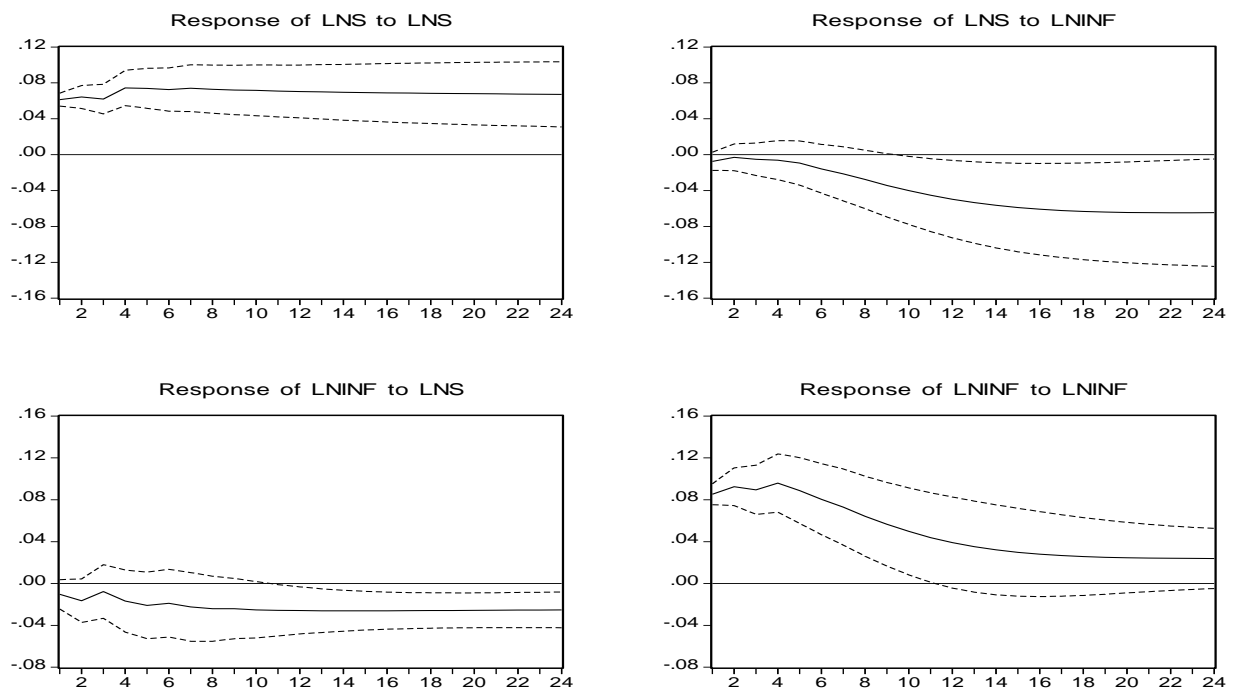
Source: Author's compilation using Eviews.

4.5 Forecast Error Variance Decomposition

Table 6 below presents forecast error variance decomposition for each variable in the model over a 24-month forecast horizon. The variance decomposition results from table 6 shows that the influence of stock prices shocks on stock prices is 100 in the first month and it falls to 91.735 after one year and then to 74 after two years, table 6 also shows that the influence of inflation shocks on stock prices is 0.00 in the first month this is because in the first month the influence of stock prices shocks on stock prices is 100, but after a year the effect of inflation on stock prices increases to 8.264 and then to 25.970 after two years. This shows that as the influence of stock prices shocks on stock prices decreases the influence of inflation on stock prices increases.

Table 6: Variance decomposition for Inflation and stock prices

Variance Decomposition of S		
Month	S	Inf.
1	100	0.00
6	99.686	0.314
12	91.735	8.264
18	80.604	19.396
24	74.029	25.970
Variance Decomposition of Inf.		
Month	S	Inf.
1	1.482	98.518
6	3.184	96.816
12	7.534	92.466
18	12.010	87.989
24	15.738	84.262

Source: Author's compilation using Eviews

The variance decomposition of inflation shows that in the first month the influence of inflation shocks on inflation is 98.518 then it falls to 92.466 after a year and then to 84.262 after two years, according to the results in table 6 the influence of stock prices on inflation is 1.482 in the first month and increases to 7.534 after a year and then to 15.738 after two years. Therefore, as the influence of inflation shocks on inflation decreases the influence of stock prices shocks on inflation starts to increase.

5. CONCLUSIONS

This study examined the relationship between the variables in the case of Zambia. The empirical methodology conducted in the study included the following, unit root test for the stationarity of the time series, the study also used the Johansen Cointegration test to test for the long-run relationship between variables, and the Granger causality was used to determine the causal relationship. The impulse response function was used to trace out the responses in the system to shocks in the error term. Finally the variance decomposition was used to show the effects of unexpected movements in the independent variables on dependent variables. The results from the stationarity test showed that the time series are non-stationary and the order of integration for the time series was found to be one, the Johansen test for cointegration indicates that there is no long-run relationship between the variables, the Granger causality results show that there is a uni-relationship between inflation and stock prices which runs from inflation to stock prices, the impulse response function indicates that the effects of the shocks are transitory and become permanent thereafter. In general the study found a negative relationship between stock prices and the concurrent rates of inflation over the last decade, the findings of this study are consistent with the general economic theory and the Fisher hypothesis which suggests a negative relationship between the variables in question. Considering these findings the stock returns may be adversely affected by inflation, because inflationary pressures threaten future corporate profits; and also nominal discount rates tend to rise under inflationary pressures, reducing the current value of future profits, and thus, stock returns. Based on the empirical findings of this study some recommendations are suggested. The findings of this study suggest that appropriate monetary measures should be adopted by monetary authorities to control inflation so that the volatility of the stock market can be minimized. The increase in industrial production can play significant positive role in the development of the capital markets of Zambia. Thus it is recommended that authorities should formulate policies which support stock prices through the promotion of industrial production.

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