INVESTIGATING THE RELATIONSHIP BETWEEN STOCK PRICES AND EXCHANGE RATES IN ZAMBIA

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Abstract:
Background*: Exchange rates are an important element in macroeconomic management and a key determinant factor of the prices of tradable goods relative to non-tradable goods. It shows the competitiveness of domestic goods relative to foreign goods. In Zambia since the early 1990s when exchange rates was left to float it has been very volatile due to external shocks and other factors such as international copper prices. These currency movements make it difficult to achieve the major goals of the government and companies such as; faster growth rate, economic diversification and poverty reduction. This volatility has also created uncertainty for the private sector and increased their transaction costs. It discourages the production of tradables by raising their risk premium compared to non-tradables. The exchange rate volatility is also transmitted to the stock market which brings about loss of confidence and unpredictability in the economy. Investors need a predictable environment to secure their investments.. Until the financial system develops private sector instruments for hedging against exchange rate risk, it is appropriate for the government and Bank of Zambia to act in the public interest to reduce such risk. In Zambia most research has been concentrated on examining the relationship of exchange rates and other macroeconomic variables; however, from the literature reviewed we are not aware of any previous study that examined the relationship between stock prices and exchange rate movements in Zambia. Therefore, this paper examines how changes in exchange rates affect the stock market and changes in stock market affect the exchange market.*

Materials and Methods *The study uses monthly time series data from January 1999 to July 2011. The sample period is chosen because data for all share indexes is available from 1999. Nominal exchange rate of the Zambian Kwacha to the US dollar is obtained and stock prices are measured using the LuSE all share index. Nominal exchange rates and all share stock index data were obtained from the Bank of Zambia (BOZ) and the Lusaka Stock Exchange (LuSE) respectively.it employs Granger causality test, Johansen Cointegration test and Generalized Autoregressive conditional Heteroscedasticity (GARCH) tests for volatility.*

Results*: Johansen cointegration test and the results show that there is no long run relationship between stock prices and exchange rates in Zambia; that is, the variables do not move together in the long run. Furthermore, Granger causality test show no causality from stock prices to exchange rates and from exchange rates to stock prices. The EGARCH estimation results show that volatility in stock market persists and that positive shocks in the stock market generate more volatility than negative shocks.*

Conclusion: *Investors on LuSE prefer to hear good news as against bad news.*

Key Word*: Exchange rate, stock prices, relationship, volatility.*

I. Introduction

Exchange rates are an important element in macroeconomic management and a key measure of the value of tradable goods relative to non-tradable goods with reference to price. It reveals the relative competitiveness of exported goods from the domestic economy to the rest of the world. The stock market, on the other hand, brings together various economic agents in its core function of moving resources from surplus units of the economy to deficit units. With the growing importance of stock markets in global economics and finance and the liberalization of capital account, research on the link between exchange rates movement and stock prices has escalated. In the literature, three types of exposure under floating exchange rates regimes are identified as being associated with these dealings; economic, translation and transaction. Translation and transaction exposures are accounting based and defined in terms of the book values of assets and liabilities denominated in foreign currency. Economic exposure is the sensitivity of company value to exchange rates movements. At the corporate level, changes in exchange rates affect the firm's value, because future cash flows of the firm will change with exchange rates (Abbas, 2010).

There are two main approaches that explain the relationship between stock prices and exchange rates; the traditional and portfolio balance approaches to exchange rates determination. Dimitrova (2005) on the other hand uses the Mundell-Fleming approach. The movements in exchange rates, according to the traditional approach, is said to influence the competitiveness of exporting firms as well as non-exporting firms. For instance, an appreciation of the Kwacha would lead to reduced competitiveness of Zambian firms, because foreign consumers have to pay more of their currency to buy the Zambian commodity. On the other hand, domestic consumers will find imports to be relatively cheaper. This reduces the demand for domestic commodities and domestic firm's profitability. The reduced profitability is then reflected in the fall of stock prices of the concerned firms. The portfolio balance approach explains how an investor's decision to hold assets influences the exchange rates. Investors can decide either to hold domestic and foreign assets depending on the risk return profile of the investor. It is assumed that an increase in stock prices leads to an increase in wealth as well as attract more capital. This is because the demand for money will increase, which would result in increased interest rates and foreign capital inflow inducing the exchange rates to appreciate.

Azman-Saini *et al* (2006), Doong and Lee (2008), Shew (2008), and Kasman (2003) have estimated the relationship between stock prices and exchange rates around the period of a financial crisis; this is because financial crises are characterised by fluctuations in stock prices and exchanges rates. Azman-Saini *et al* (2006) found that stock prices and exchange rates in Malaysia move together in the long run and that during the crisis changes in exchange rates tend to lead changes in stock prices. However, Shew (2008) found that changes in stock prices lead to changes in exchange rates in Singapore. Adjasi et al (2011) found that, in Tunisia, in the long run stock prices and exchange rates move together and that a depreciation of exchange rate drives down stock prices. Aydemir et al (2009) found positive and negative causality between exchange rates and sectorial indices.

This study aims to examine the relationship between exchange rates and stock prices in Zambia. Empirical studies of the relationship between stock prices and exchange rates in Zambia are limited. It is in light of this that the general objective is to investigate the long run relationship between stock prices and exchange rates movement with the view to contributing to existing literature.

II. Material And Methods

The study employs a quantitative approach, and secondary data was collected on stock prices and exchange rate from January 1999 to July 2011. The sample period is chosen because data for all share indexes is available from 1999. Nominal exchange rate of the Zambian Kwacha to the US dollar is obtained and stock prices are measured using the LuSE all-share index. Nominal exchange rates and all share stock index data were obtained from the Bank of Zambia (BOZ) and the Lusaka Stock Exchange (LuSE) respectively.

The relationship between stock prices and exchange rates can be represented by

$$S_t = \alpha_0 + \alpha_1 E_t + e_t$$

Where S_t is stock prices index and E_t is the exchange rates and e_t is the disturbance term. On the basis of economic theory, the coefficient α_0 can either be positive or negative. To test for stationarity, Augumented Dickey Fuller test and Philips Perron test is usually employed. The lag length is determined by Akaike Information Criterion (AIC) and Schwartz Bayesian criterion (SBC).

Johansen's cointegration has been employed to check the existence of long-run relationship among variables. Two variables are cointegrated if they move together over time. To undertake the test, the variables of the same order must be integrated. Johansen's cointegration is based on Eigen Values and trace Statistics. The basic model is;

$$y_t = \alpha_0 + \sum_{j=1}^{k} \beta_j y_{t-j} + \gamma_j \sigma_t + u_t$$

where $\alpha_0$is *n x 1* vector of constants,y_t is *n x 1* vector of variables, which contain unit root and are stationary at first difference, *k* is number of lags, β_j is vector of coefficients, σ_t is the volatility series and $\varepsilon_t$is vector of error terms. The above equation can be reformulated into the following vector error correction model as

$$\Delta y_t = C + \sum_{j=1}^{k=l} \beta_j \Delta y_{t-j} + \prod y_{t-k} + \gamma_j \sigma_t + u_t ..$$

Where $\prod = -I + \sum_{i=j+1}^{k} \beta_j$

Δ is first difference operator, I is an $n \times n$ identity matrix. y_t is a vector of non-stationary variables and C is the constant term. The information on the coefficient matrix between the levels of the $\prod$ is decomposed as $\prod = \alpha\beta$ where the relevant elements the α matrix are adjustment coefficient and the β matrix contains co-integrating vectors.

In the absence of any cointegration relationship between the variables, the standard test based on Granger (1988) method is applied. The Granger method seeks to determine how much of a variable, *S*, can be explained by the past values of S and whether adding lagged values of another variable, *E*, can improve the explanation. The following is the equation;

$$\Delta S_t = \beta_0 + \sum_{i=1}^{q} \beta_{1i} \Delta S_{t-i} + \sum_{i=1}^{q} \beta_{2i} \Delta E_{t-i} + \varepsilon_{1t}.$$

Application of Granger causality test requires two tests to run at the same time to check the relationship in each direction. The second test is

$$\Delta E_t = \alpha_0 + \sum_{i=1}^{r} \alpha_{1i} \Delta E_{t-i} + \sum_{i=1}^{r} \alpha_{2i} \Delta S_{t-i} + \varepsilon_{2t}.$$

The ε_{1t} andε_{2t} are uncorrelated stationary random process, and *t* denotes the time period. Failing to reject the hypothesis: $H_0 = \beta_{21} = \beta_{22} = \beta_{23} = ... = \beta_{2q} = 0$ implies that exchange rates do not Granger cause stock prices. On the other hand, failing to reject:

$H_0 = \alpha_{21} = \alpha_{22} = \alpha_{23} = ... = \alpha_{2r} = 0$ implies that stock prices do not Granger cause exchange rates.

To understand the volatility pattern of stock prices and exchange rates the exponential GARCH model by Nelson (1991) is used. The EGARCH model gives asymmetry and leverage of the volatility. When using this technique the variables are in first difference of their natural logarithms; that is, percentage changes in stock prices and exchange rates.

$lnS_t = 100*(lnS_t - lnS_{t-1})$

$lnE_t = 100*lnE_t - lnE_{t-1}$

$$r_i = \alpha + \beta_i r_{i,t-1} + \xi_{i,t}.$$

$$\xi_{i,t} = \sigma_t^2 z_{i,t}$$

$$\ln \sigma_t^2 = \omega + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right].$$

Where r_i is the return from market *i* i.e. either return from stock market or exchange market. σ_t^2 is known as the conditional variance since it is a one period ahead estimate for the variance calculate on any past information thought relevant. Equation (16) defines a variance, β, α, γ, ω are parameters to be estimated. Since the $\ln \sigma_t^2$ is modeled, then the significant advantage of EGARCH models is that even if the parameters are negative, σ_t^2 will be positive. The α parameter represents a magnitude effect or the symmetric effect of the model, the "GARCH" effect. β measures the persistence in conditional volatility irrespective of anything happening in the market. When β is relatively large, then volatility takes a long time to die out following a shock in the market.

The γ parameter measures the asymmetry or the leverage effect, the parameter of importance so that the EGARCH model allows for testing of asymmetries. If $\gamma = 0$, then the model is symmetric. When $\gamma < 0$, then positive shocks (good news)

generate less volatility than negative shocks (bad news). When $\gamma > 0$, it implies that positive innovations are more destabilizing than negative innovations.

III. Result

The results presented unit root tests which showed that the series are integrated of order one and are stationary in first difference. The volatility was estimated using GARCH (1,1) model, and was included in the Johansen cointegration equation as an exogenous Variable. The result shows that there is no cointegration in the long run. Implying that variables do not move together in the long run. Granger causality test shows no causal relationship between the two variables. This means that stock prices do not cause exchange rate and exchange rate do not cause stock prices.

Table 3.1.Results of a bivariate EGARCH

LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)
*RESID(-1)/@SQRT(GARCH(-1))

	Coefficient	Std. Error	z-Statistic	Prob.
DEXC(-1)	-0.747212	0.088416	-8.451086	0.0000
DPRICE(-1)	0.428754	0.096757	4.431244	0.0000
C	0.007822	0.003411	2.293284	0.0218
Variance Equation				
C(4)	-6.346744	0.163488	-38.82087	0.0000
C(5)	1.456389	0.282933	5.147461	0.0000
C(6)	0.654200	0.134450	4.865754	0.0000

R-squared	-0.310580	Mean dependent var	0.021414
Adjusted R-squared	-0.356404	S.D. dependent var	0.085242
S.E. of regression	0.099277	Akaike info criterion	-2.298622
Sum squared resid	1.409394	Schwarz criterion	-2.177657
Log likelihood	177.2473	Hannan-Quinn criter.	-2.249476
Durbin-Watson stat	2.567327		

Heteroskedasticity Test: ARCH

F-statistic	0.228977	Prob. F(1,146)	0.6330
Obs*R-squared	0.231750	Prob. Chi-Square(1)	0.6302

From the mean equation in the output, it can be observed that the coefficient of the lagged values of exchange rates has a negative sign. This shows that past values of exchange rates negatively affect stock prices. A unit change in exchange rates cause a negative change in stock prices by 0.75%. Stock prices will fall by 0.75% for a unit rise (depreciation) in exchange rates. Moreover, past values of stock prices also affect the present value of stock prices. A unit change in past values of stock prices increase present stock by 0.43%. Both coefficients are significant at 10% and 5% level of significance.

The Variance equation in the exponential ARCH does not include volatility persistence of the shocks, however from the results γ=0.645200 is positive and is significant meaning good news generate more volatility in the model than bad news. The news can come from either stock prices or exchange rates. Moreover α=1.456389 and is also positive and significant implying that volatility is sensitive to changes in the model this.

It is prudent to compare the results of this study to other studies done in developed and developing countries. However, this study differs from the other studies because of the inclusion of a volatility measure in the cointegration equation. The volatility series is included as another variable playing a role in bringing the two variables back to equilibrium. A study by Staverak (2004), Abbas (2009), Tabak (2006), and Kutty (2010) showed no cointegration between the variables, however in most countries included in their studies some cointegration were found. Abbas (2010) found no long run causality in any direction. This study is also similar to what Rahman and Uddin (2009) found; they did not find any cointegration between the variables and no variable caused the other.

On the issue of volatility, most studies used EGARCH to estimate spillover effects, however in this study does not estimate the spillover effects from one market to the other. Morales (2008) found that volatility persistence in both stock and exchange market was significant. Moreover, Doong and Lee (2005) also found persistence and asymmetry in both stock prices.

IV. Conclusion

This study employs Johansen cointegration to estimate the long run relationship between stock prices and exchange rates. Using monthly data from January 1999 to July 2011 for both bilateral nominal exchange rates (Kwacha/US$) and LuSE all share index. Having generated volatility series using GARCH (1,1) and incorporated into the cointegration equation, the results show that there is no long run relationship between stock prices and exchange rates and the volatility does not help in trying to bring the two variables to equilibrium. Even though literature suggest there is a relationship. Nath and Samanta (2003) in their study on India found no cointegration,
Abbas (2009) too found no long run relationship in all the countries studied. For Zambia the scatter plot revealed that there is no relationship between stock prices and exchange because of the pattern they portray. There are three tiers of stock prices that give different patterns.

In the absence of cointegration, a standard Granger Causality was estimated. The results show that there is no Granger causality. Changes in stock prices don't lead to changes in exchange rate. These results neither support the traditional approach nor the portfolio balance approach. As a step further in the analysis, an exponential GARCH model is estimated. In this estimation the difference of the logarithms of stock prices and exchange rates are used. The results show that the coefficient of both asymmetry and persistent are significant for stock prices. This implies that investors on LuSE prefer to hear good news as against bad news. After adjusting for Heteroscedasticity the results show that a unit change in past values of the exchange rates has a negative impact of -0.75% on stock prices while the past values of stock prices have a positive impact of 0.43% on stock prices.

With the results of no cointegration and no Granger causality between stock prices and exchange rates as the analyses of this study reveals, there appears to be no predictive ability between exchange rates and stock prices in Zambia. The results may mean that investors do not have to worry about exchange rates movements when making their investment decision to hedge against their risk exposure to currency changes, and policy makers also need not worry about managing the exchange rates with a view to influencing stock prices. This can also mean that in the long-run exchange rates volatility cannot be controlled through stock market regulation. Moreover, it reveals that there is no chance of profitable speculation in the stock market or foreign exchange market, as there is no way causal relationship between stock prices and exchange rates. Participants cannot use information of one market to improve the forecast of another market.

While hedging instruments like futures, forwards and options have always been available, their relative complexities have hindered the widespread adoption by the average investor. The LuSE has to sensitise and encourage the use of these instruments and the Exchange Trade Funds (ETF) by an average investors and trading firms. Companies with branches and subsidiaries companies in different countries should centralize the exchange risk management decision to single entities than leaving it for the parent company. Furthermore, the government needs to reduce political uncertainty and improve law and order to create a conducive investment climate to attract investors.

Since the Zambian economy responds to the shocks like international copper prices, the government should develop a clear industrial policy which guides and motivates the expansion of traditional exports to other sectors so that any changes in copper prices cushions the exchange rates because of other export commodities.

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