Can Stocks Hedge against Inflation in the Long Run? Evidence from Ghana Stock Market

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Abstract

Based on Fisher (1930) hypothesis, we test whether Ghana stock market can provide hedge against inflation in the long run using cointegration analysis. Using data for the Databank stock Index (DSI) from January 1991 to December 2007, the results give strong support for the hedge property. Thus Ghana stock market provides full hedge against inflation. The outcome of this study holds important lesson for the market participants in developing market (many of which have experienced decades of higher inflation) that current inflation may not necessarily be associated with expectations of lower future returns.

Keywords: Stock Returns, Inflation, Hedging, Cointegration

JEL: G10, G15, C32

1. Introduction

The literature on the relationship between stock returns and inflation is one of the longest most researched in economics and finance. Common stocks are expected to hedge against inflation; therefore, in a perfect market, return on common equity should keep pace with the inflation rate. Following the seminal work of Bodie (1976), this proposition has been extensively tested in the context of the Fisher hypothesis (Fisher, 1930), which originally postulated that the market interest rate comprises the expected real interest rate and expected inflation. This hypothesis, when applied to stock markets, postulates a positive one-to-one relation between stock returns and inflation. Therefore in a competitive market, equity stocks, which represent claims against the real assets of a business, may serve as a hedge against inflation; hence return on common equity should keep pace with the inflation rate. That is, stocks must compensate investors completely (and not by more) for increases in the general price level through corresponding increases in nominal stock returns, thereby leaving real returns unaffected.

The empirical evidence on the issue of whether the Fisher hypothesis holds in stock markets from developed and emerging economies is far from conclusive. The cases of developing and small markets like Ghana have not been tested. Inflation in Ghana following the economic restructuring in the 1980s and financial reforms that ensued, adherence to strict monetary and fiscal policies still remains high and volatile compare to developed countries. Inflation in Ghana has shown a general upward trend from 1990 in spite of the reforms (see Figure 1). The GSE capital appreciated by 116% in 1993 and gained 124.3% in its index level in 1994 (GSE quarterly bulletin, March 1995) adjourning GSE as sixth and best performing emerging market in 1993 and 1994 respectively. In 1995, the index grew 6.3%, this abysmal performance is partly attribute to high inflation and interest rate. A critical question worth addressing is whether the Ghana stock market is a good hedge against inflation. We provide evidence on the long-run relation between stock returns and inflation in a cointegration framework. We make contribution to the literature by bridging the gap in the literature through testing of whether the common stocks in developing market offer a hedge against inflation.

Our investigation reveals the existence of long run positive one-to-one relationship between stock returns and inflation, indicating validity of Fisher hypothesis. The empirical validity of the generalized Fisher hypothesis has insightful implications on investment (see Shrestha *et al* 2002). Also, evidence of the validity of the hypothesis gives insight of a measure of the relative efficiency of the stock market under inflationary conditions. *Ceteris*

paribus, stock prices of efficient stock market would impound information contained in expected inflation concurrently.

The rest of the paper is organised as follows: Section 2 looks at the literature review, section 3 outlines the model and section 4 discusses the data and its characteristics. Section 5 presents the empirical results and discussions. The last section concludes and summarises.

2. Literature review

Though the theory is very straight forward regarding the nature of the relationship between stock returns and inflation, results of the literature are fairly mixed. However the general conclusion is that stocks do not hedge against inflation in the short run.

Bodie (1976), Fama and Schwert (1977) examined the case of USA and find an inverse relationship between stock returns and inflation. The post war period study by Gultekin (1983) failed to find support for the Fisher hypothesis (except in UK). According to Fama (1981), inflation acts as a proxy for real-activity variables in models that relate stock returns to inflation, and therefore the observed inverse relationship between real stock returns and inflation is spurious.

There is some evidence of a significant positive relationship in the longer horizons (more than 2 years) but often with a coefficient different from one (1) so that the inflation hedge is not perfect (See Anari and Kolari ,2001). Luintel and Paudyal (2006) find positive relationship between stock returns and inflation in the UK. Spyrou (2004) examine the relationship between inflation and stock returns for ten important Emerging Stock Markets (ESM), namely, Chile, Mexico, Brazil, Argentina, Thailand, S. Korea, Malaysia, Hong Kong, Philippines and Turkey, during the 1990s. According to the results, the relationship between stock returns and inflation, for the whole sample period, is positive and statistically significant for three of the sample ESMs, while it is positive (but statistically insignificant) for a further three. Only for one ESM is the relationship negative and statistically significant.

More recently, Durai and Bhaduri (2009) tested Fama hypothesis for India in the post-liberalized period from a developing country perspective. Examining this relationship on the time-scale decomposition from a wavelet multi-resolution analysis suggests that Fama's hypothesis holds only for the long time scale and remains as a puzzle for the other time scales.

3. The Model

The Fisher hypothesis states that the nominal interest rate at time *t*, (R_t) comprises the ex-ante real interest rate $(E_{t-1}[r_t])$ and the expected inflation rate $(E_{t-1}[\pi_t])$ we can therefore write;

$$R_t = (E_{t-1}[r_t]) + (E_{t-1}[\pi_t] + \mu_t \tag{3.1}$$

where $E[\ ]$ denotes the conditional expectation operator.

Assuming that under rational expectations, the expected and the actual inflation and interest rate may differ by a stationary zero mean forecast errors (Alagidede, 2008) (ε_{1t}) and (ε_{2t}) respectively. Therefore we write (3.1) as:

$$R_t = r_t - \varepsilon_{1t} + \pi_t - \varepsilon_{2t} + \mu_t \tag{3.2}$$

Thus the ex-post real rate is

$$r_t = R_t - \pi_t + \xi_t \tag{3.3}$$

Where $\xi_t = \mu_t - \varepsilon_{1t} - \varepsilon_{2t}$

Under frictionless stock market conditions, the equation (3.3) postulates that the expected real return on common stock and the expected inflation rate vary independently so that, on average, investors are compensated for changes in purchasing power. The test of this joint hypothesis can be obtained from estimates of the following regression

$$p_t = \alpha + \beta\pi_t + \xi_t \tag{3.4}$$

where p_t is the nominal return on common stocks and π_t is the inflation rate.

The time subscript *t* denotes returns between the end of time period *t* −1 and time period *t*. ξ_t is the error correction term

We examine the long run and short run relationship using the cointegration techniques, specifically Johansen (1995) As postulated by the Fisher hypothesis, we expect the long-run vector to be close to one, thus $\beta = [1,-1]'$ if common stock completely hedge against inflation.

3.1 The Data

The data used were monthly Databank stock price index from January 1991 to December 2007 obtained from Databank Group research. The inflation variable used is the monthly consumer price index (CPI) for Ghana obtained from the International Financial Statistics (IFS of the IMF) covering the same period. The inflation rate and the stock market returns were calculated as the first differences of the logarithmic price levels of the respective series. Figure 1 shows that the inflation in Ghana is very volatile especially between 1990 and 2000 while the stock price trended upward (see figure 2). Table 1 presents a summary of descriptive statistics of the variable. Sample mean, standard deviation, skewness , and the Jacque-Bera statistic have been reported. The high standard deviation of P with respect to the mean is an indication of high volatility in the stock market. From the Jarque-Bera statistics, the null hypothesis that P and π are normally distributed at 10% level of significance can not be rejected.

There is high correlation between Databank stock prices and inflation. Stock prices movements are correlated with inflation movements, albeit before a one-month lag. The peak correlation coefficients are very large. Figure A1, in the Appendix, indicates that the cross-correlation between stock prices and inflation movements is positive, peaking before a one-month lead at 0.965. Stock prices movements are also correlated with lagged inflation peaking at -0.965 before a one-quarter lag (Figure A2 in Appendix). The high size of the correlation coefficient is an indication that greater percentage of inflation might be passed through to stock prices

4. Empirical Results

4.1 Unit root

We employ two unit root tests (DF-GLS and ADF) and one stationarity test (KPSS). Elliot et al (1996) developed the DF-GLS test which is more efficient than the usual ADF. The KPSS tests the null of stationarity, whereas ADF and DF-GLS tests the null of a unit root. If the KPSS test rejects the null but ADF and DF-GLS test does not, we can say that all the three tests support the same conclusion; that is, the series in question is an I (1) process. The results are shown in Table 2. As indicated by the ADF and DF-GLS, the null of unit root in all the series cannot be rejected at the 1% level.

4.2 Cointegration test

Given our unit root test our analysis proceeds with the empirical examination of the long-run Fisher hypothesis. We employ the Johansen (1991) cointegration test for a number of reasons: the technique is powerful than the usual Engle-Granger approach, and it is robust to various departures from normality in that it allows any of the variables in the model to be used as dependent variable while maintaining the same cointegration results. It also allows for hypothesis testing and we can generate various scenarios to analyze the short term dynamics versus the long-run relationship between nominal exchange rates and prices. Johansen's method however, does suffer from small sample bias (see Alagidede *et al, 2008*). The lag length is selected to ensure there is no further residual correlation using the Akaike Information Criterion (AIC) (see results in Table 3).

The results from Table 3 reveal that, there is at least one cointegrating vector, indicating that stock prices and inflation cointegrated. This also indicates that the system is stationary in one direction.

The results shown in Table 4 indicate that the estimated Fisher coefficient, β is 1.32 and significant at 10% level. The coefficient of π_t, β, indicate the elasticity of the changes in stock prices with respect to corresponding changes in consumer prices. The results imply that 1% increase in inflation leads to 1.32% increase in stock prices. The testing of the null hypothesis that stock prices and the price level move one-for-one ($\beta = 1$) gives a test statistic of 0.8621 which, again, has to be compared to a $\chi^2(1)$-distribution. The critical significance level is 35% which leads to the unambiguous test result that the null can not be rejected. The conclusion is strong support for the long-run inflation hedge hypothesis.

To test for robustness, we conducted a number of diagnostic test and stability test of the VECM and interestingly, the model passes all the diagnostics test (see Table 5) and stability test (see Figure 3)

5. Conclusion

We examined whether Ghana stock Market provides a hedge against inflation, focusing explicitly on the long-run horizon. We have tested the Fisher hypothesis based on the long-run relation between stock prices and the general price level, estimated by cointegration analysis.

Using the Consumer Price Index as the relevant price measure, the results give strong support to the hedge hypothesis. The result is robust over time evidenced by the diagnostic test. The evidence confirms that the Ghana market is efficient in inflationary environments as investors are compensated in high stock returns when prices of goods are on the rise. The outcome of this study hold important lesson for the market participants in developing market (many of which have experienced decades of higher inflation) that higher current inflation may not necessarily be associated with expectations of lower future returns.

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Table 1. Summary of Descriptive statistics

	Mean	*Median*	*St. Dev.*	*Skew*	*JB*	$Corr_{(p,\pi)}$
P	2.953	2.983	0.633	-0.055	8.153	0.965
π	1.468	1.508	0.465	-0.342	16.134	0.965

Table 2. Unit Root Test

	P_t	π_t	ΔP_t	$\Delta \pi_t$
DF_GLS	1.80	-1.03	-8.57	-6.74
ADF	-0.65	-1.37	-8.39	-6.65
KPSS	1.69**	0.35*	0.05	0.11

Note: The null hypothesis for the DF-GLS and ADF test is that the data process under examination contains a unit root. Critical values for the DF-GLS are 2.58 and 1.94 for the 1% and 5% levels respectively, given by Elliott et al. (1996). Critical values of ADF 1% and 5% are -3.43 and -2.86 respectively (see MacKinnon, 1991). KPSS critical values for 1% and 5% are 0.21 and 0.146 respectively, from Kwiatkowski *et al* (1992). **, * indicates significance at the 1% and 5% levels respectively.

Table 3. Trace and Maximum Eigenvalue Tests

	Trace Test			**Max. Test**		
	λ_{trace}	0.05 Critical Value	Prob.	$\lambda_{\max}$	0.05 Critical Value.	Prob.
Lags		2			2	
$r = 0$	23.90	20.26	0.015*	19.72	15.89	0.011*
$r \leq 1$	4.18	9.16	0.385	4.18	9.16	0.385

Note: The λ_{trace} and $\lambda_{\max}$ give the trace statistics, and the maximal-eigenvalue statistic respectively. The null hypothesis for these two tests here is that the data generating processes under consideration are not cointegrated. Critical values for both trace and maximum-eigenvalue statistics at the 5% level are given by MacKinnon-Haugh-Michelis(1999). * denotes the rejection of the hypothesis at the 1% level

Table 4. Long Run Relationship between P_t and π_t

Cointegration Vector	Adjustment Coefficient
$p_t = 0.0269 + 1.32\,\pi_t + \xi_t$ $[0.055]^* \quad [0.0712]^*$	-0.004744(0.00188)
Cointegration Restriction $\beta = 1$	
$\chi^2(1) = 0.8621[0.3531]$	

Note: $\beta = 1$ is the restriction that the Fisher coefficient is equal to 1.The formal test of this hypothesis is based on the likelihood ratio statistic LR test of restrictions: $\chi^2(1)$. Probability in the [ ] and standard error in ( ).

Table 5. VECM Model Diagnostic Tests

Serial Correlation F(4, 15)=0.406[0.666]	Functional Form F(1, 193)=1.398[0.238]
Heteroskedasticity F(12, 19)=1.3236[0.2832]	Normality $\chi^2(2)$=4.52169[0.10426]]

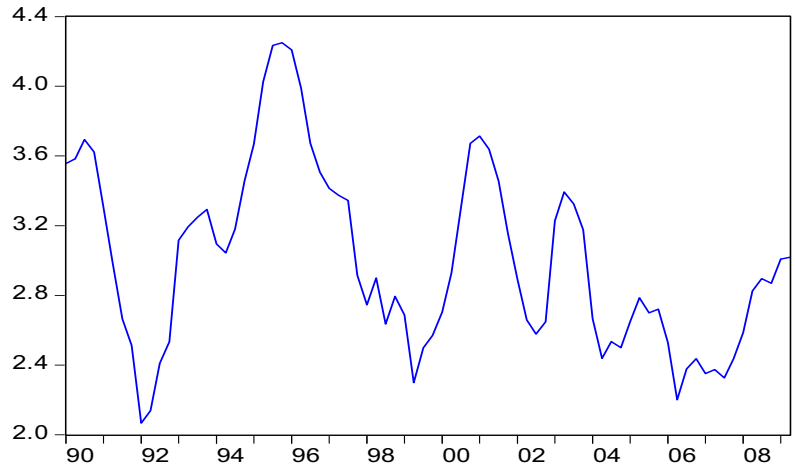

Figure 1. Monthly inflation rate

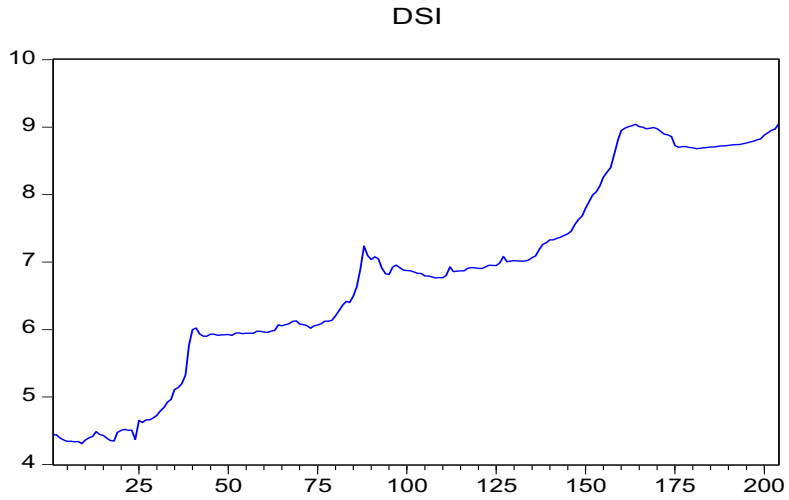

Figure 2. Databank Stock Index

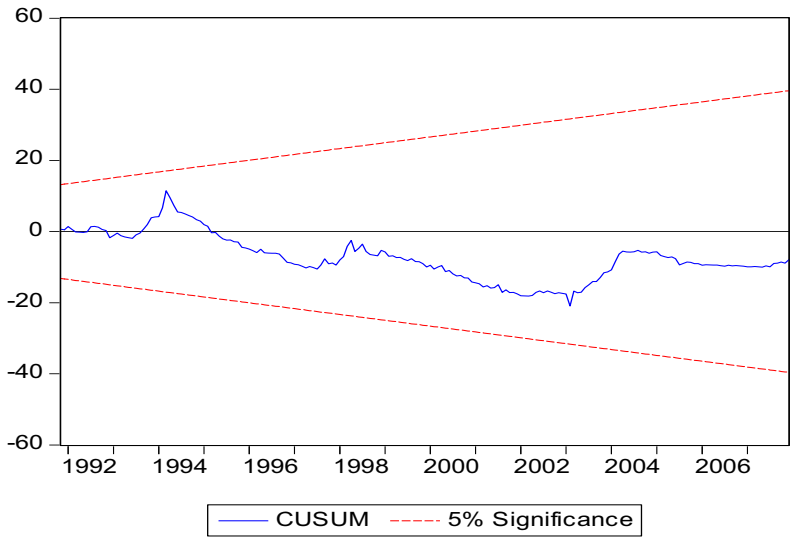

Figure 3. Plots of CUSUM of Recursive residuals

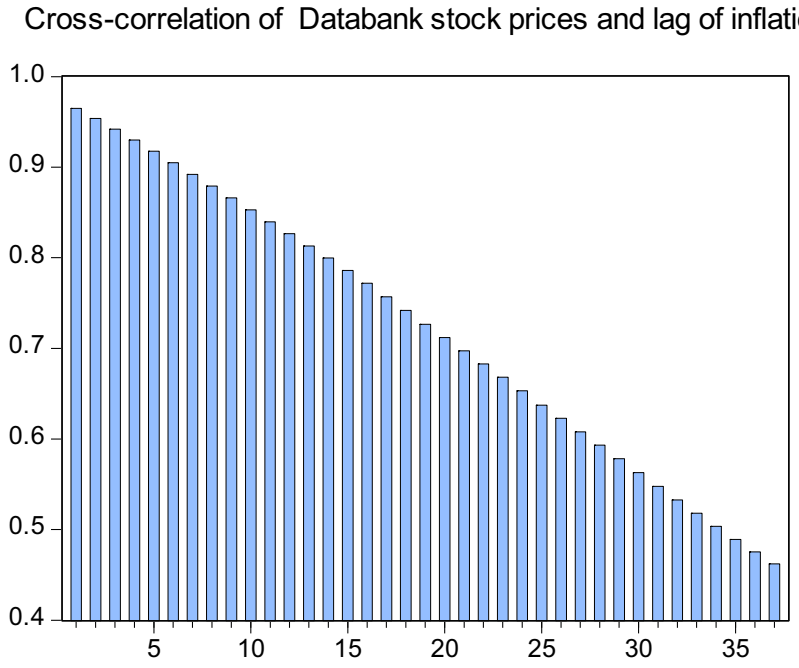

Figure 4.

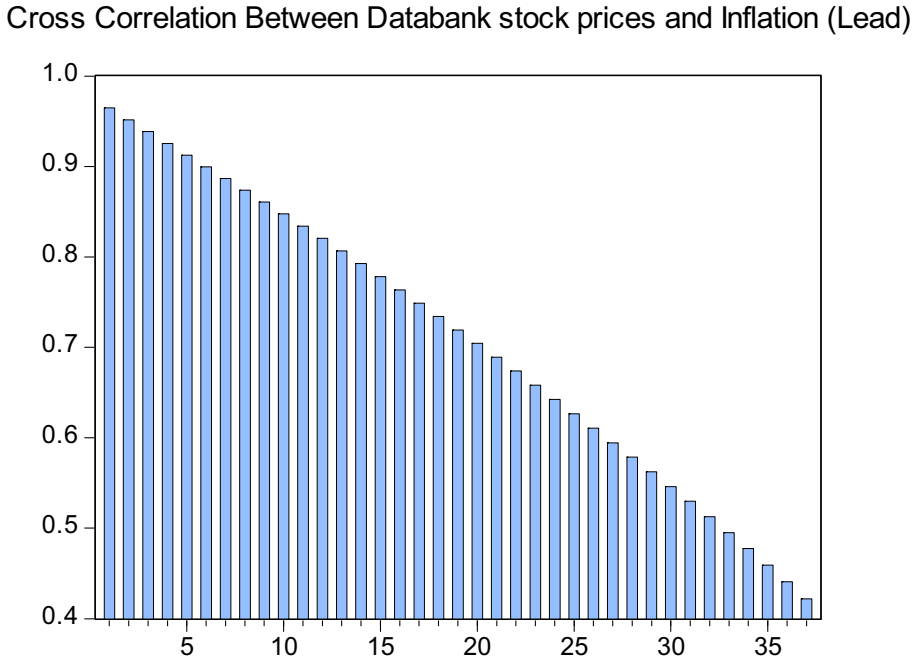

Figure 5.